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Post-Appendectomy Outcomes in Patients Infected with Pandemic COVID-19

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Abstract

Introduction. The pandemic of COVID-19 infection becomes a dilemma for surgical patients, and because it presents with respiratory and abdominal symptoms that demands a serious consideration in surgical wards and operating theater.
Purpose. To assess the post-appendectomy outcomes in patients with corona virus infection.
Materials and methods. This is a prospective cross-sectional study, which was achieved in emergency department. 223 patients aged (19–45 year) and 132 Male and 91 female, they were complained of abdominal pain mostly at the right lower region of the abdomen, associated with mild fever, malaise, anorexia for different period of days (2–5 days). The patients were divided into control and test group with comparison according to the following postoperative parameters: Recovery time, level of consciousness, respiratory effort, vital signs, Oxygen saturation and hospitalization. Any suspicion of symptoms and signs of corona virus, it was ordered for rapid COVID-19 Test and chest x-Ray, if chest x-Ray is suggestive of pneumonia a CT-Scan of the chest is done. Under strict precautions according to the Higher Committee for the Safety and National Health guidelines in Iraq, the patients were undergone an emergent appendectomy.
Results. Among the 223 patients, 134 (60%) were male and 89 (40%) were female. 137 patients (61.43%) were non infected, while 86 patients (38.57%) were registered as infected (rapid COVID-19 was Ig G (+ve) or and Chest X ray revealed bilateral pneumonic patches, beside mild fever, anorexia feeling of fatigability and abdominal pain). All patients recovered after appendectomy smoothly and discharging with good health status. There is no morbidity nor morbidity encountered as in non-infected group.
Conclusions. There is no difference in post-appendectomy observation among patients infected with COVID-19 in comparison with non-infected patient in mild to moderate cases.
Keywords: acute appendicitis, COVID-19, personal protective equipment, appendectomy, abdominal pain

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INTRODUCTION

Corona virus is a single stranded R.N.A. with a spherical envelope which is crowned by multiple spikes of minute size (65–125 nm in diameter) [1]. It is transmitted through nasal droplets to be inspired by contact person [2]. The infected person became contagious within first hours of viral nasal inhabitant and P.C.R. test would be positive sensitivity of 75% [3]. During which there is intracellular viral multiplications, viremia will disappear and there is production of Ig M antibodies at the 5th day of infection and symptoms start to be clear (fever, insomnia, cough, malaise, sneezing, anorexia, abdominal pain, nausea then respiratory symptoms including dyspnea and decrease oxygen saturation [4]. At the day 10 there is increase level of Ig G and decrease level of Ig M [5]. Real time-PCR and CT scan of the chest still he main slandered test to diagnose COVID-19 [6].

Sometimes patients with COVID-19 may present with abdominal pain that may mimic acute abdomen that renders the diagnosis to be difficult [7]. Therefore, meticulous history and examination, based on investigation including CT scan of the chest may decrease false positive results. Using protective measures (Personnel Protective Equipment (PPE)) is essential to get rid of suspecting trans-infection (viral droplets settled on the bared skin or objects in a form of fomites, subsequently contaminating the hands, which then may settle down viral droplets on eyes, nose, or mouth). These include: Head cap, goggles or face shield, surgical mask, protective safety coverall suit and over surgical gown, cover shoes and double gloves [8]. Blood and surgical smoke from the electrical cauterization have to be avoided during surgery to protect the surgical team [9, 10].

PURPOSE OF THE STUDY

To assess the post-appendectomy outcomes in patients with corona virus infection.

MATERIALS AND METHODS

This is a prospective cross-sectional study, which was achieved in the Emergency department at Al-Yarmouk Teaching Hospital, in Baghdad downtown from April 2020 to the last of December 2021.

They were complained of abdominal pain mostly at the right lower region of the abdomen, associated with mild fever, malaise, anorexia and nausea for different period of das (2–5 days). Good history taking and thorough clinical examination was conducted. They were investigated for complete blood picture, fasting blood sugar, blood urea and serum creatinine, abdominal ultrasonography, virology tests including (hepatitis B virus and H.I.V.), rapid COVID-19 Test and chest x Ray and if chest x Ray is suggestive of pneumonia a CT-Scan of the chest was done. The patients were divided into two groups: control group and infected group.

Criteria for Infected Group

The control group was those whom do not have symptoms and signs of COVID-19 and rapid test is negative and chest X ray is normal. The infected group was those whom have mild (fever, malaise, cough, head ache, abdominal pain, increased D-dimer, increased ferritin, rapid test is positive (IgM (+ve), IgG / IgM (+ve), IgG (+ve)) and chest X Ray or chest CT scan reveals scattered pneumonic patches but with normal oxygen saturation.

Under strict precautions according to the Higher Committee for the Safety and National Health guidelines that obliges to wear (Personnel Protective Equipment (PPE)): Head cap, goggles or face shield, surgical mask, protective safety coverall suit and over surgical gown, cover shoes and double gloves. The patients were prepared for surgery and seek the anesthetist assessment the vital status of the patients including measurements of oxygen saturation. The patients were signed for consent of the operation. The appendectomies were done as a slandered technique, but to be careful regarding the vapor of the cautery which it should be evacuated via the sucker machine to prevent incidental inhalation. The bleeding was dealt with it meticulously. All excide appendices were sent for histopathological examination. Postoperative notes were recorded regarding (recovery time, level of consciousness, respiratory effort, vital signs, surgical incision site).

■ RESULTS

Among the 223 patients, 134 (60%) were male and 89 (40%) were female (Table 1). Regarding histopatholigical examination of the excide appendix (Table 2), the control group (137 patients): 3 (2.19%) were normal appendices and 43 (31.39%) were catarrhal appendicitis, 57 (41.6%) were phlygmonous appendicitis and 34 (24.82%) were perforated appendicitis while in infected (Test) group 86 (43.75%): 9 (10.465%) were normal

Table 1
Sex of patient distribution

Sex	No.	%
Male	134	60%
Female	89	40%

Table 2
Histopathological examination, control and infected patients

No. of patients (%) / Histopathology	Control		Infected (Test)		Total	
Normal	3	2.19%	9	10.465%	12	5.38%
Catarrhal	43	31.39%	25	29.07%	68	30.49%
Phlegmonous	57	41.6%	34	39.535%	91	40.81%
Perforated	34	24.82%	18	20.93%	52	23.32%

Table 3
Chest Imaging finding in infected patients

No. of patients with symptoms / Histopathology	IgM (+ve) IgG / IgM (+ve) IgG (+ve)	CXR		Chest CT. Scan
		Normal	Residual patches	Residual patches
Normal	9	3	6	6
Catarrhal	25	4	21	21
Phlegmonous	34	6	28	28
Perforated	18	3	15	15

Table 4
Postoperative assessment parameters

Postoperative parameters	Control group	Test group
Recovery time	12.3 +/– 1	12.1 +/– 1
Level of consciousness	15 (G.C.S.)	15 (G.C.S.)
Respiratory effort	100%	100%
Vital signs	Stable (100%)	Stable (100%)
Oxygen saturation	98% +/– 1%	97% +/– 1%
Wound healing period	99% +/– 1%	98% +/– 1%
Hospitalization (24–48 hrs.)	99% +/– 1%	98% +/– 1%

appendices and 25 (29.07%) were catarrhal appendicitis, 34 (39.535%) were phlygmonous appendicitis and 18 (20.93%) were perforated appendicitis.

The patients with corona virus (86 patients) were increased in numbers on July, reaching 50% in September. 9 (10.465%) patients with normal appendix presented with normal Chest X ray in 2 patients and residual patches in 6 patients (Table 3). 25 (29.07%) patients presented with Catarrhal appendix, presented with normal Chest X ray in 4 patients and residual patches in 21 patients. 34 (39.535%) patients with phlygmonous appendix, presented with normal Chest X ray in 6 patients and residual patches in 28 patients. 18 (20.93%) patients had perforated appendix with normal Chest X ray in 3 patient and residual patches in 15 patients. All patients with residual patches in Chest X ray were confirmed on chest CT scan.

Regarding postoperative period, as shown in Table 4, the recovery time was the same as for control group, the infected group does not suffer from respiratory distress and oxygen saturation was above 95%. vital signs parameters were stable in all patients. The surgical incision sites were monitored for healing process revealing no changes in comparing with control group and the patients were hospitalized (24–48 hrs.) for both groups, then they were discharged well. There is no morbidity nor morbidity were encountered as in non-infected group and they did not need for respiratory care unit. All patients recovered after appendectomy smoothly and discharging with good health status.

■ DISCUSSION

This study shows the confounding presentation of acute appendicitis, precautions of patients with COVID-19 rendering surgical operation and verifies the impact of Iraqi Higher Committee for the safety and National Health guidelines in dealing with surgical patients in operating theater.

Nine patients infected with COVID-19, presented with symptoms of acute appendicitis with normal histopathological examination of the excised appendix, that may be contributed to involvement of enteric nervous system but it is still under investigation [11, 12] and it was a dilemma in diagnosing acute abdomen [13].

There is an incremental increase in the number of patients whom infected with COVID-19. Some patients got infected but they denied symptoms or unaware of it. Using P.P.E. strictly among the surgical team partners was highly protective against getting infected which was followed up during the research period [14, 15]. Meticulous dissection

during opening the skin layers passing through muscle separating or muscle cutting technique avoiding any blood drops contamination. Beside evacuation of the vaporized fume cauterization by suction tube, decrease the probability of getting infection as Jonathan Pavlinec et al. did [16].

Regarding postoperative period: the postoperative parameters were recorded regarding (recovery time, level of consciousness, respiratory effort, vital signs , surgical incision site), showing that there is no significant changes between the control group and test group as Hrishikesh Salgaonkar et al. study showed that the post-operative observations were similar in both groups [17] in contrary to Jochem C.G. et al. that there is increased in postoperative complications in pre-COVID-19 period [18].

There was increased normal appendectomy among infected group this is because clinical presentation of some patients whom infected with COVID-19 may mimic acute abdomen, hence gives false impression, this is because that ACE2 receptors are found in the gastrointestinal tract mucosa that is integrated to the virus antigen entrance to the cells provoking inflammatory reactions that contributes to these presentations [19, 20].

■ CONCLUSIONS

The Appendectomy in patients infected with (mild to moderate) COVID-19 infection were feasible and there were no differences in the postoperative outcomes. Personal protective equipment mandatory even in negative rapid test because the first five days of the infection is mystical. The instruction of the Higher Committee for the Safety and National Health guidelines has to be followed. Isolation of the infected patients is crucial to prevent contamination. Patients with COVID-19 may present with acute abdomen that may mimic acute appendicitis, that needs further investigations. Abdominal pain concerning gastrointestinal COVID-19 infection must alarming in all patients presented in surgical emergency department so as not to be confused with other cases of acute abdomen.

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Predictive Value of the Neutrophil-to-Lymphocyte Ratio for Postoperative Complications in Emergency General Surgery: A Prospective Cohort Study

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Authors' contribution: Ali Laibi Zamil – conceptualization, data curation, investigations, methods, project administration, resources, software, validation, visualization, writing – original draft and writing – review & editing; Hussein Mohammed Aziz – conceptualization, data curation, methods, project administration, resources, software, writing – original draft and writing – review & editing.
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Abstract

Introduction. After general surgery, complications can cause extended stay in the hospital, which can increase medical costs, especially when the healthcare system has limited resources, such as in Iraq. The neutrophil-to-lymphocyte ratio (NLR), calculated from routine blood tests, reflects the systemic inflammatory response and has been proposed as a predictor of postoperative (PO) complications.
Purpose. To evaluate NLR as a preoperative (PreO) predictor of complications among patients undergoing emergency general surgery (EGS) at a private facility in Baghdad, Iraq.
Materials and methods. This was a prospective cohort study carried out in the General Surgery Department of two private hospitals located in Baghdad, Iraq for a period of one year. It included 220 adult patients who underwent EGS procedures. Venous blood samples were obtained on admission before surgery, and NLR was calculated based on the absolute neutrophils and absolute lymphocytes. PO complications were tracked through 30 days after surgery and categorized using the Clavien – Dindo classification.
Results. PO complications occurred in 27.7% of patients. The median PreO NLR for those patients who suffered a complication was significantly greater than for those who did not (7.9 vs 3.4, $p<0.001$). ROC analysis determined an optimal cut-off value of 5.2 (Sensitivity 76.2%, specificity 71.4%). Further analysis with multivariate logistic regression identified NLR ≥ 5.2, ASA class ≥ III, and prolonged operative time as independent predictors of having a complication POly.
Conclusions. PreO NLR is a low-cost, simple, and effective biomarker that independently predicts patients developing complications after having EGS in a private setting in Iraq. Using NLR in routine PreO assessment may assist with predicting complications by providing important information for risk stratification in settings that may not have the ability to use more complex scoring systems.
Keywords: NLR, PO complications, emergency general surgery, systemic inflammation, risk stratification

INTRODUCTION

Emergency surgery is an operative intervention performed to treat an acute threat to life, organ, limb, or tissue [1]. PO complications remain a major determinant of morbidity, mortality, and healthcare costs following major abdominal surgery [2]. Despite advances in surgical techniques and perioperative care, rates of complications such as infections, anastomotic leaks, and organ dysfunction remain substantial, often ranging between 20% and 40% in high-risk cohorts [3]. Compared with elective operations, emergency surgery patients are up to five times more likely to die within 30 days after their operation. Reported data suggest that 4.2 million deaths will occur within 30 days of surgery worldwide each year, half of which are in low- and middle-income countries [4]. Patients who present for care in low-resource settings often have a much greater risk for complications due to a delay in seeking care, a lack of diagnostic and/or critical care support, and variable staffing during the perioperative period than patients in higher resource countries. Therefore, the early and accurate identification of high-risk patients undergoing surgery should be considered a clinical priority and not simply an academic exercise [5]. Serious trauma from surgery, significant infection, or a serious injury can generate changes in the immune system in a person's body. The systemic inflammatory response is characterized by neutrophilia and relative lymphopenia [6]. Previous studies have demonstrated that the Neutrophils to Lymphocytes Ratio (NLR) is a more accurate predictor of outcome than either neutrophils alone or lymphocytes alone [7]. In many studies, NLR continues to be evaluated concerning short-term PO outcomes in many surgical populations outside cancer [8]. However, the predictive strength of NLR remains variable across studies, with differing patient populations, surgical types, and NLR cut-offs contributing to inconsistent results [9].

Iraq and particularly Baghdad symbolize many of these challenges. Poor public health infrastructure and increased reliance on private sector medical care have created a surgical environment with variability in advanced perioperative risk stratification resources. Composite scoring systems that quantify PO complications following surgeries as the POSSUM and ASA physical status classification may not routinely or timely be available, particularly in private hospitals [10]. Therefore, there is a need for inexpensive and readily available markers that require no more than a standard complete blood count, which is routinely performed upon admission to an emergency, makes NLR an attractive biomarker for EGS populations in locations that are limited in resources, like Iraq. As far as we can determine, there have been no prospective studies evaluating the predictive value of PreO NLR in EGS for patients who are treated privately in Baghdad. Patient demographics, severity of disease at presentation, and peri-operative patient care processes differ from both the local public teaching hospital sector and from the predominantly European and East Asian populations.

PURPOSE OF THE STUDY

To evaluate NLR as a preoperative (PreO) predictor of complications among patients undergoing emergency general surgery (EGS) at a private facility in Baghdad, Iraq.

MATERIALS AND METHODS

Study Design and Setting

An observational cohort study was carried out in the General Surgery Department at two private hospitals located in Baghdad, Iraq for a period of one year from February 2025 to February 2026.

Study Population

This study included 220 adult patients presented for an emergency general surgical procedure during the study period. Patients that were less than eighteen years of age; those who received elective / planned procedures, had a laparotomy as a result of trauma; diagnosed with a blood malignancy or disorder that affected their baseline neutrophil and/or lymphocyte count (ex: leukemia, lymphoma, aplastic anemia); those with chronic immunosuppression or having received corticosteroids in the four weeks before surgery; had an active malignancy receiving chemotherapy, had an active infectious process (>72 hours) that was not related to their presenting surgical condition, pregnant women, and those who refused to participate were excluded from this study. Also, patients that die intraoperatively or within 24 hours of surgery (unrelated to surgical complication) (ex: pre-existing terminal cardiac disease) were also excluded from the complication analysis, although these instances were infrequent.

Sample Size

To calculate the minimal amount of sample size needed, we used the following formula [11]: $n=Z^2xPx(1-P)/E$, as Z= 1.96 (For 95% confidence interval); P = Complication rate (0.25%); E = Marginal Error (6%). Based off prior EGS references [12], the total sample size is 220 (Figure 1).

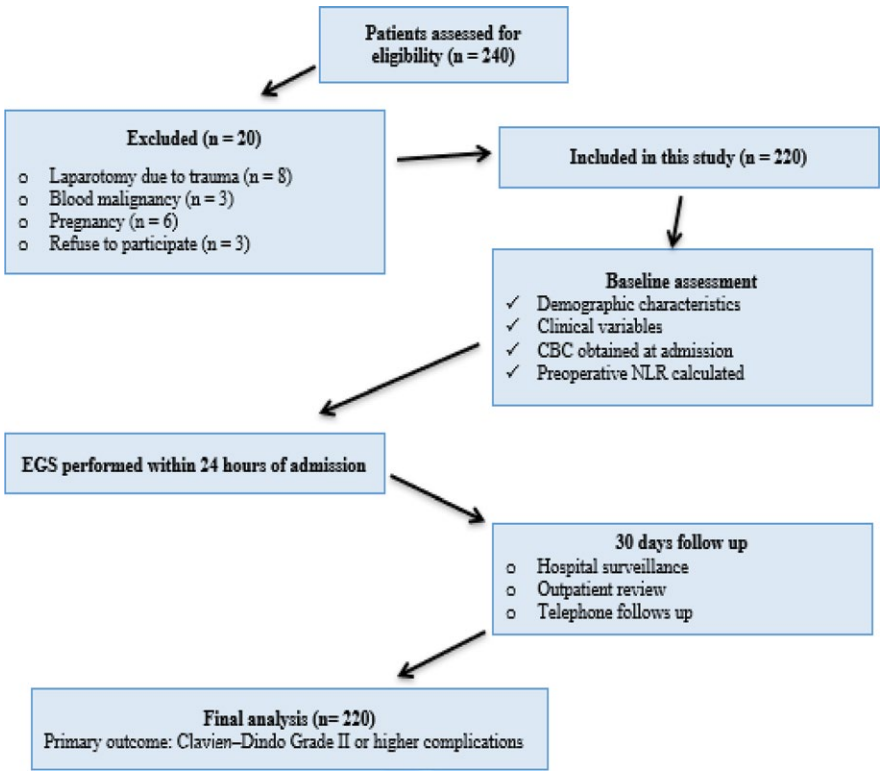

Fig. 1. Patient flow diagram

Data Collection

The demographic characteristics (age and gender), presence / absence of comorbidities (diabetes mellitus, hypertension, cardiovascular disease, and chronic renal disease), ASA physical status classification, admission vital signs, provisional and final operative diagnoses, the type and urgency of the operative procedure as well as its duration, and the type of anaesthesia and intraoperative findings (e.g., whether there was perforation, gangrene, and/or peritoneal contamination, if appropriate) were all recorded on a standardised data collection form.

For all recruited patients and before surgery, any fluid resuscitation was performed other than initial stabilization, and before any corticosteroid was administered, a venous blood sample was taken at the time of admission. CBC, including both absolute neutrophil and absolute lymphocyte counts, were measured in the hospital's central laboratory using an automated haematology analyser. NLR was calculated by dividing the absolute neutrophil count by the absolute lymphocyte count.

Other inflammatory markers regularly assessed at the time of admission, such as total WBC and, where performed, C-reactive protein (CRP), were also included to be able to compare the diagnostic performance of the NLR with those well-established inflammatory markers.

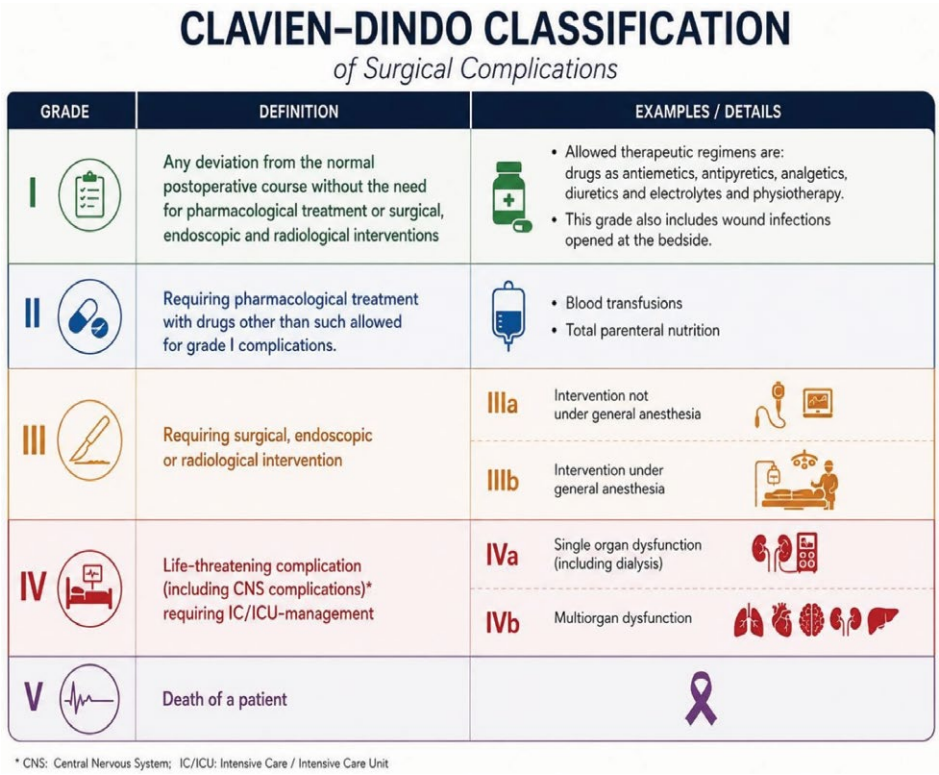

Fig. 2. Clavien – Dindo classification [13]

Outcome Assessment

All patients were clinically tracked throughout their hospital stays and through structured telephone check-ins or outpatient reviews 30 days after the surgical procedure.

The primary outcome was the number of PO complications that occurred within 30 days of surgery, with complications defined and graded per the Clavien – Dindo classification which is used to rank the severity of a surgical complication. It is based on the type of therapy needed to correct the complication. It consists of five grades as shown in Figure 2. Grade II and higher complications were considered clinically significant for the primary binary analysis (if complications occurred or did not occur) [13].

This analytical method was consistent with those used in similar NLR research on appendicitis. Secondly, specific complication types (surgical site infection, intra-abdominal collection, anastomotic or wound dehiscence, respiratory complications, and sepsis), length of hospitalization, need for intensive care unit admission, reoperation within 30 days, and 30-day survival were analyzed. All PO complications were confirmed by two independent members of the surgical team, and disagreements will be resolved by a third surgeon.

Statistical Analysis

Statistical analyses were performed using SPSS Statistics version 28.0 on IBM (SPSS Inc., Chicago, IL). To determine normality of continuous variables, the Shapiro – Wilk test was conducted, and summary statistics were provided for continuous variables (mean±SD or median with interquartile range) and categorical variables (frequencies and percentages). Independent-samples t-tests and Mann-Whitney U-tests were utilized, and chi-square tests or Fisher's exact tests were used. Receiver operating characteristic curves were generated to evaluate the ability of the PreO NLR to predict PO complications; cut-off points were determined via the Youden index, and sensitivity, specificity, were calculated for these cut-offs. Those variables that were significant at $P< 0.05$ in univariate analysis were included in a multivariate logistic regression model; the results were presented as odds ratios (aOR) with 95% CI. A two-tailed $p<0.05$ was considered statistically significant.

■ RESULTS

Follow-up for the entire 30-day post-operative period was complete (no lost to follow-up) on 220 patients. The mean age was 41.6±15.3 years and ranged from 19 to 67 years, with males comprising 128 (58.2%) of the total sample. The primary diagnosis for surgical intervention was acute appendicitis (36.4%). There were 61 patients (27.7%) who developed at least one Clavien – Dindo Grade II or above PO complication within 30 days of surgery, with the most common complications identified as surgical site infections (13.6% of total group). A comparison of patients with and without PO complications for demographic, clinical and laboratory data are summarized in Table 1. The complication group was older than the non-complication group, had a greater proportion of ASA class III and above, longer operative times and greater values for intraoperative contamination or perforation. The median PreO NLR was significantly different between the complication group and the non-complication group ($P<0.001$) which indicating that elevated PreO NLR is associated with an increased risk of PO complications.

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Table 1
Baseline characteristics of patients with and without PO complications

Variable	PO complications		P-value
	Yes (n=61)	No (n=159)	
Age, years (mean±SD)	48.1±16.0	39.0±14.3	<0.001*
Male sex, n (%)	38 (62.3)	90 (56.6)	0.44***
ASA class ≥III, n (%)	26 (42.6)	22 (13.8)	<0.001***
Diabetes mellitus, n (%)	19 (31.1)	26 (16.4)	0.014***
Operative time, min (mean±SD)	98.4±32.6	68.2±24.1	<0.001*
Intraoperative contamination/ perforation, n (%)	24 (39.3)	21 (13.2)	<0.001***
PreO WBC, $\times 10^9$/L (median, IQR)	13.8 (10.9–17.2)	10.6 (8.4–13.1)	<0.001**
PreO NLR (median, IQR)	7.9 (5.1–11.2)	3.4 (2.2–4.9)	<0.001**
Length of hospital stay, days (median, IQR)	7 (5–11)	3 (2–4)	<0.001**

Notes: * student t-test, p<0.05 used for normally distributed data; ** Mann – Whitney U-test used for not normally distributed data; *** Chi square test used for categorical data.

Receiver operating characteristic (ROC) curve analysis was constructed for PreO NLR and WBC count as predictors for risk of development of PO complications. The cut point of PreO NLR was 5.2 and of PreO WBC was 12.4×10^9/L. The PreO NLR >5.2 and PreO WBC >12.4×10^9/L are predictive for risk of development of PO complications, as a large significant area under the curve (AUC=78% and 66% respectively) indicating significant association between higher level of PreO NLR and WBC count with risk of development of PO complications. PreO NLR level was 76.2% sensitive and 71.4% specific; while PreO WBC count was 62.3% sensitive and 64.8% specific in predicting risk of development of PO complications (Table 2).

Multivariable logistic regression analysis identified (Table 3) using results of PO complications as the dependent variable. Three factors were found to be important

Table 2
Diagnostic performance of PreO NLR and comparator markers for predicting PO complications

Marker	AUC (95% CI)	Optimal cut-off	Sensitivity (%)	Specificity (%)
PreO NLR	0.78 (0.71–0.85)	5.2*	76.2	71.4
PreO WBC count	0.66 (0.58–0.74)	12.4×109/L*	62.3	64.8

Note: * ROC analysis used to predict the cut-off value.

Table 3
Multivariate logistic regression analysis of independent predictors of PO complications

Predictor	Adjusted OR	95% CI	P-value
NL++-R ≥ 5.2	3.8	1.9–7.6	<0.001
ASA class ≥III	2.9	1.4–6.02	0.004
Operative time >90 min	2.35	1.15–4.8	0.019
Intraoperative contamination / perforation	1.98	0.95–4.13	0.068
Age >60 years	1.65	0.79–3.44	0.183

Table 4
PO outcomes stratified by PreO NLR group

Outcome	NLR ≤5.2 (n=141)	NLR >5.2 (n=79)	P-value
Any complication, n (%)	22 (15.6)	39 (49.4)	<0.001
ICU admission, n (%)	5 (3.5)	14 (17.7)	<0.001
Reoperation within 30 days, n (%)	3 (2.1)	9 (11.4)	0.003
30-day mortality, n (%)	0 (0)	2 (2.5)	0.045
Length of stay, days (median, IQR)	3 (2–4)	6 (4–9)	<0.001

independent risk factors for PO complications. Patients with NLR >5.2 were 3.8 times more likely to develop PO complications (aOR=3.8 with 95% CI: 1.9 to 7.6), ASA class ≥III is 2.9 and operative time >90 min is 2.35 more likely increase the PO complication rate (aOR=2.9 with 95% CI: 1.4–6.02 and aOR=2.35 with 95% CI: 1.15 to 4.8).

In comparison to patients who PreO NLR was 5.2 or less, those with an NLR > 5.2 had much poorer PO results (Table 4). Strong statistical significance (P<0.05) was observed in the significantly higher rates of any complication (49.4% vs. 15.6%), ICU admissions (17.7% vs. 3.5%), and reoperations within 30 days (11.4% vs. 2.1%), all in the high-NLR group. Furthermore, the high-NLR group was the only one to show 30-day mortality (2.5%, P=0.045), and they also had a significantly longer median hospital stay (6 days vs. 3 days, p < 0.001).

■ DISCUSSION

While NLR has been studied in different surgical populations, there is a lack of prospective data from low – and middle – income countries, especially when it comes to emergency surgery. To our knowledge, this is the first prospective study to use the standardized Clavien – Dindo classification to assess the prognostic power of PreO NLR for patients undergoing EGS in private healthcare facilities. The results have important implications for Iraq, a country with limited healthcare resources and perioperative risk-stratification tools. This inexpensive and readily available biomarker could help with early risk assessment, PO monitoring, and the evidence-based distribution of scarce surgical resources. An internal audit of appendectomy outcomes in Baghdad documented a negative appendectomy rate of about 20% with considerable burdens of PO pain and ileus and wound-related morbidity after routine surgery [14]; thus, the appropriate use of inexpensive, immediately-useful and actionable risk markers (NLR) in Iraqi surgical practice may provide evidence to guide the decision-making process for the intensity of PO monitoring, the threshold of surgical intensive care referral, and patient counselling more broadly within the private-hospital model in Iraq, wherein resource allocation, decisions are made at the level of the admitting team instead of through a centralised public system [15]. According to this prospective cohort study conducted in two private hospitals in Baghdad, Iraq, the PreO NLR is a significant and independent predictor of PO complications among adult patients undergoing EGS. An NLR of greater than 5.2 (With AUC of 0.78) quadruples the adjusted odds of experiencing a Clavien – Dindo Grade II or greater complication and has also been associated with increased rates of intensive care admission, reoperation, prolonged length of hospital stays, and mortality. These findings are consistent with previous studies by Zahorec R. [16], Mortaz E et al. [17], and Firment J et al. [18] concerning NLR as a marker

of surgical stress and PO risk into an unstudied population and healthcare setting and support the biological premise of Zahorec index that the relationship between neutrophil mediated innate immunity and lymphocyte mediated adaptive immunity provides clinically useful prognostic information that is not completely captured using either cell lineage alone, or using total white blood cell count alone. AUC is 0.78 and this might be explained by the fact that PO complications are multifactorial, and while NLR represents systemic inflammation, no single blood measure can capture all of them. This study found that PreO WBC had a lower predictive performance (AUC=0.66) than NLR (AUC=0.78), suggesting that NLR more accurately discriminates patients at risk of PO complications. In contrast to WBC, which solely shows the amount of WBC, NLR considers the suppression of lymphocytes caused by physiological stress and immunological dysfunction as well as the innate inflammatory activation mediated by neutrophils [19]. This dual representation provides a more comprehensive assessment of the host inflammatory response, which is why NLR showed better predictive accuracy in our group. Although pre-operative blood samples were standardized, NLR is a dynamic biomarker that changes as acute sickness progresses. Patients' varying degrees of inflammation, perforation, or sepsis at the time of presentation may explain why NLR readings were so variable [20].

However, not all studies have found NLR to have a strong independent association with complications in patients undergoing emergency abdominal surgery as studies conducted by Oreskov KO et al. [21] and Haghi SE et al. [22].

The evidence to date of the consistent association between NLR and the occurrence of complications across multiple surgical specialties that have drastically different underlying pathology and method of surgical procedures provides additional support for the possibility that NLR reflects some underlying characteristic of physiological reserve and inflammatory readiness, rather than effects specific to any given surgical specialty [23]. This characteristic of NLR provides it with utility within a diverse population of EGS patients who have a wide range of severity of underlying diseases and a range of physiological functional reserve, but share a common physiological stress associated with undergoing an elective surgical procedure [24].

■ CONCLUSIONS

This study showed that PreO NLR represents a simple, inexpensive, and readily available biomarker to assess PreO risks in EGS as it found an independent relationship between elevated PreO NLR and considerably higher risk of PO complications. Moreover, there is a relation between elevated NLR and longer hospital stays, higher rates of intensive care unit admissions and higher 30-day mortality. The accuracy of NLR (compared to both Total WBC count alone or ASA classification alone) was superior, and it is a common blood test ordered routinely through triage into the hospital as part of a workup prior to any surgical procedure. Given overall resource limitations often found in Iraq's surgical practices, the use of NLR test values to set PreO standards (such as the 5.2 value found in the given population) could permit a more focused allocation of resources to patients in need of PO monitoring and critical care facilities until further studies confirm positive results in large multi-centre trials within private and public hospitals throughout Iraq.

So, incorporating an available and relatively inexpensive pre-operative threshold of NLR to the decision-making process at presentation will allow for close observation of post-surgical patients who require closer observation, earlier visit from a senior surgeon

or those whose condition warrants more intensive post-surgical care. This stratification process will be valuable in private hospital systems where resources are limited and require a process to allocate them in an efficient manner.

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Surgical Versus Conservative Management of Traumatic Acute Subdural Hematoma: An Observational Cohort Study

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Abstract

Introduction. Acute subdural hematoma is the bleeding that occurs between the dura mater and the arachnoid mater of meninges surrounding the brain, usually resulting from traumatic brain injury.
Purpose. To determine the mortality and morbidity associated with traumatic acute subdural hematoma in Erbil, to assess the potential benefits of surgical intervention in improving patient outcomes and to identify key prognostic factors that influence recovery and survival.
Materials and methods. A combined retrospective and prospective observational cohort study. The outcome of acute subdural hematoma focusing on two treatment approaches: surgical intervention and conservative treatment, the clinical follow-up period for the participants is one month. The mean follow-up period was one month.
Results. Out of the total patient group, fourteen individuals (29.4%) died within the first 72 hours following surgery. Three patients (5.9%) survived but remained in a persistent vegetative state. Five patients (10.8%) showed improvement but were left with moderate to severe neurological deficits, eleven patients (23.9%) improved with mild to moderate complications, and thirteen patients (28.3%) treated conservatively showed recovery and improvement. Among them, five patients (10.8%) were discharged without any sequel, another five (10.8%) with minimal complications, while the remaining three patients died due to other associated injuries.
Conclusions. The mortality and morbidity rates of traumatic acute subdural hematoma remain high. A significant correlation exists between the patient's level of consciousness at admission, as measured by the Glasgow Coma Scale (GCS), and their eventual outcome. Hypoxia and hypotension upon admission are strongly linked to unfavorable prognoses.
Keywords: acute subdural hematoma, conservative, prognosis, craniotomy, cranioctomy

■ INTRODUCTION

Acute subdural hematoma (ASDH) is the bleeding that occurs between the dura mater and the arachnoid mater of meninges surrounding the brain, usually resulting from traumatic brain injury [1]. It is seen in approximately one third of patients with severe traumatic brain injury, it can lead to rapid neurological deterioration because of the severity of the initial injury. The condition is fatal, with a mortality rate of between 40% to 90% [2]. It is usually due to an injury to the bridging veins which extend from the surface of the brain or superficial cortical arteries. Patients with the ASDH may have delayed neurological deterioration between 24 and 72 hours after injury because of cerebral edema and contusion enlargement [3]. It is caused by high-speed impacts that accelerate the brain relative to fixed dural structures, tearing bridging veins that traverse the space between the cortical surface and the venous sinuses [4]. It can also result from injury to the surface of the brain that causes bleeding from cortical vessels into the subdural space. The clinical findings of ASDH are related to the cause, site, size, and rapidity of growth of the hematoma and severity of the diffuse parenchymal injury of the brain [2, 3]. Two common causes of ASDH: Accumulation around parenchymal laceration (usually frontal or temporal lobe). There is usually severe underlying primary brain injury (Often no "Lucid interval"). Focal signs usually occur later, and they are less prominent. Surface or bridging vessels torn from cerebral acceleration-deceleration during violent head motion [4]. With this etiology, brain damage is usually less severe, a lucid interval often occurs, and later rapid deterioration manifests, it represents a major clinical entity in traumatic brain injury, diagnosed on neuroimaging computed tomography, it most commonly appears as a crescent-shaped extra-axial collection overlying a cerebral convexity [1, 5].

■ PURPOSE OF THE STUDY

To determine the mortality and morbidity associated with traumatic acute subdural hematoma in Erbil, to assess the potential benefits of surgical intervention in improving patient outcomes and to identify key prognostic factors that influence recovery and survival.

■ MATERIALS AND METHODS

Design and Setting

A combined retrospective and prospective observational cohort study. It examines the factors influencing the outcome of acute subdural hematoma focusing on two treatment approaches: surgical intervention and conservative treatment, the clinical follow up period for the participants is one month**.** Patients who are admitted to the neurosurgical ward at Erbil Teaching Hospital and the West Emergency Hospital. The study included the admission, management, and follow-up of 46 patients with traumatic ASDH conducted over two-year period from March 2023 to March 2025. The mean follow-up period was one month.

Operation

Craniotomy was done for 33 patients. The type of craniotomy is designed over the site of the hematoma collected. Except in cases with severe brain swelling at the time

of operation, where Decompressive craniectomy was done for them. The conservatively treated ASDH patients were admitted to the neurosurgical ward for treatment and follow-up.

Data Collection

All patients underwent an accurate clinical history and examination according to the following questionnaire: (Information from most cases taken from the family, relatives or health attendants) History: Age, Sex Occupation (Maybe an occupational injury), Address Presenting symptom (Headache, Nausea, Vomiting, LOC, and bleeding) associated injury, i.e., to the chest, abdomen, or extremity), Duration of injury (The duration lasts from the time of injury to the arrival at the hospital), Type of Injury (Blunt or penetrating head injury), Extent of Injury (localized or generalized), Nature of Injury (blast injury, gunshot injury, road traffic accident), Vital signs, Consciousness level (as assessed by GCS), Complete neurological examination (sensory, motor, and autonomic systems), Pupillary examination to assesses brain stem function.

Investigation

All patients were sent for brain CT scan and conventional x-ray imaging for the lateral cervical area (chest, and other parts x-ray as needed if there is an associated injury).

Treatment

Thirteen patients with ASDH were treated conservatively and admitted to the neurosurgical ward for treatment and follow-up. Craniotomy was done on 33 patients, follow-up continues post-RCU until the patients are discharged from the neurosurgical ward.

Statistical Analysis

Data were presented as frequency, mean, SD and percentage. Statistical Analysis was done using the SPSS version 24.0 (Chicago, US). The Fisher's exact test was used. P-value <0.05 was considered significant.

■ RESULTS

A total of 46 patients with traumatic acute subdural hematoma were included, of whom 82.6% were male (38 patients) and 17.4% female (8 patients). Ages ranged from infancy to 85 years (mean age ~35.7 years). Patients were categorized into five age groups: Infant (0–1 years) 2 patients, child (1–12 years) – 6 patients, young adult (13–40 years) – 20 patients, middle-aged (40–60 years)10 patients, and elderly (60–85 years) 8 patients. Overall survival was 63% (29 patients), and the mortality rate was 37% (17 patients). The overall mortality observed (37%) is within the reported range for severe ASDH Most injuries were caused by high-velocity trauma: road traffic accidents (RTA) accounted for 59% (27/46) of cases, followed by FFH in 24% (11/46). Associated intracranial injuries were common: cerebral contusions in 30% (14 patients). About 56.5% had significant extracranial trauma. Glasgow Coma Scale (GCS) on admission was mild (13–15) in 28.3% of patients (13/46), moderate (9–12) in 17.4% (8/46), and severe (<8) in 54.3% (25/46). Hemodynamic status on arrival was stable in 60.9% and unstable in 39.1%. By one-month follow-up, 29 patients (63%) were alive, and 17 (37%) had died (Table 1).

Table 1
Summarizes each variable's survival outcomes by category

Factor	Category	Alive	Dead	Mortality (%)	p-value
Age Group	Infant (0–1 yr)	2	0	0	0.57
	Child (1–12 yr)	5	1	16.7	
	Young Adult (13–40 years)	12	8	40	
	Middle-aged (40–60 years)	6	4	40	
	Elderly (60–85 years)	4	4	50	
Gender	Male	23	15	39	0.69
	Female	6	2	25	
Glasgow Coma Scale	Mild (GCS 13–15)	10	3	23	0.24
	Moderate (GCS 9–12)	6	2	25	
	Severe (GCS ≤8)	13	12	48	
Type of Accident	Road Traffic Accident (RTA)	14	13	48.1	0.11
	Fall from Height	8	3	27.3	
	Low ground fall/blunt	7	1	12.5	
Associated Head Injury	Contusion	8	6	42.9	0.96
	Extradural hematoma (EDH)	3	1	25	
	Linear skull fracture	6	4	40	
	Intracerebral hemorrhage	4	2	33.3	
	None	8	4	33.3	
Other Injuries	Chest injury	4	6	60	0.31
	Abdominal injury	4	2	33.3	
	Other (extremity/spine)	6	4	40	
	None	15	5	25	
Vital Signs on Admission	Stable	20	8	28.6	0.12
	Unstable (hypotension/hypoxia)	8	9	52.9	
Treatment	Surgical intervention	19	14	42.4	0.38
	Conservative management	10	3	23.1	

The surgical group had a substantially higher early mortality (42% vs. 23%) and no cases of complete recovery without deficits (0% vs. 38%). Nearly half of surgically treated patients died, typically within the first 72 hours. In contrast, 13 of 13 conservatively managed patients survived the acute phase, with only three later succumbing to other injuries (23% mortality overall in that group). The difference in vegetative outcomes is also notable: 3 patients (9%) in the surgical group remained in a persistent vegetative state, whereas none in the conservative group did (Figure).

Neurological disability among survivors was common in both groups, but was distributed differently.

Surgical Outcomes

Of the 19 surgical survivors, the majority had some degree of neurological impairment. Five patients (15%) had moderate to severe deficits (e.g., hemiplegia, significant motor or cranial nerve deficits). Eleven 11 patients (33%) improved but with mild to moderate complications, such as seizures, personality changes, memory loss, or minor motor

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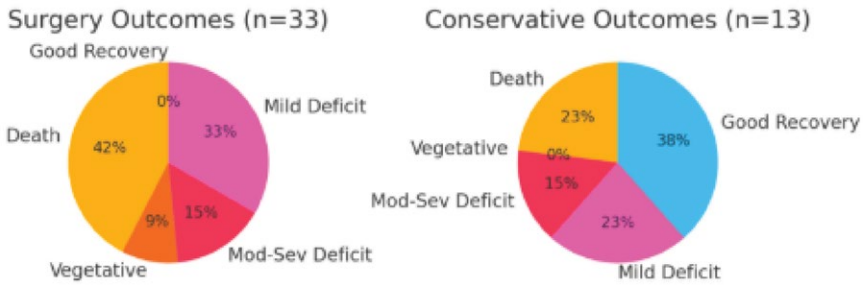

Outcome distribution for surgical vs. conservative management. The pie charts show the percentage of patients in each outcome category 1 month after injury. Surgically treated patients had a higher proportion of deaths and vegetative outcomes

Table 2
Outcome distribution in surgically treated vs. conservatively treated patients (30-day outcome)

Outcome	Surgical Group (n=33) No. (%)	Conservative Group (n=13) No. (%)
Death	14 (42.4)	3 (23.1)
Vegetative state	3 (9.1)	0
Moderate-Severe deficit	5 (15.2)	2 (15.4)
Mild deficits/complications	11 (33.3)	3 (23.1)
Good recovery (no deficit)	0	5 (38.5)

symptoms. No surgical patient in this series had a completely uncomplicated recovery at 1 month (though some had only subtle issues). These figures reflect the severity of initial injuries in the operated group. Notably, early surgical intervention was often lifesaving, one patient who was initially managed conservatively required a delayed craniotomy upon neurological decline, and surgery prevented their death (Table 2).

Conservative Outcomes

Outcomes were markedly better in the non-operated group. Five patients (38.5%) recovered well with no neurological sequel. Another five patients had residual deficits: 3 (23%) with mild deficits (e.g., mild weakness, minor cognitive or personality changes) and 2 (15%) with moderate deficits. No patient in this group ended up in a vegetative state. Thus, about 62% of conservatively managed patients recovered with no or only mild impairments, and only 23% died. These patients were carefully monitored with bed rest, head elevation, oxygen, fluid management, sedation, and anticonvulsants, and they improved without needing surgery. The few deaths in the conservative group were attributable to severe other injuries rather than the ASDH itself. It is important to emphasize that the treatment approach was not randomly assigned surgical patients had more severe hematomas (often larger than 1cm thick on CT, causing significant midline shift) and/or worse neurological status. In contrast, conservative patients had smaller ASDH with minimal mass effect (Table 2).

■ DISCUSSION

In this study, we evaluate the factors that affect the prognosis and outcome of 46 acute subdural hematoma patients who were admitted to Erbil teaching hospital and west Emergency Hospital, despite the neurosurgical intervention, which ranged from conservative measures to operative evacuation of the hematoma with treatment of the associated cranial injury, The mortality rate in this study reached about 37% of all cases of ASDH admitted. Most studies in the literature report mortality rates of over 50%, and none record a mortality rate of less than 35% [6–8]. In this study, most cases are within the young age group, which comprises 43.4% of the cases studied. The mortality rate of this group was 40.0%. While the mortality in the old age group is 50%. The lowest mortality rate was seen in the pediatric and young age groups [9]. Maxeiner and Wolff found that the mortality rate was 20% for patients under 40 years old and 65% for patients over 40 years old [10].

Kaewborisutsakul and Tunthanathip found that the mortality rate was 34% for patients between 19 and 40 years old, and 70% for patients older than 65 years [9]. Patients' state of consciousness as measured by GCS preoperatively is reliably related to the outcome. Patients with GCS ≤7 have a lower outcome despite the neurosurgical intervention. 25 patients of 46 patients were admitted with GCS ≤7, and the mortality rate reached 48.0%. Whereas patients admitted with a GCS of more than 7 were 8 of 46, and the mortality rate is about 25%, especially in the older age group. Kaewborisutsakul and Tunthanathip found a strong correlation between GCS scores and mortality: nearly all patients with acute SDH and GCS scores of 3 died (93% mortality), patients with GCS scores of4-6 had a mortality of 45–67% [9].

In this study, the mortality rate in ASDH without concurrent brain injury was 8.7%, and with brain injury, it was 28.2%. In one study, the mortality rate in ASDH without concurrent brain insult was 22%, and with brain injury, it was 30% [11].

Potapov et al. found that the mortality rate in conscious patients at the time of operation was 9%, whereas it is 40-65% in unconscious patients operated on [12]. ASDH is usually not presented alone; 73.9% of cases are associated with concomitant skull and parenchymal injury. 34 of 46 cases presented with some associated injury. The most common is the underlying cortical contusions, which comprise 30.4% of total cases. Also, this injury carries a tremendous burden on morbidity and mortality. Road traffic accident was the most common cause of injury, and the mortality rate was (48.1%) most of them are young age, and the mortality rate of those with FFH was (27.3%). In one study the mortality of RTA was (58%), and the mortality of FFH was (50%) [13].

Vital signs at the time of admission are essential to predict patient outcome. In this study, 18 patients of the 46 were unstable ten of them, was died, 55.6%. In one study, the mortality rate of patients who have both hypoxia and hypotension have a mortality rate of 57.2% [14]. However, Bullock et al. and Fountain et al. have shown that prompt operation has an essential bearing on outcome [11, 15].

Elevation in postoperative ICP, especially when refractory to medical treatment, has a poor prognosis [16]. Early neurosurgical intervention is essential in this study, we try to operate on the patients within the first 4 hours after initial injury. Most patients were operated on within 1-6 hours of initial diagnosis.so we did not find a correlation between the time of surgery and outcome. Other associated injuries have unfavorable outcomes;

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the mortality of patients with chest injury in our study is 60.0%. In one study, the Mortality of patients with chest injury is 43%, which is higher than for patients with only TBI with comparable Glasgow coma scale [17]. This is because all patients who were operated on were those with severe head injury, and most of them had concurrent brain injury, such as contusion, ICH, and other associated injuries [18]. However, the surgery was life-saving in many cases. While the conservatively treated patients were those with minor head injury and small SDH, one of them, who was treated conservatively, deteriorated clinically, and the hematoma expanded, which made the neurosurgical intervention mandatory in the end. In one study, there was no effect of the timing of surgery on outcome [19]. In the absence of ICP monitoring (intra-operatively or post-operatively), we neither estimate the number of patients who had increased ICP nor estimate the death rate that correlates directly to this complication.

The management outcomes indicate that surgery was often necessary and lifesaving, but it is not a guarantee of good recovery given the underlying brain trauma. Conservative treatment yielded promising results in selected mild cases, but required vigilant monitoring; delayed deterioration in one case was rescued by late surgery. The key prognostic factors for mortality were the level of consciousness (GCS) at admission and the presence of secondary insults [20].

■ CONCLUSIONS

The mortality and morbidity rates of traumatic acute subdural hematoma (ASDH) remain high. A significant correlation exists between the patient's level of consciousness at admission and their eventual outcome. Hypoxia and hypotension upon admission are strongly linked to unfavorable prognoses. Early surgical intervention has been shown to reduce mortality in patients who undergo surgery. Surgery proved life-saving in many cases, particularly for those initially managed conservatively who later experienced neurological deterioration and required surgical intervention. The presence of additional brain injuries or hematomas, such as intracerebral hemorrhage, intraventricular hemorrhage, or epidural hematoma, further elevate the risk of mortality, severe extracranial injuries tended to worsen prognosis. Patients with major chest injuries (e.g. Lung contusions, pneumothorax) had the highest mortality. Postoperative complications like neurological deficits and seizures being common among this subgroup.

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Surgical Outcome in Supratentorial Cavernoma-Related Epilepsy

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Abstract

Introduction. Cerebral cavernous malformations (CCMs) are common vascular lesions frequently associated with epilepsy, particularly in supratentorial locations. Surgical resection is an established treatment; however, factors influencing postoperative seizure outcome remain incompletely defined.
Purpose. To evaluate postoperative seizure outcomes in patients with supratentorial cavernoma-related epilepsy treated surgically and to describe clinical and surgical factors related to seizure control.
Materials and methods. This retrospective single-center cohort study included 16 patients who underwent surgical resection of supratentorial cerebral cavernous malformations between October 2020 and October 2025. Clinical, radiological, surgical, and follow-up data were reviewed. Postoperative seizure outcome was assessed at the last available follow-up using the Engel Epilepsy Surgery Outcome Classification.
Results. Sixteen patients were included. There were 9 males (56.3%) and 7 females (43.8%). The mean age at seizure onset was 23.06 years, the mean epilepsy duration was 8.5 years, and the mean age at surgery was 31.1 years. Lesionectomy was performed in 12 patients (75.0%), while 4 patients (25.0%) underwent extended resection. Complete resection was achieved in 15 patients (93.8%). After a mean follow-up of 34 months, 11 patients (68.8%) achieved Engel class I outcome, while 5 patients (31.3%) had Engel class II–IV outcomes. Permanent neurological deficits occurred in 2 patients (12.5%). Patients with Engel class II–IV outcomes showed descriptive trends toward longer epilepsy duration and larger lesion size, but these differences were not statistically significant.
Conclusions. Surgical treatment of supratentorial cavernoma-related epilepsy was associated with favorable seizure control in most patients in this cohort. Because of the small sample size, the study was underpowered to identify independent prognostic factors. Early referral, careful preoperative evaluation, and complete resection when safely achievable may help optimize seizure outcomes, but larger studies are needed to confirm predictors of postoperative seizure freedom.
Keywords: cavernoma, intractable epilepsy, engel outcome, cerebral cavernous malformations, brain parenchyma

■ INTRODUCTION

Cerebral cavernous malformations (CCMs) account for approximately 5–15% of central nervous system vascular malformations [1]. They are considered a subtype of angiographically occult vascular malformations (AOVMs) because they are not visualized on conventional cerebral angiography [2]. CCMs are benign vascular lesions composed of endothelial-lined, blood-filled channels without intervening brain parenchyma and lacking mature vascular wall elements. Repeated microhemorrhages often result in the formation of a hemosiderin rim surrounding the lesion. In contrast to arteriovenous malformations (AVMs), CCMs are low-flow lesions without arterial supply or venous drainage, and they may be thrombosed. Macroscopically, they appear as reddish-purple, mulberry-like lesions of variable size, which may be single or multiple [3–6]. The most common clinical presentation of CCMs is seizure disorders, occurring in approximately 35–70% of patients, with 20–40% developing pharmacoresistant (intractable) epilepsy [7]. Repeated microhemorrhages lead to the extravasation of excitotoxic blood products, resulting in neuronal loss, alterations in neurophysiology, free radical formation, and gliosis. These pathological changes contribute not only to the formation of a primary epileptogenic focus in the perilesional cortex, but also to the development of secondary epileptogenic zones in distant regions, such as the mesiotemporal structures [4, 5]. Furthermore, recurrent microhemorrhages and thrombosis are believed to underlie the dynamic nature of CCMs, as these lesions may enlarge or regress over time rather than remain stable [6, 8].

CCMs may occur throughout the central nervous system, including the brain and brainstem; however, 70–80% are located in the supratentorial region [3]. Before the widespread use of magnetic resonance imaging (MRI), diagnosis of these angiographically occult lesions was relatively uncommon. However, with the increasing use of MRI, CCMs are now more frequently identified as a cause of intractable epilepsy, and up to 40% of cases are discovered incidentally [4]. MRI is highly sensitive and specific for the diagnosis of CCMs due to its ability to detect hemoglobin degradation products. On T1-weighted images, CCMs typically appear hypointense to isointense, while on T2-weighted images they show hyperintense or mixed signal with a surrounding hypointense rim due to hemosiderin deposition. On T2*-weighted (gradient echo) sequences, they demonstrate a characteristic "blooming artifact" [3].

In a large review of 1,226 patients with supratentorial cavernomas, Englot et al. identified several predictors of favorable surgical outcome, including small lesion size (<1.5 cm), single lesions, medically controlled seizures, absence of secondary generalization, shorter duration of epilepsy, and complete lesion resection [7]. In 2011, von der Brelie and Schramm conducted a systematic review of 27 studies and highlighted significant limitations in the existing literature, including inconsistent definitions of epilepsy subtypes, inadequate characterization of drug-resistant epilepsy, and insufficient reporting of surgical techniques and outcomes, limiting the ability to draw firm conclusions [4].

Recent reports have also highlighted the occurrence of cavernous hemangiomas in extra-cranial and peripheral nerve locations, further expanding the spectrum of this vascular pathology. For instance, Algarnawee et al. described a rare case of median nerve cavernous hemangioma, emphasizing the need to consider vascular malformations in

the differential diagnosis of peripheral nerve lesions [9]. In addition, the same authors demonstrated the limited role of diagnostic cerebral angiography in detecting cavernous malformations, reinforcing the concept that these lesions are typically angiographically occult and are best evaluated using magnetic resonance imaging [10].

Although surgery is an established treatment for cavernoma-related epilepsy, seizure outcomes may vary according to epilepsy duration, lesion location, lesion size, and extent of resection. In addition, data from single-center experiences remain useful because surgical decision-making is often individualized according to lesion location, seizure pattern, and available preoperative evaluation.

■ PURPOSE OF THE STUDY

To evaluate postoperative seizure outcomes in patients with supratentorial cavernoma-related epilepsy treated surgically and to describe clinical and surgical factors related to seizure control.

■ MATERIALS AND METHODS

Study Design

This study was conducted as a retrospective observational cohort study aimed at evaluating surgical outcomes and describing clinical, radiological, and surgical factors related to postoperative seizure outcome in patients undergoing resection of supratentorial cerebral cavernous malformations (CCMs). The study focused on correlating clinical, radiological, and surgical variables with postoperative seizure outcomes.

Study Setting

The study was carried out at the American University of Beirut Medical Center (AUBMC), a tertiary referral center with specialized neurosurgical and epilepsy services. All patient data were obtained from institutional medical records and neurosurgical databases.

Study Period

Patient records were reviewed for a five-year period, from October 1, 2020, to October 1, 2025.

Study Population

The study included patients diagnosed with supratentorial cerebral cavernous malformations who underwent surgical resection during the study period.

Inclusion Criteria

Patients were included if they met the following criteria:

- Histologically or radiologically confirmed supratentorial cavernoma.
- Underwent surgical resection (lesionectomy or extended resection).
- Availability of complete medical records, including:
  - Clinical presentation.
  - Radiological imaging (MRI).
  - Surgical details.
  - Follow-up data.

Exclusion Criteria

Patients were excluded if:

- They had infratentorial cavernomas.
- Medical records were incomplete or missing key variables.
- Follow-up data regarding seizure outcome were unavailable.

Sample Size

A total of 16 patients met the inclusion criteria and were included in the final analysis.

Preoperative evaluation

All patients underwent a comprehensive preoperative assessment, which included:

- Detailed medical history and neurological examination.
- Analysis of seizure semiology.
- Magnetic Resonance Imaging (MRI) of the brain.
- Interictal electroencephalography (EEG) in all patients.
- Video-EEG monitoring in selected cases.
- WADA test for patients undergoing temporal lobe resections.
- Functional MRI (fMRI) for lesions located in eloquent brain areas (motor or premotor cortex). Eloquent brain areas were defined as cortical or subcortical regions that directly control critical motor, sensory, language, visual, or memory functions. Lesions were categorized as eloquent when they were located within or adjacent to these functional areas based on MRI findings, functional imaging when available, and neurosurgical assessment.

In selected complex cases, invasive EEG monitoring and staged surgical procedures were performed.

Drug-resistant epilepsy was defined as failure of adequate trials of two tolerated and appropriately chosen antiseizure medications, whether used as monotherapy or in combination, to achieve sustained seizure freedom.

Surgical Techniques

The surgical approach was selected according to lesion location, seizure semiology, MRI findings, EEG results, and the relationship of the lesion to eloquent cortex. Lesionectomy was performed when the epileptogenic zone was considered limited to the cavernoma and surrounding hemosiderin-stained tissue, especially in extratemporal lesions. Extended resection was considered in selected temporal lobe cases, long-standing epilepsy, or when preoperative evaluation suggested involvement of adjacent epileptogenic cortex. Extended resection included removal of the cavernoma, hemosiderin-stained tissue, and adjacent epileptogenic cortex when this could be performed safely.

Histopathological Confirmation

Cavernoma diagnosis was based on preoperative MRI findings and was confirmed histopathologically after surgical resection when tissue diagnosis was available. Radiological diagnosis was based on typical MRI features of cavernoma, including mixed-signal intensity with a hemosiderin rim and blooming artifact on susceptibility-sensitive sequences.

Outcome Measures

The primary outcome measure was postoperative seizure control, assessed using the Engel Epilepsy Surgery Outcome Classification at the last available follow-up visit. The Engel classification is widely used in neurology and neurosurgery as a standard grading system for evaluating seizure outcomes after epilepsy surgery. It classifies postoperative seizure outcome into four main categories: Class I, seizure-free; Class II, rare seizures; Class III, worthwhile improvement; and Class IV, no improvement. For the purpose of analysis in this study, Engel class I was considered a favorable seizure outcome, while Engel classes II–IV were grouped as non-Engel class I outcomes.

Secondary outcome measures included postoperative neurological deficits, surgical complications, extent of cavernoma resection, need for reoperation, and duration of follow-up.

Postoperative Follow-Up and Seizure Outcome Assessment

Follow-up data were obtained from outpatient clinic records and hospital documentation. Seizure outcome was assessed at the last available follow-up visit using the Engel classification. The mean follow-up duration was 34 months. Patients lost to follow-up were not included in the final analysis.

Postoperative Antiseizure Medication Management

This was individualized according to seizure outcome, preoperative epilepsy duration, EEG findings, and the treating neurologist's recommendation. Antiseizure medications were generally continued during the early postoperative period. Dose reduction or withdrawal was considered only in selected seizure-free patients during follow-up and was performed gradually under neurological supervision.

Data Collection

Data were extracted from patient charts and recorded using a structured data collection sheet. Each patient was assigned a unique study code to ensure confidentiality.

The following variables were collected:

- Demographic data: age, gender.
- Clinical variables:
  - Age at seizure onset.
  - Duration of epilepsy.
  - Seizure type.
  - Family history.
- Radiological findings: lesion size, location.
- Surgical details: type of surgery, extent of resection.
- EEG findings (interictal and ictal).
- Postoperative outcomes (Engel classification).
- Complications and neurological deficits.

All identifiable patient information was removed prior to analysis.

Data Management and Confidentiality

All collected data were stored securely in a restricted-access database. A separate coding sheet linking patient identifiers to study codes was kept in a locked and

confidential location, accessible only to the principal investigator. Data used for analysis were anonymized to maintain patient privacy.

Statistical Analysis

Statistical analysis was performed using SPSS software (version 26; SPSS Inc., Chicago, IL, USA). Continuous variables were summarized as mean, standard deviation, and range when appropriate. Categorical variables were presented as frequencies and percentages. Because of the small sample size, the analysis was mainly descriptive. Patients were grouped according to postoperative seizure outcome into Engel class I and Engel class II–IV. Comparisons between groups were performed using Fisher's exact test for categorical variables. For continuous variables, the Mann – Whitney U test was preferred because of the small number of patients and the uncertain normality of data distribution. A p-value <0.05 was considered statistically significant. No multivariable regression analysis was performed because the small sample size and limited number of unfavorable outcomes were insufficient for reliable multivariable modeling.

Ethical Considerations

Ethical approval was obtained from the Medical Ethical Committee of Al-Farqadein University (approval no. 65, dated 24/12/2024). Permission to access and analyze the anonymized clinical data was obtained from the study center before data collection. All patient data were handled confidentially and anonymized before analysis.

■ RESULTS

During the study period, 16 patients met the inclusion criteria and were included in the final analysis. No patients included in the final analysis were lost to follow-up. There were 9 males (56.3%) and 7 females (43.8%). The mean age at seizure onset was 23.06 years, the mean duration of epilepsy was 8.5 years, and the mean age at surgery was 31.1 years. All patients had a single supratentorial cavernoma. Family history of epilepsy was reported in 4 patients, while no patient had a family history of cavernoma. Continuous variables according to postoperative seizure outcome are shown in Table 1. A total of 16 patients were identified during the study period, and all 16 fulfilled the inclusion criteria and had complete clinical, radiological, surgical, and follow-up data; therefore, all were included in the final analysis.

The localization of cavernomas and categorical clinical, radiological, surgical, and outcome variables are shown in Table 2. All patients underwent interictal EEG recording, and 6 patients underwent scalp video-EEG recording. Interictal and/or ictal EEG abnormalities co-localized with the cavernoma in 13 patients. One patient was

Table 1
Continuous variables according to postoperative seizure outcome

Variable	Engel class I (n=11), mean±SD	Engel class II–IV (n=5), mean±SD	p-value
Age at seizure onset, years	24.4±7.8	19.2±6.4	0.214
Epilepsy duration, years	6.6±4.1	9.5±5.2	0.183
Age at surgery, years	29.1±8.6	32.6±7.9	0.438
Cavernoma size, cm	1.5±0.6	1.8±0.7	0.327

Table 2
Categorical clinical, radiological, surgical, and outcome variables of the studied patients

Variable	Total patients, n=16
Demographic variables	
Male	9 (56.3%)
Female	7 (43.8%)
Radiological variables	
Temporal cavernoma	5 (31.3%)
Frontal cavernoma	9 (56.3%)
Parietal cavernoma	1 (6.3%)
Other location	1 (6.3%)
Single cavernoma	16 (100.0%)
Preoperative epilepsy evaluation	
Interictal EEG performed	16 (100.0%)
Video EEG performed	6 (37.5%)
Video EEG not performed	10 (62.5%)
Seizure type	
Simple partial seizure	6 (37.5%)
Complex partial seizure	6 (37.5%)
Secondary generalization	4 (25.0%)
Surgical variables	
Lesionectomy	12 (75.0%)
Extended resection	4 (25.0%)
Complete resection	15 (93.8%)
Reoperation for residual hemosiderin	1 (6.3%)
Postoperative seizure outcome	
Engel class I	11 (68.8%)
Engel class II	2 (12.5%)
Engel class III	2 (12.5%)
Engel class IV	1 (6.3%)
Engel class II–IV	5 (31.3%)
Postoperative neurological outcome	
Permanent neurological deficit	2 (12.5%)

evaluated with invasive monitoring and two-stage surgery. Lesionectomy was performed in 12 patients, whereas 4 patients underwent extended resection. Complete resection with surrounding hemosiderin was achieved in 15 patients, while 1 patient required reoperation for residual hemosiderin. After a mean follow-up of 34 months, 11 patients (68.8%) achieved Engel class I outcome, 2 patients (12.5%) were classified as Engel class II, 2 patients (12.5%) as Engel class III, and 1 patient (6.3%) as Engel class IV. Two patients (12.5%) developed permanent neurological deficits. One patient developed right-sided hemianopia after left temporal lobectomy, and another patient developed right-hand motor deficit following left rolandic lesionectomy. Patients with Engel class II–IV outcomes

showed descriptive trends toward longer epilepsy duration and larger cavernoma size; however, these differences were not statistically significant.

■ DISCUSSION

In the present study, 68.8% of patients achieved Engel class I seizure freedom after surgical resection of supratentorial cavernoma-related epilepsy. This finding supports the role of surgery as an effective treatment option for selected patients with cavernoma-related epilepsy. However, because the study included only 16 patients, the results should be interpreted cautiously, especially when evaluating factors related to seizure outcome [11–13]. This finding is comparable to the study by Dziedzic et al. (2022, Poland), who reported that 77.8% of patients achieved seizure freedom after surgery for supratentorial cavernous malformations, with minimal postoperative morbidity [11]. Similarly, Kemerdere et al. (2021, Turkey) demonstrated that approximately 70% of patients became seizure-free following surgical resection, emphasizing the importance of removing the lesion along with the surrounding hemosiderin rim [12]. In addition, Baumann et al. (2007) reported that more than two-thirds of patients achieved seizure freedom after surgery, further confirming the effectiveness of surgical intervention [13].

In the present cohort, patients with Engel class II–IV outcomes had a longer mean epilepsy duration than those with Engel class I outcome. However, this difference was not statistically significant, so epilepsy duration cannot be considered a confirmed predictor in this study. Still, this descriptive trend is consistent with previous reports showing that shorter epilepsy duration before surgery may be linked to better postoperative seizure control [14–16]. Nico et al. reported higher seizure freedom rates after early surgery compared with delayed surgery (92% vs. 53%) [14]. Similarly, Kapadia et al. found better outcomes among patients with shorter seizure history (94.7% vs. 62.5%) [15]. Englot et al. also reported shorter preoperative seizure duration as a predictor of postoperative seizure freedom in larger cohorts [16].

In the current study, lesion location appeared clinically relevant, particularly for temporal and eloquent-area cavernomas. However, the small sample size did not allow confirmation of lesion location as a statistically significant predictor of seizure outcome. This finding should therefore be interpreted as descriptive rather than conclusive. Previous studies have shown that temporal cavernomas may be associated with drug-resistant epilepsy, especially when mesiotemporal structures are involved [17]. Schuss et al. reported favorable outcomes in 90% of temporal cavernoma cases, but also emphasized the need for extended resection in selected patients [18]. Rosenow et al. concluded that the epileptogenic zone may extend beyond the cavernoma, particularly in temporal lobe epilepsy [19].

In our cohort, complete resection including the hemosiderin-stained tissue was achieved in 15 patients, which may have contributed to the favorable seizure outcomes observed. However, because almost all patients underwent complete resection, this study could not statistically compare complete versus incomplete resection as a predictor of seizure outcome. Previous studies support the importance of removing the cavernoma and surrounding hemosiderin-stained tissue when safely possible [12, 16, 20]. Baumann et al. demonstrated that removal of the hemosiderin rim significantly improves seizure outcome [20]. Similarly, Kemerdere et al. emphasized that complete excision of both

the cavernoma and surrounding gliotic tissue is important for seizure control [12]. More recently, Zou et al. reported that intraoperative electrocorticography was an independent predictor of seizure remission, suggesting that tailored resections may further improve outcomes [21].

Permanent neurological deficits occurred in 2 patients (12.5%) in the present study. This morbidity rate appears higher than some published series, but this comparison should be interpreted cautiously because of the small sample size and the presence of lesions in functionally important areas. Dziedzic et al. reported postoperative deficits in 4% of patients, while Baumann et al. reported deficits in approximately 7% [11, 13]. Kemerdere et al. also reported generally low complication rates after surgery for supratentorial cavernomas [12].

Overall, the present findings support the role of individualized surgical planning in patients with supratentorial cavernoma-related epilepsy. In this small cohort, favorable seizure control was achieved in most patients after surgery. However, epilepsy duration, lesion size, lesion location, and extent of resection should be interpreted as clinically relevant factors rather than statistically confirmed predictors in this study. Larger prospective studies are needed to clarify their independent effect on postoperative seizure outcome [14–21].

Clinical Implications

The findings of this study support the role of surgical treatment in selected patients with supratentorial cerebral cavernous malformations presenting with epilepsy. Although the present cohort was too small to confirm independent predictors of seizure outcome, early referral for surgical evaluation remains clinically important, especially in patients with persistent seizures. Complete resection of the cavernoma and surrounding hemosiderin-stained tissue, when safely achievable, may contribute to better seizure control. The presence of lesions in eloquent brain areas poses a surgical challenge, often limiting the extent of resection and potentially affecting seizure prognosis. Therefore, advanced preoperative planning is crucial to balance maximal resection with preservation of neurological function. Additionally, the relatively low rate of permanent neurological deficits suggests that surgery can be performed safely in specialized centers. These findings are consistent with the view that earlier surgical evaluation may be considered in selected patients, although larger studies are needed to confirm the benefit of early intervention.

Future Considerations

Future research should focus on larger prospective multicenter studies to identify and validate predictors of postoperative seizure freedom and improve the generalizability of findings. Standardization of surgical strategies requires further investigation, particularly in relation to long-term seizure outcomes.

The integration of advanced neuroimaging techniques, including MRI spectrometry, may enhance surgical planning and outcome prediction. Moreover, studies exploring the role of electrocorticography-guided resection could provide deeper insights into optimizing epilepsy control. Long-term follow-up studies are also needed to assess seizure recurrence, quality of life, and neurocognitive outcomes. Finally, the development of

predictive models incorporating clinical, radiological, and electrophysiological variables may help guide individualized treatment decisions.

Limitations

This study has several limitations that should be acknowledged. First, the retrospective design introduces the potential for selection and information bias, and limits the ability to establish causal relationships. Second, the small sample size reduces the statistical power and may limit the generalizability. Therefore, the study was underpowered to perform reliable multivariable analysis or to confirm independent predictors of postoperative seizure outcome. Third, this was a single-center experience and may not reflect outcomes in other institutions with different surgical expertise. Additionally, variability in surgical approach (lesionectomy versus extended resection) and the lack of standardized intraoperative monitoring protocols may have influenced seizure outcomes. The follow-up duration, although adequate for short- to mid-term assessment, may not fully capture long-term seizure recurrence or late neurological complications. Finally, the absence of detailed neuropsychological and quality-of-life assessments limits the evaluation of broader functional outcomes beyond seizure control.

■ CONCLUSIONS

In this retrospective single-center cohort, surgical treatment of supratentorial cavernoma-related epilepsy resulted in favorable seizure control in most patients, with 68.8% achieving Engel class I outcome at follow-up. Complete resection was achieved in most cases, and permanent neurological deficits occurred in 12.5% of patients. Because of the small sample size, this study cannot confirm independent predictors of seizure outcome. The findings support the role of individualized surgical planning based on lesion location, seizure characteristics, and the safety of complete resection. Larger prospective studies are needed to confirm factors associated with postoperative seizure freedom.

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Predictive Value of Syntax Score II for ST Segment Elevation Myocardial Infarction Underwent Primary Percutaneous Coronary Intervention

Conflict of interest: nothing to declare.
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Abstract

Introduction. SYNTAX score II (SS-II) has a good prognostic value for the outcome of patients with coronary artery disease who have undergone percutaneous intervention (PCI); however, there are limited data regarding its role in patients with ST-segment elevation myocardial infarction (STEMI).
Purpose. To assess the prognostic value of SS-II in predicting in-hospital mortality and morbidity in STEMI patients who underwent primary PCI.
Materials and methods. This cross-sectional, single-center observational study included 200 consecutive patients who underwent primary PCI between January 2023 and January 2024. Demographics: Age, sex, duration of chest pain and comorbidities, and laboratory investigations including creatinine, glucose, and complete blood count were measured. All patients underwent ECG, echocardiography, and coronary angiography, from which the SSII was calculated.
Results. The majority of patients (108, 54%) had low SYNTAX score II, 55 patients (27.5%) had intermediate score, and 37 patients (18.5%) had high score. Patients with older age, female sex, longer time interval between symptom onset and admission, and history of diabetes mellitus or hypertension had higher SS-II scores. A high SII was associated with a reduction in left ventricular ejection fraction (LVEF) and a higher rate of morbidity and in-hospital mortality compared with low and intermediate scores. The area under the curve (AUC) for SSII in prediction short term morbidity was 0.890, 95% CI=0.819–0.962, with the best cut off value of 32.0, at which the sensitivity and specificity were 83% and 91%, respectively.
Conclusions. Syntax score II is a feasible, amenable, and reliable predictor of short-term morbidity and in-hospital mortality in patients with STEMI undergoing PPCI.
Keywords: SYNTAX score, coronary artery disease, percutaneous intervention, STEMI, ventricular ejection fraction

INTRODUCTION

According to WHO survey (2017), death from coronary artery disease (CAD) in Iraq reached about 18.5% of total deaths]1[and in 2019 survey it increased to 27%, non-communicable diseases are the leading cause of morbidity and death in Iraq, 30% of Iraqis have high blood pressure, 14% have diabetes, more than 30% are obese, 38% of Iraqi males smoke, and growing number of school children 20% males and 9% females) aged 13 and 15 years are tobacco users [2]. STEMI is a significant public health concern worldwide, accounting for a substantial proportion of cardiovascular-related morbidities and mortalities. The incidence of STEMI varies across different regions and populations and is influenced by various factors, including age, sex, lifestyle, and access to healthcare [3]. Gender differences also exist in the epidemiology of STEMI. Men are generally at a higher risk of developing STEMI than are premenopausal women. However, the risk for women increases after menopause, narrowing the sex gap [4]. Age is a significant determinant of STEMI risk, with the incidence rates increasing with advancing age. Elderly individuals, particularly those over 65 years, have a higher prevalence of comorbidities, including atherosclerotic disease, hypertension, and diabetes, contributing to increased STEMI susceptibility [5]. Furthermore, socioeconomic factors, lifestyle choices, and access to healthcare services influence the prevalence and outcome of STEMI. Lower socioeconomic status, unhealthy dietary habits, smoking, physical inactivity, and limited access to timely medical care have been associated with an increased risk of STEMI [6].

STEMI diagnosis involves a combination of clinical evaluation, electrocardiography (ECG), and advanced imaging modalities. Early and accurate diagnosis is crucial for the prompt initiation of reperfusion therapy and improved patient outcomes [6].

Electrocardiography (ECG) remains the cornerstone for the diagnosis of STEMI. It provides real-time information about the electrical activity of the heart and identifies characteristic changes associated with myocardial ischemia [7[. ST-segment elevation (measured at the J-point) is considered suggestive of ongoing coronary artery acute occlusion in the following cases: New ST elevation at the J point in at least two contiguous leads:

- ≥2.5 mm in men aged <40 years, ≥2 mm in men aged ≥40 years, or ≥1.5 mm in women regardless of age in leads V2–V3
- and/or ≥1 mm in the other leads in the absence of left ventricular [LV] hypertrophy or left bundle branch block [LBBB].

In patients with suspected inferior STEMI, it is recommended to record the right precordial leads (V3R and V4R) in order to assess ST-segment elevation [5]. Posterior leads (V7–V9) can also be recorded to investigate posterior STEMI, particularly in patients with ongoing symptoms and an inconclusive standard 12-lead electrocardiogram (ECG).

ST-segment depression in leads V1–V3 (especially when the terminal T wave is positive) and/or ST-segment elevation in leads V7–V9 are highly suggestive of posterior coronary artery occlusion (often the left circumflex artery) [8].

ST-segment elevation in the V3R and V4R is highly suggestive of RV ischemia [17[. ST depression ≥1 mm in ≥6 surface leads (inferolateral ST depression) coupled with ST-segment elevation in aVR and/or V1 suggests multivessel ischemia or left main coronary artery obstruction, particularly if the patient presents with haemodynamic compromise [9].

The SYNTAX score was developed through expert consultation and integrated with previous angiographic scores that assessed lesion complexity: the American Heart Association (AHA) classification modified for the Arterial Revascularization Therapy Study (ARTS) study, the Leaman score, the American College of Cardiology (ACC)/AHA lesion classification system, the total occlusion classification system, and the Duke and ICPS classification systems for bifurcation lesions. Subsequently, the Medina classification of bifurcation lesions was introduced [7].

The SYNTAX score was designed to quantify the complexity of left main (LM) or three-vessel disease. The SYNTAX score corresponds to lesion complexity measured by the coronary tree characteristics, lesion locations, and specifics. One of the most crucial features of the SYNTAX score is that it is a lesion-based score that integrates all lesions to determine the degree of myocardium that is at risk and the technical success rate of treating each lesion [10].

The SYNTAX score II algorithm

The SYNTAX II score was calculated using a computer program consisting of sequential and interactive, self-guided questions. The algorithm consisted of 12 main questions. The patients were divided into two groups. The first three determine the dominance, total number of lesions, and vessel segments involved per lesion, and they appear once. The maximum number of lesions allowed was 12, and each lesion was characterized by a number of 1–12. The lesions were scored in the numerical order mentioned in Question 3. Each lesion may involve one or more segments. In such cases, each vessel segment contributes to lesion scoring [11–13].

■ PURPOSE OF THE STUDY

To assess the prognostic value of SS-II in predicting in-hospital mortality and morbidity in STEMI patients who underwent primary PCI.

■ MATERIALS AND METHODS

Study Design and Settings

This was a cross-sectional single-center observational study that included 200 consecutive adult patients undergoing PPCI at Basrah Cardiac Hospital from January 2023 to January 2024. STEMI was defined based on the following criteria: a typical increase or decrease in cardiac biomarkers, ongoing ischemic symptoms, a newly developed LBBB pattern, or a new ST elevation in two or more contiguous leads, with readings of at least 0.2 mV in leads V1, V2, and V3 or at least 0.1 mV in the remaining leads. The study protocol was approved by the Iraqi Council of Specializations and Ethical Commission of the Basra College of Medicine.

Inclusion Criteria

Patients presenting with STEMI who had:

- Chest pain with ST-segment elevation ≥1 mm in ≥2 contiguous electrocardiographic leads or with presumably new LBBB.
- Admission <48 hrs after symptom onset.

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Exclusion Criteria

Patient receiving fibrinolysis prior to intervention.

Ethical Consideration

Verbal consent was obtained from each participant prior to data collection after explaining the aim of the study. Each patient was given a completely unconditioned choice to withdraw at any time. The confidentiality of data throughout the study was guaranteed, and the patients were assured that the data would be used for research purposes only.

Data Collection

Demographics: age, sex, duration of chest pain and comorbidities (T2DM and hypertension), and smoking status. 12 lead ECG for each patient: creatinine clearance, glucose, and complete blood count were measured in all patients on admission.

Echocardiography

Transthoracic echocardiography was performed by a cardiologist on call (using a portable Philips cx50) with the patient in a partial left lateral decubitus position. All examinations, measurements, and calculations were performed according to the recommendations of the American Society of Echocardiography. Assessment of RWMA LV function and EF using the Simpson method was performed for all patients.

Coronary Angiogram and Syntax Score

All coronary angiogram syntax scores were calculated by two cardiologist. All primary PCI procedures were performed by experienced interventional cardiologists using the femoral approach. The decision to use direct or conventional stenting was made at the discretion of the operator. Each lesion with a diameter of ≥1.5 mm and ≥50% stenosis was scored using the online SS calculator, version 2.28. Culprit lesions were scored based on angiographic views of the infarct-related artery before intervention. The SSII was calculated based on two anatomical variables (SS and left main coronary artery [LMCA] disease) and six clinical variables (age, sex, chronic obstructive pulmonary disease [COPD], peripheral arterial disease [PAD], creatinine clearance, and LVEF) using an online calculator [14].

Outcome

The in-hospital morbidity and mortality rates have also been reported. The primary endpoints were major adverse cardiac and cerebrovascular events (MACCE), recurrent nonfatal MI, repeat coronary revascularization, nonfatal ischemic stroke and renal failure. The mortality was defined as death due to cardiac complications. Recurrent nonfatal MI was characterized by the recurrence of ischemic symptoms or new ECG changes showing ST-segment elevation or depression of at least 0.1 mV in at least two continuous leads, accompanied by an increase in cardiac biomarkers by at least 20% compared to preceding values. Repeat revascularization was defined as revascularization prompted by clinical ischemic symptoms.

Statistical Analysis

All data were recorded in Microsoft Excel and analyzed using the Statistical Package for Social Sciences (SPSS) software version 24.0. Continuous variables were expressed as mean ± standard deviation (SD) and analyzed using an independent t-test, while categorical variables were expressed as frequency and percentage and analyzed using the chi-square test. A receiver operating characteristic (ROC) curve was used to evaluate the predictive value of the SSII in anticipating the morbidity and mortality of patients. Pearson's correlation was used to explore the possible correlation between the SSII and the other parameters. Statistical significance was set than 0.05.

■ RESULTS

Demographic Characteristics of the Patients

This cross-sectional study included 200 patients with ST-segment elevation myocardial infarction (STEMI). The mean age of the patients was 56.35±11.84 years with the majority of them (79.5%) being male. The mean duration between symptom onset and admission was 6.32±5.84 hrs (range: 1.0–32.0 hrs). Hypertension was the most common past medical history, accounting for 52% of the patients, followed by diabetes (50.5%), and smoking (39%) as shown in (Table 1).

Clinical Characteristics of the Patients

Anterior STEMI was the most common site of infarction, reported in 52% of the patients, followed by inferior STEMI (40.5%) and lateral STEMI (5.5%). Similarly, anterior hypokinesia was the most common echo finding recorded in 62% of the patients, followed by inferior hypokinesia (35.5%) and lateral hypokinesia (3.5%). The mean LVEF was 53.38%±8.11. The vast majority of the included patients (83.5%) had preserved EF, whereas only 33 patients (16.5%) had reduced EF (Table 2).

Laboratory Findings

The mean RBG was 185.15±76.66 mg/dl. The mean blood urea and serum creatinine was 31.92±16.1 mg/dl and 0.93±0.75 mg/dl, respectively. Regarding hematologic indices, the mean total leukocyte and platelet count were 10.04±3.59×10⁹/L and 249.3±63.06×10⁹/L, respectively (Table 3).

Table 1
Demographic characteristics the patients (n=200)

Variables	Value
Age, years	
Mean ± SD	56.35±11.84
Range	28–84
Sex	
Male	159 (79.5%)
Female	41 (20.5%)
Duration, hrs	
Mean±SD	6.32±5.84
Range	1,0–32,0
Past medical history	
Hypertension	104 (52%)
T2DM	101 (50.5%)
Smoking	78 (39%)

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Table 2
Clinical characteristics of the patients (n=200)

Variables	Value
Site of infarction	
Anterior	104 (52%)
Inferior	81 (40.5%)
Lateral	11 (5.5%)
Anterio-lateral	4 (2%)
Hypokinesia	
Anterior	124 (62%)
Inferior	65 (32.5%)
Lateral	7 (3.5%)
Anterio-lateral	4 (4%)
LVEF, %	
Mean±SD	53.38±8.11
Range	25–71
Preserved	167 (83.5%)
Reduced	33 (16.5%)

Table 3
Laboratory findings

Variables	Value
Random blood glucose, mg/dl	
Mean±SD	185.15±76.66
Range	97–578
Blood urea, mg/dl	
Mean±SD	31.92±16.1
Range	14–134
Serum Cr, mg/dl	
Mean±SD	0.93±0.75
Range	0.8–6.0
Total WBC count× 10^9/L	
Mean±SD	10.04±3.59
Range	4.5–22.0
PLT count ×10^9/L	
Mean±SD	249.3±63.06
Range	101–401

Syntax Score II

The syntax score was categorized into three categories: low score (1-22), intermediate (23-31) and high (>31). The majority of patients (108, 54%) had low SYNTAX score, 55 patients (27.5%) had intermediate score, and 37 patients (18.5%) had high score.

Morbidity Rate

Out Of 190 surviving patients, 12 patients (6.32%) had one MACCE, while the other 178 patients (93.68%) were MACCE-free.

Mortality Rate

Out Of 200 included patients, 10 patients (5%) died during hospitalization, while the remaining 190 patients (95%) survived.

Association of Demographic Factors with SSII

All included demographic characteristics were significantly associated with the SSII. The mean age of patients with a high SSII Score was 67.14±9.9 years which was significantly higher than that of patients with intermediate score (60.22±10.75years) or those with low score (50.69±9.43 years). Females represented 54.05% of patients with high SSII scores compared with 16.36% of patients with intermediate scores and 11.11% of those with low scores, with highly significant differences. The mean time interval between symptom onset and admission was 9.0±8.39 hrs in patients with high SSII score which was significantly higher than that of patients with intermediate score (5.78±3.7 hrs) or those with low score (5.67±5.43 hrs) with a high significant difference. The frequency of hypertension and T2DM was significantly higher among patients with high SSII scores (83.78% and 70.27%, respectively) than those with intermediate scores (49.09% and 34.55%, respectively) or those with low scores (59% and 51.85%, respectively) with significant differences (Table 4).

Association of Clinical Factors with SSII Score

Neither the infarction site nor hypokinesia were significantly associated with the SSII score. In contrast, the mean LVEF in patients with high SSII score was 43.68±7.12%, which was significantly lower than that of patients intermediate score (54.95±6.5%) or low score (59.1±6.62%). Accordingly, the incidences of reduced LVEF in patients with high, intermediate, and low SSII scores were 35.14%, 5.45%, and 5.56% with a significant difference. Both mortality and morbidity were more common among patients with high SSII scores (35.71% and 24.32%, respectively) than those with intermediate scores (3.7% and 1.82%, respectively) or those with low scores (0% for both), as shown in Table 5.

Association of Laboratory Findings with SSII Score

Each of RBG, urea and creatinine were significantly elevated in patients with high SSII score (212.95±93.36 mg/dl, 5.57±28.5 mg/dl and 1.28±1.07 mg/dl, respectively) compared

Table 4
Association of demographic factors with SSII Score

Variables	Low (n=108)	Intermediate (n=55)	High (n=37)	p-value
Age, years Mean±SD Range	 50.69±9.43[a] 28-73	 60.22±10.75[a] 35-82	 67.14±9.9[b] 50.84	 <0.001
Gender Male Female	 96 (88.89%) 12 (11.11%)	 46 (83.64%) 9 (16.36%)	 17 (45.95%) 20 (54.05%)	**<0.001**
Duration, hrs Mean±SD Range	 5.67±5.43[a] 1–32	 5.78±3.76[a] 2–24	 9.0±8.39[b] 1–24	**<0.008**
Risk factors HTN DM Smoking	 46 (50%) 56 (51.85%) 44 (40.74%)	 27 (49.09%) 19 (34.55%) 15 (27.27%)	 31 (83.78%) 26 (70.27%) 19 (51.35%)	 **<0.001** **0.003** 0.058

Note: different small letters indicate significant difference.

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with patients with intermediate SSII score (187.04±73.14 mg/dl, 31.22±11.73 mg/dl and 0.87±0.39 mg/dl, respectively) or those with low score (174.13±6.75 mg/dl, 27.6±7.27 mg/dl and 0.85±0.74 mg/dl, respectively). Although there were noticeable variations in WBC and PLT counts between the three groups, the differences were not significant (Table 6).

Table 5
Association of clinical factors with SSII score

Variables	Low (n=108)	Intermediate (n=55)	High (n=37)	p-value
Site of infarction				
Anterior	54 (50%)	30 (54.55%)	20 (54.05%)	
Inferior	48 (44.44%)	18 (32.73%)	15 (40.54%)	
Lateral	6 (5.56%)	5 (9.09%)	0	0.134
Anterio-lateral	0	2 (3.64%)	2 (5.41%)	
Hypokinesia				
Anterior	68 (62.96%)	36 (65.45%)	20 (54.05%)	
Inferior	36 (33.33%)	14 (25.45%)	15 (40.54%)	
Lateral	4 (3.7%)	3 (5.45%)	0	0.171
Anterio-lateral	0	2 (3.64%)	2 (5.41%)	
LVEF, %				
Mean±SD	59.1±6.62[a]	54.95±6.5[a]	43.68±7.12[b]	<0.001
Range	25-71	38-70	30-57	
Preserved	102 (94.44%)	52 (94.55%)	24 (64.86%)	<0.001
Reduced	6 (5.56%)	3 (5.45%)	13 (35.14%)	
Morbidity				
Non-morbid	108 (100%)	52 (96.3%)	18 (64.29%)	<0.001
Morbid	0	2 (3.7%)	10 (35.71%)	
Mortality				
Survived	108 (100%)	54 (98.18%)	28 (75.68%)	<0.001
Died	0	1 (1.82%)	9 (24.32%)	

Note: different small letters indicate significant difference.

Table 6
Association of laboratory findings with SSII score

Variables	Low (n=108)	Intermediate (n=55)	High (n=37)	p-value
RBG, mg/dl				
Mean±SD	174.13±6.75[a]	187.04±73.14[a]	212.95±93.36[b]	0.031
Range	99–480	97–372	120–578	
Blood urea, mg/dl				
Mean±SD	27.6±7.27[a]	31.22±11.73[a]	45.57±28.5[b]	<0.001
Range	14–46	17–80	15–134	
Serum Cr, mg/dl				
Mean±SD	0.85±0.74[a]	0.87±0.39[a]	1.28±1.07[b]	0.009
Range	0.2–6.0	0.08–2.2	0.45–5.4	
WBC count ×10⁹/L				
Mean±SD	9.68±5.53	10.7±3.74	10.13±2.92	0.112
Range	4.6–20.0	5.0–22.0	4.5–14.0	
PLT× 10⁹/L				
Mean±SD	257.2±66.58	234.75±43.55	248±73.83	0.098
Range	143–401	170–351	101–362	

Note: different small letters indicate significant difference.

Predictive Value of SSII Score for In-Hospital Mortality and Morbidity

A receiver operating characteristic (ROC) curve was used to evaluate the predictive value of SSII in predicting morbidity and in-hospital mortality in patients with STEMI. Regarding prediction of morbidity, the area under the curve (AUC) was 0.890, 95% CI=0.819–0.962, p<0.001). The best cutoff value was 32.0. At this cut off value, the sensitivity and specificity of the test were 83% and 91%, respectively (Figure 1).

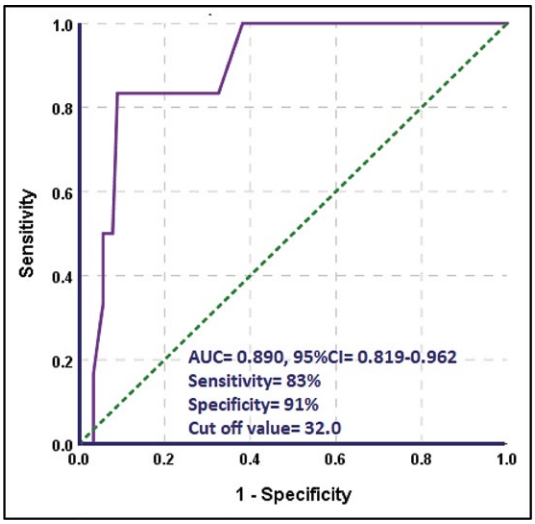

Fig. 1. ROC curve for SSII in predication of morbidity in patients with STEMI

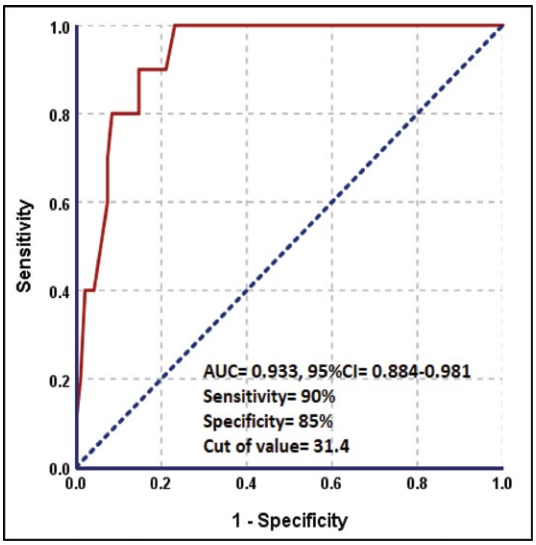

Fig. 2. ROC curve for SSII in predication of in hospital mortality in patients with STEMI

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Regarding prediction of in hospital mortality, the AUC was 0.933, 95% CI=0.884–0.981, p<0.001). The best cut-off value was 31.4. At this cut off value, the sensitivity and specificity of the test were 90% and 84%, respectively (Figure 2).

■ DISCUSSION

The present study aimed to assess the prognostic value of SS-II in predicting mortality and morbidity in patients with STEMI who underwent primary PCI. According to the results of the study, the majority of patients had low SSII scores, and minorities had high SSII scores. Patients with a high SSII were older and had a higher prevalence of diabetes mellitus and hypertension than those with a moderate or low SSII. In accordance with this result, a study conducted in the Netherlands by Vroegindewey et al. [15] found that patients with a high SSII were older, had a higher prevalence of T2DM, hypertension, hypercholesterolemia, and COPD, and more frequently had a history of renal insufficiency or heart failure than patients with a mid or low SSII.

In an Italian study, Di Maio et al. [16] found that high SS tertiles were associated with old age, DM, smoking, and a family history of CAD. A very recent Indian study conducted by Satheesh et al. [16] found that the group with the highest SYNTAX score II had older patients, more females, hypertension, diabetes, and COPD.

In another Indian study, Choudhary [17] found that 47% of patients with high SYNTAX SSII score have associated diabetes as compared to those with low score. In a Chinese study by Kurniawan et al. [18] found patients in the higher tertile of SS-II for PCI were associated with older age, a higher proportion of females, shorter, more frequent COPD, and previous myocardial infarction with lower weight.

El-Kersh et al. [19] investigated 52 Egyptian patients to calculate their overall syntax scores. Comparisons were then made between the populations with and without each risk factor. Advanced age, diabetes mellitus, and cigarette smoking are considered as independent risk factors for the complexity of coronary artery lesions.

Regarding the association between clinical data and SSII, the present study indicated lower LVEF% and higher morbidity and mortality rates in those with high scores than in those with intermediate and low scores. Kurniawan et al. [18] found patients in higher tertile of SS-II for PCI were associated with lower LVEF, all causes mortality and cardiac mortality. Also, a study from Spain by Cid Alvarez et al. [20] on 1689 patients found that those with high tertile SSII scores had significantly lower LVEF% compared to the other two groups.

In retrospective study of 325 consecutive STEMI patients from Turkey, both in-hospital (20.8% vs. 1.2%; p< 0.001) and long-term mortality (45.0% vs. 11%; p< 0.001) were higher among the patients with a high SSII than among those with a low SSII [21].

Another prospective study from Egypt included 150 patients with multivessel coronary artery disease. Ramadan et al. [22] found that SSII showed a statistically significant association with in-hospital mortality and 90 days mortality and the need for renal replacement therapy (P=0.007, 0.043, and 0.012, respectively).

Moreover, in-hospital mortality was significantly lower in patients with low and mid SS-II when those with high SS-II (0.7% vs. 0.5% vs. 16.4%, p=0.001), as demonstrated in a study in Spain [20]. In a recent study from Italy, Di Maio et al. [16] performed a retrospective, observational, single-center cohort study of 915 patients. They found that, compared to patients in the lower tertiles, patients with high SS-II presented lower LVEF

values at admission (all p<0.001 for SS-II). Compared to patients in the lower SS-II tertiles, hypertension and a history of prior MI were more frequently reported in patients with high SS-II (both p<0.001), high SS-II was significantly associated with the risk of all-cause mortality at long-term follow-up, with the risk of cardiovascular death, risk of recurrent MI, and reclassification of the risk of long-term mortality.

Moreover, another study from Turkey conducted on a total of 1,508 patients by Rencuzogullari et al. [23] found a significant association between a high tertile SSII score and DM, baseline creatinine level, peak creatinine, increased creatinine %, and eGFR.

Another single-center, retrospective, observational cohort study that enrolled 538 consecutive unselected non-randomized eligible patients who were hospitalized for STEMI and underwent PPCI found that blood glucose, HbA1C, creatinine, leukocyte, and C-reactive protein (CRP) levels were associated with high SSII scores [24].

In contrast to our study, data from the REN-ACS study on 181 consecutive patients showed that a high tertile SSII was not associated with RBS, blood urea, and creatinine, and even with a history of chronic kidney disease (CKD), but with a glomerular filtration rate (GFR) [25].

The present study indicated usefulness of SSII scoring in predicting the morbidity (AUC=0.89, 83% sensitivity, and 91% specificity) and mortality (AUC=0.93, 90% sensitivity, and 84% specificity). This has also been reported by several studies worldwide. Kocas et al. [26] retrospectively analyzed 743 STEMI patients treated with PPCI and used ROC curves to assess the usefulness of the SSII in predicting in-hospital mortality. The area under the curve obtained AUC was 0.82. This is lower than that observed in the present study.

In a similar study, Satheesh et al. [6[included 1000 Indian patients with STEMI who underwent PPCI. SSII was used to predict morbidity and mortality, with AUC of 0.859, sensitivity of 78.3 %, and specificity of 78.3% for all-cause mortality at 12 months. The AUC was 0.864, with sensitivity of 79.6% and specificity of 79.6% for cardiovascular mortality at 12 months. The AUC 0.895, with sensitivity of 82.1% and specificity of 81.3% for predicting the hospital mortality, which very close to ours.

Similarly, Karabağ et al. [27] reported an AUC of 0.93. The sensitivity and specificity for SSI prediction in-hospital mortality were 92% and 80%, respectively, with a cutoff value of 39.24. On the other hand, the AUC was 0.798 with a sensitivity and specificity of 81% and 69%, respectively, in prediction of long-term mortality for SS-II with bets cut off value of 32.82.

Wang et al. [28] investigated the effects of SS-II on 1-year major adverse cardiac events (MACEs), including all-cause mortality, recurrent MI, and TVR in 477 patients with STEMI. The investigators showed that a high SS-II is a predictor of all major adverse cardiovascular events in patients with STEMI who have undergone p-PCI, and the rates of MACE increased with high SS-II.

In an Italian study of 915 patients who underwent PCI, Di Maio et al. [16] found that the SS-II had a significantly higher discriminative ability for all-cause and long-term mortality (AUC=0.82) (area under the curve, 0.82).

Thus, there is almost general agreement about the usefulness of SSII in predicting in-hospital mortality and long-term morbidity in patients with STEMI who have undergone PPCI, although the accuracy of this tool differs between studies [29–32].

low proportion (18.5%) of STEMI patients undergoing PPCI had high SSII score. Short-term Morbidity and in-hospital mortality in STEMI patients undergoing PPCI were 6.32%

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and 5%, respectively. Older age, female sex, longer time interval between symptom onset and admission, and a history of DM and hypertension are risk factors for high SS II scores in STEMI patients undergoing PPCI. Reduced LVEF and high rates of morbidity and mortality are consequences of a high SSII score. Blood urea, serum creatinine, and RBG levels were elevated in patients with STEMI undergoing PPCI with a high SSII score.

■ CONCLUSIONS

Syntax score II is a feasible, amenable, and reliable predictor of short-term morbidity and in-hospital mortality in patients with STEMI undergoing PPCI.

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Nutritional Status Among Pediatric Patients with Surgical Problems: A Single Center Experience

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Abstract

Introduction. Nutritional status is an important determinant of recovery in pediatric surgical patients, yet malnutrition may remain unrecognizable, leading to a complicated intra- and postoperative course.
Purpose. To evaluate the frequency of malnutrition among pediatric surgical patients in Basrah, Iraq, and report its correlation with clinical outcomes.
Materials and methods. A descriptive cross-sectional study was conducted at the department of pediatric surgery in Basrah Children Specialty Hospital from March to September 2021. Fifty-six patients were recruited, the ages ranged from one month to fourteen years. All patients underwent clinical evaluations for their nutritional status. Anthropometric measurements were assessed and applied to specific growth charts, in addition, nutrition screening tool (Subjective Global Assessment) was relied upon. Blood sample for complete blood count and serum albumin was obtained for all enrolled patients.
Results. Malnutrition was reported among 21.42% according to World Health Organization charts, while Subjective Global Assessment revealed significantly higher frequency of malnutrition (51.79%), notably mild-moderate and severe malnutrition (39.29%, 12.5%) respectively. Malnutrition was significantly associated with clinical symptoms; like vomiting (p=0.003) and poor feeding (p=0.03). On the other hand, mean serum albumin was significantly lower in malnourished patients (28.8±8.7 g/L) than in well-nourished children (39.2±4.2 g/L; p=0.002). Critically malnourished patients had significantly longer hospital stays than well-nourished children (10.3±6.8 vs. 6.8±3.8 days respectively), p value 0.024, more unplanned re-admissions (33.3% vs. 2.27%) p value 0.001, and increased unplanned re-operations (25% vs. 2.27%), p=0.007. Mortality was also significantly higher in the malnourished patients than well-nourished patients' group (16.67% vs. 0.00%) respectively, p value 0.043.
Conclusions. Assessment of nutritional status is important for all patients admitted to the surgical wards, aiming for early detection of malnutrition, which is strongly associated with adverse surgical outcomes and post-operative complication.

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Keywords: malnutrition, nutritional assessment, pediatric surgery, surgical outcomes, pediatric surgery

■ INTRODUCTION

Malnutrition has been documented as a major problem in pediatric patients with surgical problems and has a significant effect on the surgical outcome, prolonged hospitalization, and increased comorbidities and mortality. Surgery is one of the most stressful events that can stimulate several inflammatory and catabolic pathways, where adequate nutritional status allows the body to respond properly to this stressor and recover more quickly and efficiently [1]. Pediatric patients who undergo surgery with poor nutritional status at admission or worsening of nutritional status during hospitalization are recognized to badly affect clinical outcomes and lead to delayed recovery and prolonged hospital stay, which increases the economic burden on the health care system and limits hospital bed availability [2, 3].

Several studies revealed the correlation of an impaired nutritional status and worse perioperative outcome due to an over-triggered inflammatory response, due to a lack of proteins and energy sources for the injured body [4, 5]. Many studies showed that malnutrition in hospitalized patients has been considered a critical, prevalent, and costly problem for patients and the health care system [5–7]. Therefore, identification of malnutrition and correction of nutritional status helps to decrease both operative and post-operative complications and infections by using appropriate screening tools for patients admitted to the hospital [8].

■ PURPOSE OF THE STUDY

To evaluate the frequency of malnutrition among pediatric surgical patients in Basrah, Iraq, and report its correlation with clinical outcomes.

■ MATERIALS AND METHODS

The study was designed as a descriptive cross-sectional study was conducted at the department of pediatric surgery in Basrah Children Specialty Hospital from March to September 2021. Fifty-six patients age 1 month – 14 years with surgical problems were enrolled in the study. Patients were referred to the surgical department and stayed for at least three days.

All patients underwent physical examination including nutritional assessment and anthropometric measurements (weight, height, and BMI); accordingly were plotted on the WHO or CDC growth charts. In addition, Subjective Global Assessment (SGA), which is a nutrition assessment tool assesses dietary intake, weight change, gastrointestinal symptoms, and physical signs like muscle wasting and edema. Laboratory investigations in the form of serum albumin, hemoglobin, and white blood cell (WBC) counts were analyzed.

Data was analyzed using SPSS version 26, utilizing Chi-square, t-tests, and Fisher's exact tests, with $p<0.05$ considered significant.

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RESULTS

A total of 56 patients were included in the study, their ages ranged from 1month-14years (mean age was 45.86±43.15 months). Table 1 shows a higher frequency of studied patients were females (64.28%), and (44.64%) of the patients were aged 1–6 years. More than half of patients (57%) were from Basrah peripheries, and a higher frequency of illiteracy among the mothers (64.3%) outweighed that of the fathers (46.4%). Most of the families (82.1%) belonged to the low-income class, with no history of surgical or medical problems (82.36%).

Table 2 shows nutritional status of 46 patients older than 6 months according to WHO criteria as underweight, wasting and stunting. Ten infants under 6 months had a modified

Table 1
Socio-demographic characteristics of the patients

Characteristics		No.	%
Gender	Male	20	35.72
	Female	36	64.28
Age group	1–12 months	15	26.79
	>1–6 years	25	44.64
	>6–10 years	10	17.85
	>10–14 years	6	10.72
Residence	Basrah City Center	22	39.28
	Basrah peripheries	32	57.14
	Other governorates	2	3.58
Feeding	Breast feeding	4	7.14
	Bottle feeding	13	23.22
	Mixed feeding	9	16.07
	Ordinary	30	53.57
Education of patients	Not in school yet	40	71.43
	Primary school	16	28.57
Education of mothers	Illiterates	36	64.29
	Primary school	11	19.64
	Secondary school	5	8.93
	College graduated	4	7.14
Education of fathers	Illiterates	26	46.43
	Primary school	14	25.00
	Secondary school	9	16.07
	College graduated	7	12.50
Family history	Same surgical problem	2	3.57
	Other surgical diseases	2	3.57
	Medical condition	7	12.50
	None	45	80.36
Family income	Low	46	82.14
	Middle	10	17.86
Number of siblings	<3	17	30.36
	≥3	39	69.64
Total		56	100%

Table 2
Nutritional status of studied patients according to the WHO classification

Classification	Moderate malnutrition		Severe malnutrition	
	No.	%	No.	%
Underweight (Wt./Age)	10	21.74	9	19.56
Wasting (Wt./Lt or Ht.)	3	6.52	8	17.39
Stunting (Lt or Ht./Age)	7	15.22	3	6.52
BMI	3	6.52	8	17.39

Table 3
Nutrition assessment according to SGA

Classification	No.	%
Well-nourished	27	48.21
Mild – Moderate malnutrition	22	39.29
Severe malnutrition	7	12.50
Total	56	100

Table 4
Distribution of the studied patients according to age, sex, and residency

Characteristic	Variables	Malnutrition		Well-nourished		p-value
		No.	%	No.	%	
Sex	Male (20)	5	41.67	15	34.09	0.627
	Female (36)	7	58.33	29	65.91	
Age group	1–12 months	4	33.33	11	25.00	0.563
	>1–6 years	3	25.00	22	50.00	
	>6–10 years	3	25.00	7	15.91	
	>10–14 years	2	16.67	4	9.09	
Residence	Basrah City Center	3	25.00	19	43.18	0.367
	Basrah peripheries	8	66.67	24	54.55	
	Other governorates	1	8.33	1	2.27	
Total		12	100	44	100	

criterion for malnutrition. The frequency of malnutrition was 21.42% (12/56) among the studied patients. Table 2 below shows that 9 (19.56%) of patients were severely underweight, 8 (17.39%) were severely wasted, and 3 (6.52%) were severely stunted.

Table 3 shows increasing frequency of mild-moderate malnutrition among studied patients (39.28%), and a lower frequency of severe malnutrition (14.28%) according to subjective global assessment tool than what was reported according to the WHO classification.

Among the studied patients, 12 patients were designated as malnourished (21.43%), 11 of them were classified according to weight for length or height, and remaining one of the patients was aged below 6 months and labeled as severely malnourished according to specific criteria. The rest of the patients, 44 (78.57%), were well nourished. Table 3 below shows a higher frequency of malnutrition reported among female patients than males (58.3% vs. 41.7%). About one-third of the malnourished patients studied were below 1 year (33.33%), and two-thirds of them were from Basrah peripheries (66.66%), but the difference was not statistically significant (Table 4).

Table 5 shows higher frequency of malnourished patients belonging to illiterate mothers, but statistically not significant (p=0.721), and most of them (83.33%) had no family history of surgical or medical problems. Malnutrition was frequently reported in children belonging to low-income and large families, with 3 or more siblings (75%, 66.67%), respectively.

Table 6 shows that vomiting was the commonest presenting symptom in malnourished patients (91.66%), compared to (43.1%) of well-nourished patients with statistically significant results (p=0.003), as well as poor feeding, which was a presenting symptom in (41.66%) of malnourished patients, with a statistically significant result (p=0.03).

Table 5
The relation of socio-demographic characteristics to the nutritional status

Characteristic	Variables	Malnutrition		Well-nourished		p-value
		No.	%	No.	%	
Type of feeding	Breast-feeding	1	8.33	3	6.82	0.685
	Bottle-feeding	3	25.00	10	22.73	
	Mixed feeding	1	8.33	8	18.18	
	Ordinary	7	58.34	23	52.27	
Education of patients	Not in school yet	7	58.33	33	75.00	0.257
	Primary school	5	41.67	11	25.00	
Education of mothers	Illiterate	8	66,67	28	63.64	0.721
	Primary School	3	25.00	8	18.18	
	Secondary School	1	8.33	8	18.18	
Education of fathers	Illiterate	4	33.33	22	50.00	0.177
	Primary School	5	41.67	9	20.45	
	Secondary School	3	25.00	13	29.55	
Family history	Same condition	2	16.67	0	0.00	0.063*
	Other surgical diseases	0	0.00	2	4.55	
	Medical diseases	0	0.00	7	15,90	
	None	10	83.33	35	79.55	
Income	Low	9	75.00	37	84.10	0.570
	Middle	3	25.00	7	15.90	
Number of siblings	< 3 siblings	4	33.33	13	29.55	0.830
	3 and more	8	66.67	31	70.45	
Total		12	100.0	44	100.0	

Note: * Fischer's exact test.

Table 6
Presenting symptoms of studied children in relation to nutritional status

Symptoms	No.	%	Malnutrition		Well-nourished		p-value
			No.	%	No.	%	
Vomiting	30	53.6	11	91.67	19	43.18	0.003
Diarrhea	5	8.9	2	16.67	3	6.81	0.289
Constipation	22	39.3	7	58.33	15	34.09	0.127
Poor feeding	11	19.6	5	41.67	6	13.63	0.030
Other	13	23.2	3	25.00	10	22.72	0.869

Table 7
Hematological parameters and serum albumin

Investigations	Mean±S.E.	Malnourished No. (12)	Well-nourished No. (44)	P-value*
Hemoglobin	10.90±0.229	10.9±1.9	10.8±1.6	0.970
WBC	11.75±0.609	13.0±5.3	11.4±4.3	0.342
Albumin	36.95±0.926	28.8±8.7	39.2±4.2	0.002

Note: * t-test.

Table 8
Selected surgical characteristics in relation to the nutritional status

Characteristic	Variables	Malnutrition		Well-nourished		P-value
		No.	%	No.	%	
Type of surgery	Elective	8	66.67	36	81.82	0.257
	Emergency	4	33.33	8	18.18	
Underlying surgical disease	Hirschsprung's disease	6	50.00	13	29.55	0.344*
	Intestinal obstruction	4	33.33	11	25.00	
	Congenital GIT anomalies	2	16.67	14	31.82	
	Others	0	0.00	6	13.63	
Duration of underlying disease	<7 days	1	8.33	12	27.27	0.056*
	>7 days	4	33.33	3	6.82	
	>30 days	0	00.00	5	11.36	
	Since birth	7	58.34	24	54.55	
Co-morbidities	Anemia	2	16.67	10	22.72	0.021
	Hypoproteinemia	5	41.67	3	6.82	
	Others	1	8.33	3	6.82	
	None	4	33.33	28	63.64	
Surgical approach	Open	7	58.33	34	77.27	0.189
	Laparoscopic	5	41.67	10	22.73	
Classification of surgery	Moderate	1	8.33	10	22.72	0.348
	Major	6	50.00	17	38.64	
	Super-major	5	41.67	17	38.64	
Wound morbidity	Superficial infection	6	50.00	10	22.73	0.203*
	Surgical site infection	1	8.33	5	11.36	
	Abscess	2	16.67	0	0.00	
	None	3	25.00	29	65.91	
Immediate complications	Bleeding	1	8.33	0	0.00	0.386*
	Respiratory distress	0	0.00	1	2.27	
	None	11	91.66	43	97.73	
Early post-op complications	Chest infection	1	8.33	6	13.64	0.349
	Paralytic ileus	2	16.67	4	9.09	
	None	9	75.00	34	77.27	
Total		12	100	44	100	

Note: * Fischer's exact test.

Table 9
Follow-up criteria of the patients studied

Variables		Malnutrition		Well-nourished		p-value
		No.	%	No.	%	
Unplanned re-admission		4	33.33	1	2.27	0.001
Unplanned re-operation		3	25.00	1	2.27	0.007
Death		2	16.67	0	0.00	0.043*
Length of Hospital Stay (days)	<7	4	25.00	28	63.64	0.060
	>7	8	75.00	16	36.36	
Mean hospital stays (days)±SD		10.3±6.8		6.8±3.8		0.024

Note: * Fischer's exact test.

Table 7 shows that; mean hemoglobin level and white blood cell counts did not show a significant statistical difference between well-nourished and malnourished patients. However, mean serum albumin was significantly lower in malnourished patients than in well-nourished patients (p=0.02).

Upon reviewing the surgical characteristics of studied patients, as shown below in Table 8, malnourished patients had a higher frequency of elective surgery than emergency surgery (66.7% vs 33.3%), respectively. More than 50% of the malnourished patients had had their underlying diseases since birth and underwent open surgery, but that difference was statistically insignificant. Concerning the underlying diseases, half of the malnourished patients had Hirschsprung's disease, and about one-third of them complained of intestinal obstruction (50%, 33.33%), respectively. Hypoproteinemia was reported in 41.67% of patients as a co-morbidity in malnourished children and had a statistically significant association. Superficial wound infection was reported in malnourished patients and well-nourished patients at a frequency of 50%, 22.73% respectively and was not statistically significant.

All patients were followed up, and Table 9 showed that patients with unplanned re-admission and unplanned re-operation were more frequently encountered in malnourished patients with statistically significant results (p-values were 0.001 and 0.007, respectively). Mean days of hospital stay were significantly longer among malnourished patients than well-nourished children (10.3±6.8), (6.8±3.8), which was again statistically significant (p=0.024). Two malnourished patients died during the study period, while no mortality was reported among well-nourished patients, resulting in statistically significant results (p=0.043). Both patients died due to sepsis as a complication of malnutrition and Hirschsprung's disease.

■ DISCUSSION

The present study reveals that the frequency of malnutrition in pediatric patients with surgical problems was 21.43%, including severe underweight, severe wasting, and severe stunting. Lower frequency of malnutrition in pediatric patients with surgical problems; (13.4%) was detected by Durakbaşa, et al. [9] in Balkan, on the other hand, the higher frequency was reported by Al-Bassam, et al. [10] in Kingdom of Saudi Arabia 28% of the pediatric patients with surgical problems were malnourished, this variation could be due

to pre-existing nutritional status and frequency of undernutrition or the hospital's policy toward pre-operative nutritional support.

Nutritional screening by subjective global assessment reveals an increased frequency of mild to moderate malnutrition (39.28%), and severe malnutrition (14.28%), this is in agreement with Fontes, et al. [11] study whom record a frequency of moderate malnutrition (41.6%) and severe malnutrition (12.4%), and another study carried out by Rojratsirikul C., et al. [12] in Thailand report that mild to moderate malnutrition (25%) and severe malnutrition (16.7%), these studies show that subjective global assessment is more helpful in the detection of mild to moderate malnutrition in hospitalized patients with surgical problems at risk of malnutrition.

The current study shows that (58.3%) of malnourished patients were females, more than one-third of malnutrition patients was below one year similar to the study in Balkan by Durakbaşa, et al. [13] on pediatric patients with surgical problems, and other studies as Dubale S., Negash E., Shuramu M., et al. in South West Ethiopia [14], Ahmed, Ashraf Uddin, et al. in Bangladesh [15] revealed that malnutrition more in children under 12 months. This could be explained by rapid growth and improper feeding habits, in addition to the effects of underlying surgical disease.

More than fifty percent of malnourished patients were residents from Basrah peripheries similar result was reported by Yadav, Sachin Singh, et al. [16] in Haryana, William, F R., et al. [17] in Karaikal District. and the National family health survey (NFHS3) [18] India, who concluded that malnutrition is significantly much more in rural areas than in urban areas, as well as Vyas, Shaili, et al. [16] found that the proportion of malnutrition was much higher in the rural area as compared to the urban area which might be attributed to inadequate diet, the prevalence of infectious diseases, limited health services.

Malnourished patients belonged to illiterate and low-educated parents, and especially their mothers' similar result concluded by Rijal P., et al. [19] in Nepal, National Family Health Survey (NFHS-3) [18] and Sengupta P., et al. [20] in India. Parent illiteracy, especially mothers affect pediatric patients' growth and health, resulting from poor feeding practice and hygiene, as well as the lack of health awareness about the pediatric patient's illness.

Low socioeconomic status has been reported in a higher frequency of studied patients; similar results were concluded by Verma, et al. [21] in Rajasthan, Pawellek, et al. [22] in Germany, and McCarthy, et al. [23] due to decreased availability of appropriate nutrition and care for those patients with special requirements.

Malnutrition was more frequent in patients belonging to large families, in concordance with a study carried out in Zambia, by Grantham-McGregor, et al. [24] and Sengupta, et al. [20] in India, who found that malnutrition was associated with large families (five to seven members).

Common co-morbidities in malnourished patients are low serum albumin, similar results reported by Kudsk, et al. [25] in the Blackwell study, because serum albumin is an indicator of the nutritional status and the immune response or inflammation.

Common underlying diseases, such as Hirschsprung's disease, intestinal obstruction, and presentation were vomiting, constipation, and poor feeding, which are related symptoms of these surgical diseases. A similar result was concluded by El Koofy, et al. [26] in Egypt, and Al-Bassam, et al. [10] in the Kingdom of Saudi Arabia.

In Livingstone, the article by Secker et al. [27], in Australia, Bernal, Carlos, et al. [28] and two English studies in 2009 and 2005 [29, 30], discovered that patients who were

malnourished had an increase in length of hospital stay, infectious complications, and postoperative complications like immediate or delayed or wound morbidity, similar to the present study the percentage of postoperative complications increased in malnourished pediatrics surgical patients but was statistically insignificant this due to the fundamental effects of the nutritional status on the immune response of the pediatric patients with surgical problems.

The current study found that malnutrition significantly increases in patients with co-morbidities like hypoproteinemia and anemia, similar to the findings in the study of Pelizzo, Gloria, et al. [31] in Italy, Kudsk, Kenneth A., et al. [25] in Blackwell, and El Koofy, Nehal, et al. [26] in Egypt. Might be due to the accumulation effects of co-morbidities with the underlying surgical diseases, leading to malnutrition, and also malnourished patients are more liable for hypoproteinemia and anemia, which increase post-operative complications in these pediatric surgical patients.

In the existing study, there is a significant relationship between malnourishment and re-admission and re-operation and death occurrence similar to the finding in the study of Ben-Ishay, Offer, et al. [32], El Koofy, Nehal, et al. [26], Alshehri, Abdullah, et al. [33] and Norman, Kristina, et al. [34] agree with that in the present study, death occurs in this study among patients with severe malnutrition more frequently than the well-nourished patients could be due to accumulation to the effects of malnutrition on the immune and respiratory and cardiovascular systems and the effects of the underlying disease and its complications and the effects of the surgical stress itself.

■ CONCLUSIONS

Assessment of nutritional status is important for all patients admitted to the surgical wards, aiming for early detection of malnutrition, which is strongly associated with adverse surgical outcomes and post-operative complication. So, a real need for dietician and nutrition support team for managing pediatric surgical patients with complex nutritional needs.

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The Role of CT Scan in Diagnosis of Bowel Wall Thickening

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Abstract

Introduction. Bowel wall thickening (BWT) are a collection of entities, involving normal variants, malignancies, and inflammatory diseases. Computed tomography (CT) become the most important radiological tool for detecting pathologies of abdomen and pelvic regions.
Purpose. To determine the roles of abdominal CT scan in detection of BWT and to assessed the patterns of BWT by CT scan in Babylon province.
Materials and methods. A prospective study of patients who were referred for abdominal/pelvic CT scans with suspicion of bowel pathologies between the dates of 30th June 2025 to 1st June 2026. Collected data included age, gender, sign, Drug history, Past history, Smoking, Alcohol, Family history, and site. CT scan data included type of findings, wall thickness, symmetry, enhancement and final diagnosis. The diagnosis was confirmed by histopathology of surgical specimen.
Results. A total of 28 patients with CT-detected BWT were included. Histopathology confirmed malignant disease in 20 patients and benign disease in 8 patients. The most common site of involvement was the colon. Regarding the pattern of BWT, multiple lesions were the most frequent finding (9, 32.1%), followed by diffuse thickening (6, 21.4%), segmental thickening (4, 14.3%), focal thickening (3, 10.7%), and local thickening (3, 10.7%). Most lesions demonstrated asymmetrical BWT (24, 85.7%). Heterogeneous contrast enhancement predominated, occurring in 22 cases (78.6%). Based on the CT diagnosis, rectal adenocarcinoma was the most frequent diagnosis (10, 35.7%).
Conclusions. On CT, asymmetrical BWT is the strongest predictor of malignancy. Wall thickness >10 mm and heterogeneous contrast enhancement were more common in malignant lesions but showed only moderate diagnostic performance and are not independently significant predictors. The exploratory weighted CT malignancy score (0–4), based on asymmetrical thickening, heterogeneous enhancement, and wall thickness ≥15 mm, effectively differentiated malignant from benign lesions. A score ≥3 identified high-risk lesions with high sensitivity, moderate specificity, and high 82.1% accuracy.
Keywords: BWT, segmental thickening, Computed tomography, rectal adenocarcinoma, CD

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■ INTRODUCTION

BWTs are a collection of entities, involving normal variants, malignancies, and inflammatory diseases [1]. Computed tomography (CT) become the most important radiological technique for detecting pathologies of abdomen and pelvic regions. It is utilized to investigate cases with acute abdominal complaints, malignancies, abdomino-pelvic traumas and inflammatory diseases. The findings of CT scan that required to be analyzed when determining thickened bowel are attenuation pattern; thickening degrees; symmetric vs. asymmetric appearance; diffuse, segmental, or focal involvement; and related peri-enteric abnormalities [2, 3]. Evaluation of parameters accurately resulted in more specific differential diagnosis [3]. Normal and abnormal variants or conditions may lead to BWT [1].

The bowel wall thickened segment that showed attenuation pattern is an important sign for distinguishing an accurate differential diagnosis. Directly, it is correlated to the IV contrast administration. There are 2 exceptions to this, which are central fat deposition and intestinal pneumatosis presence. Here, the attenuations are vary and can be depicted on CT without contrast because of the differences in tissue attenuation is markedly notable [1].

Post IV contrast administration, there are two distinct patterns of BWT attenuation: homogeneous and heterogeneous [1, 3]. The differential diagnosis of homogenous attenuation BWT on CT [1], are: Submucosal hemorrhage (hematoma); Infarcted bowels; Tumors; Crohn's disease; Radiation enteritis and Pseudo-thickening (incomplete distention and residual fluids).

Heterogeneous attenuation of BWT is display a stratified (alternating) pattern or a mixed pattern [4, 5], these help in the differential diagnosis. Stratified pattern appears as a double halo (Inner low-attenuation ring surrounded by an outer higher attenuation ring) or a target configuration (Both layers of high attenuation surround a central area of low attenuation), which are visualized through the late arterial and early portal venous phases post IV contrast enhancement [1, 6, 7].

Degree of thickening is a variable aiding an evaluating mild BWT (1–2 cm). Generally, the benign conditions caused thicken <2 cm, while that >3 cm is present in neoplastic conditions [8, 9].

Symmetrically or asymmetrically thickened is another criteria of CT scan BWT. Symmetric mean the involved segment have the same BWT degree thickening throughout the abnormal segment circumference that seen in inflammatory conditions, bowel edema, infections, hemorrhage, ischemia and scirrhous carcinoma [10, 11]. Asymmetric thickening presented as different degrees of eccentric thickening around the circumference mainly in malignancy (stromal tumors, adenocarcinoma, carcinoid tumors and metastases) [12, 13].

Length of BWT is divided into focal (<10 cm) as (neoplasms, diverticulitis and appendicitis), segmental (10-30 cm) as (Crohn's disease, infectious ileitis, radiation enteritis, ischemia, intramural hemorrhage and lymphoma) and diffuse (involve most of the small bowel or colon) as (ulcerative colitis, low-protein states, cirrhosis, ischemia, SLE, and vasculitis) [1–3, 11].

CT have ability to show extraintestinal manifestations, these include lymph nodes; mesenteric calcification (stranding); abscess; sinus fistulas; fat proliferation; vascular occlusion; and solid organ abnormalities [10–13]. Indications of CT in BWT are Known

or suspected Crohn's disease; Obscure GI bleeding; Unknown causes of diarrhea; Unknown causes of abdominal pain; CT used to evaluate for the presence and causes of low-grade obstruction; In the examination for findings or complications of other small bowel disorders (small bowel diverticulosis, celiac disease, polyposis syndromes); Screening for colorectal cancer (CRC); CT used as focused evaluation for various diagnostic reasons (incomplete colonoscopy) and simultaneous colonic evaluation and distant staging of initially diagnosed CRC or surveillance of known CRC [1, 14].

■ PURPOSE OF THE STUDY

To determine the roles of abdominal CT scan in detection of BWT and to assessed the patterns of BWT by CT scan in Babylon province.

■ MATERIALS AND METHODS

Study Design and Setting

A prospective study of patients who were referred for abdominal/pelvic CT scans with suspicion of bowel pathologies between the dates of 30th June 2025 to 1st June 2026, that carried out at Al-Hilla Teaching Hospital. A total of 28 patients, 18 males and 10 females were enrolled.

Data Collection

Collected data included age, gender, sign (Pallor, loose stool, rectal bleeding, vomiting, constipation, diarrhea, abdominal pain and habitus alteration), Drug history, Past history, Smoking, Alcohol, Family history, and site (Ileum, Caecum, colon, Hepatic flexure, Splenic flexure, Sigmoid and Rectum). CT scan data included type of findings (Normal or Proctitis, Colitis, Diverticular disease, Adenomatous polyps, infective, ischemic and neoplastic), finding (Local, diffuse, ascites, Fat streak, LAP, Marked, Gray attenuation, Focal, Segmental), Wall thickness (<10 mm or >10 mm), symmetry, Enhancement (Homogeneous or Heterogeneous) and final diagnosis.

Inclusion Criteria

- Age ≥18 years.
- GIT bleeding unknown causes.
- Bowel walls involve by large masses by US.
- Abnormal thicken bowel by US/barium or endoscopy.

Exclusion Criteria

- Previous abdominal surgery.
- Pregnancy.
- Allergy to contrast.
- Impaired renal function tests.

CT Scan Protocols

CT scan (PHILIPS Brillionce-64 (Philips, Holland)) was used. The scan performed as an abdominal routinely, with imaging extend from diaphragm to pubic symphysis (supine position). Contrast-oral and -IV materials were administered in all patients. The diagnosis

was confirmed by cytology or histopathology of any biopsy or surgical specimen, if not done, diagnosis was confirmed by clinical response to medical treatment.

Statistical Analysis

SPSS version 24.0 (Chicago, USA, IBM Inc.) was used. Categorical variables expressed as number and percentage and continuous variables described as (mean, and SD). Chi-square Test / Fisher's Exact Test used to compare categorical variables. Samples t-test for comparing continuous variables between two groups. Multivariate analysis was performed to identify predictive factors. A Two-sided $P<0.05$ was considered significant.

■ RESULTS

Patient Characteristics

A total of 28 patients with CT-detected bowel wall thickening were included. Histopathology confirmed malignant disease in 20 patients and benign disease in 8 patients. Rectal adenomyosis was classified as a non-malignant diagnosis. Baseline characteristics are shown in Table 1. The two groups were generally comparable in age, sex, smoking status, drug history, past medical history, and family history. Twenty (71.4%) patients with malignant lesions and 8 (28.6%) with benign/non-malignant lesions.

CT Scan and Histopathology Findings

Table 2 summarizes the CT scan findings in patients with BWT. The most common site of involvement was the colon (12, 42.9%). The mean bowel wall thickness was 12.1±6.2 mm. Regarding the pattern of BWT, multiple lesions were the most frequent finding (9, 32.1%). Gray attenuation was observed in 2 patients (7.1%), while marked thickening was the least common finding (1, 3.6%). Most lesions demonstrated asymmetrical BWT (24, 85.7%). Similarly, heterogeneous contrast enhancement predominated, occurring in 22 cases (78.6%). Based on the CT diagnosis, rectal adenocarcinoma was the most frequent diagnosis.

Table 1
Patient characteristics of the study

Variable		Total, n=28	Malignant, n=20	Benign, n=8	p-value
Age, years, mean±SD		38.4±11.7	40.6±10.6	33.0±13.3	0.133
Sex	Male	18 (64.3%)	12 (60.0%)	6 (75.0%)	0.669
	Female	10 (35.7%)	8 (40.0%)	2 (25.0%)	
Drug history	Yes	16 (57.1%)	13 (65.0%)	3 (37.5%)	0.231
Past history	Yes	10 (35.7%)	9 (45.0%)	1 (12.5%)	0.194
Smoking	Yes	15 (53.6%)	11 (55.0%)	4 (50.0%)	1.000
Alcohol use	Yes	6 (21.4%)	2 (10.0%)	4 (50.0%)	0.038
Family history	Yes	10 (35.7%)	7 (35.0%)	3 (37.5%)	1.000
Clinical features	Multiple	21 (75.0%)	15 (75.0%)	6 (75.0%)	0.6
	Constipation	2 (7.1%)	1 (5.0%)	1 (12.5%)	
	Abdominal pain	2 (7.1%)	1 (5.0%)	1 (12.5%)	
	Rectal bleeding	3 (10.7%)	3 (15.0%)	0	

Table 2
CT scan findings of BWT

Parameters		No.	%
Site	Caecum	1	3.6
	Colon	12	42.9
	Sigmoid	4	14.3
	Rectum	11	39.3
Wall thickness (mm)		**12.1±6.2 (median=14)**	
Feature	Multiple	9	32.1
	Diffuse	6	21.4
	Gray attenuation	2	7.1
	Focal	3	10.7
	Marked	1	3.6
	Segmental	4	14.3
	Local	3	10.7
Symmetry	Symmetrical	4	14.3
	Asymmetrical	24	85.7
Enhancement	Homogeneous	6	21.4
	Heterogeneous	22	78.6
Diagnosis	Rectal adenocarcinoma	10	35.7
	Colonic adenocarcinoma	8	28.6
	Adenocarcinoma of the sigmoid colon	3	10.7
	Inflammatory/infectious colitis	2	7.1
	Colitis	1	3.6
	Diverticulitis (colitis/diverticular disease)	1	3.6
	Caecal adenocarcinoma	1	3.6

The histopathology of BWT, revealed that adenocarcinoma was the predominant diagnosis, accounting for 20 of 28 patients (71.4%). Rectal adenocarcinoma was the most common malignancy (10, 35.7%), followed by colonic adenocarcinoma (7, 25.0%) and rectosigmoid adenocarcinoma (3, 10.7%). Benign and inflammatory conditions comprised 8 cases (28.6%), including ulcerative colitis (3, 10.7%), diverticulitis (2, 7.1%), Crohn's disease (1, 3.6%), infectious colitis (1, 3.6%), and rectal adenoma (1, 3.6%).

Diagnostic Performance Analysis

Asymmetrical BWT was the strongest CT feature associated with malignancy. Wall thickness >10 mm and heterogeneous enhancement were more frequent in malignant cases, but their individual associations were weaker for differentiating malignant from benign BWT. BWT >10 mm was identified in 18 patients (64.3%), including 14 (70.0%) with malignant lesions and 4 (50.0%) with benign lesions. Although lesions with a wall thickness >10 mm had 2.33-fold higher odds of malignancy (OR=2.33, 95% CI: 0.43–12.57), (p =0.4). This CT feature demonstrated a sensitivity of 70.0%, specificity of 50.0%, and an overall diagnostic accuracy of 64.3%. Asymmetrical BWT was the strongest predictor of malignancy, being observed in 23 patients (82.1%) overall, including all 20(100.0%) with malignant lesions compared with only 3 (37.5%) in the benign side. This finding was strongly associated with malignancy (OR=64.43, 95% CI: 2.88–1443.29; p<0.001).

Asymmetrical thickening achieved a sensitivity of 100.0%, specificity of 62.5%, PPV of 87.0%, NPV of 100.0%, and the highest overall diagnostic accuracy among the evaluated CT findings (89.3%), indicating excellent diagnostic performance for identifying malignant bowel wall thickening. Heterogeneous contrast enhancement was present in 21 patients (75.0%), including 17(85.0%) with malignant lesions and 4(50.0%) with benign lesions.

Table 3
Diagnostic performance of individual CT findings in BWT

CT finding	Total, n=28	Malignant, n=20	Benign, n=8	OR (95%CI)	p-value	Sensitivity	Specificity	PPV	NPV	Accuracy
Wall thickness >10 mm	18 (64.3%)	14 (70.0%)	4 (50.0%)	2.33 (0.43–12.57)	0.400	70.0%	50.0%	77.8%	40.0%	64.3%
Asymmetrical thickening	23 (82.1%)	20 (100.0%)	3 (37.5%)	64.43 (2.88–1443.29)	<0.001	100.0%	62.5%	87.0%	100.0%	89.3%
Heterogeneous enhancement	21 (75.0%)	17 (85.0%)	4 (50.0%)	5.67 (0.89–36.09)	0.142	85.0%	50.0%	81.0%	57.1%	75.0%

Notes: OR – odds ratio; CI – confidence interval; PPV – positive predictive value; NPV – negative predictive value.

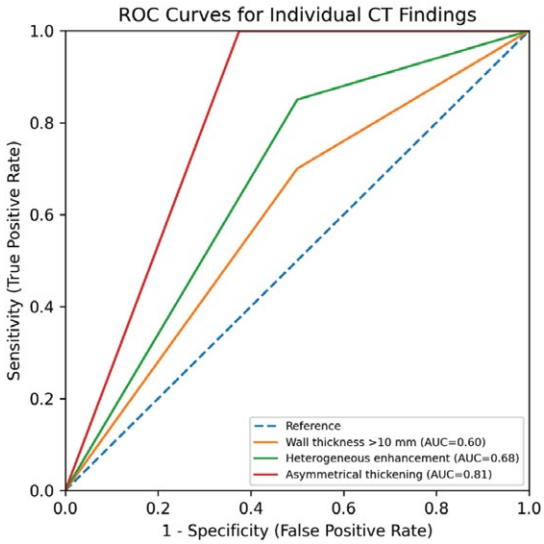

Fig. 1. ROC curves of individual CT findings for predicting malignant BWT

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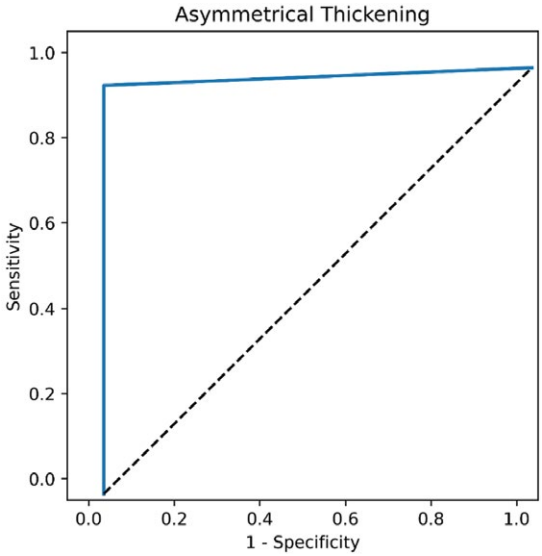

Fig. 2. ROC curve of asymmetrical BWT diagnostic performance by CT scan

Although heterogeneous enhancement was associated with a 5.67-fold raise in the odds of malignancy (OR=5.67, 95%CI: 0.89–36.09) (p=0.142). This feature demonstrated a sensitivity of 85.0%, specificity of 50.0%, PPV of 81.0%, NPV of 57.1%, and an overall diagnostic accuracy of 75.0% (Table 3 and Figure 1).

Overall, among the individual CT findings evaluated, asymmetrical BWT demonstrated the best diagnostic performance, with perfect sensitivity (100.0%), excellent NPV (100.0%), and the highest overall accuracy (89.3%), making it the most reliable imaging characteristic for predicting malignant BWT in this cohort. In contrast, wall thickness >10 mm and heterogeneous enhancement showed only moderate diagnostic performance and were not independently associated with malignancy (Figure 2).

■ DISCUSSION

Bowel wall thickening (BWT) represent a key radiological finding in GIT imaging, indicating several illnesses like IBD, TB, ischemic conditions, and malignancy. In the current study, twenty (71.4%) patients with malignant lesions and 8(28.6%) with benign lesions were confirmed histopathologically. Patients with malignant lesions had a higher mean age than those with benign lesions with male to female ratio of 3:1. These results were dissimilar to Daniel et al. [15] study, whom enrolled 91 cases (57 men and 34 women) with BWT aged 58±16 years. They found 52 cases with upper GIT thickening and 39 cases in lower GIT thickening. Most cases assessed for abdominal pain, followed-up for malignancies and GI bleeding. Tumors and inflammatory mucosal changes were reported in 39.6% and 30.8% of cases, respectively. Also, they found no significant association of past medical history of cancer or a history of GI malignancy as an indication for CT scan. Also, the results mismatched with several retrospective works in recent years, as Karim et al. [16] revealing that 10% of patients had neoplastic pathologies and Troppmann et al. [17] found that 80% of patients with BWT on CT had pathologic abnormalities.

In 2024, a cross-sectional study by Lnu and co-authors [18], showed male predominance (53.33%) among female (46.67%) with majority of cases belonged to age between 20 to 29 years (33.33%). They reported chief complaints of CT scan indication as abdominal pain (35%), altered bowel habits (20%), BPR (16.67%), constipation (15%), diarrhea (8.33%), and vomiting (5%). Also, 50% had a history of the present illness, 36.7% were drug used and 30% with positive family history. 17 of 60 cases were smokers and 9 of 60 cases were alcoholic. In the study by Ohri et al. [19] and Bassiouny et al. [20], the average age of cases was around 38 years. Our findings are consistent with these studies.

Meanwhile, Tapasvi et al. [21] studied 35 malignant BWT lesions and 15 benign. Malignant reasons were seen in much older patients with 23 (65.7%) out of 35 cases seen with abdominal pain as commonest complain in the benign arm while anorexia (weight loss) was the commonest symptom in the malignant arm. Seven cases discovered in stomach, in 13 cases in small bowel and 30 cases in large intestine.

Tapasvi et al. [21] found that white attenuation was seen in benign BWT as 100% specific for the benign conditions. The specificity and sensitivity of in predicting the benignity of a lesion was greatly specific with a specificity of 96% but, a dismal sensitivity of 27%. Heterogeneous enhancement pattern was a specific marker for the malignant lesions. Mild BWT was a sensitive marker for picking up a pathology but not that specific; on the other hand, marked BWT was a specific marker for malignant lesion but not as sensitive. Asymmetrical BWT was having good sensitivity and specificity for malignancy. Focal or segmental involvement of bowel wall was greatly sensitive for malignancy. Gray attenuation pattern was neither a specific nor a sensitive marker for malignancy. Associated CT findings like ulceration, cavitation, necrosis and surrounding fat stranding were belonged to the malignant group.

The histology results of Daniel et al. [15], 14 of 15 cases were correctly diagnosed as benign on CT, and 33 of 35 cases were correctly diagnosed as malignant on CT. A strong correlation was evident between the presence of LAP on CT and an outcome of malignancy ($p=0.002$), suggested that cases presenting with BWT on CT and LAP are more likely to have neoplastic lesions. The most common site at which BWT was reported was the stomach followed by the rectum. 29.7% of cases displayed diffuse BWT, whereas 70.3% of patients showed local BWT. Of these, 8.8% revealed normal findings, whereas inflammation and malignancy were discovered in 25% and 51.6% of biopsies, respectively. All CT scans were assessed for diffuse thickening, ascites, fat streaking and LAP.

Lnu et al. [18], mentioned that IBD was most common in <10 mm BWT, while malignant lesions were predominant in those with >10 mm thickening. In addition, symmetrical thickening was more common in infective and inflammatory disorders, whereas malignant lesions were more asymmetrical features. In terms of focal vs. segmental and diffuse BWT, malignancies were primarily focal, while IBD was more commonly segmental or diffuse. Homogeneous enhancement was typical of IBD, whereas heterogeneous enhancement was more common in malignancy.

Similarly, Insko et al. [22] reported that ¾ of malignant cases show asymmetrical thickening and its vice versa for benign cases.

Lnu et al. [18] and Uzzaman et al. [23], mentioned that homogeneous enhancement of BWT was most commonly noticed in inflammatory colitis as IBD, infectious colitis as TB, and ischemic conditions. In contrast, heterogeneous enhancement was strongly related to neoplastic lesions.

The diagnostic performance in the present study achieved a sensitivity of 100.0%, specificity of 62.5%, PPV of 87.0%, NPV of 100.0%, and the highest overall diagnostic accuracy among the evaluated CT findings (89.3%), indicating excellent diagnostic performance for identifying malignant bowel wall thickening for asymmetrical thickening. Although heterogeneous enhancement was associated with a 5.67-fold raise in the odds of malignancy with sensitivity of 85.0%, specificity of 50.0%, PPV of 81.0%, NPV of 57.1%, and an overall diagnostic accuracy of 75.0%. The severe BWT is often indicative of malignancy, whereas mild thickening is more related to inflammatory and infective conditions [15].

In Lnu et al. [18] study, CT scans exhibited strong diagnostic performance with a sensitivity of 83.33%, specificity of 95.24%, PPV of 88.24%, and NPV of 93.02%, resulting in an overall accuracy of 91.67%. Mangini et al. [24] reported 82.4% concordance between MDCT findings and outcome diagnoses for acute bowel conditions, while Bassiouny et al. [20] reported sensitivity (90%), specificity (93%), PPV (98%), and NPV (71%). Ramaswamy et al. [25] achieved an 88.3% accuracy rate for small bowel pathologies, and Jyothi et al. [26] reported 100% accuracy rate. Bas et al. [27] documented high sensitivity of 95.6% and specificity of 90.4% for malignancy, with even greater values for identifying benign lesions with 97.2% sensitivity and 97.9% specificity. Although the present study demonstrated excellent sensitivity (100%) for asymmetrical bowel wall thickening in identifying malignant lesions, its specificity (62.5%) was considerably lower than that reported by others, who documented specificities ranging from approximately 90% to 95%.

We explored CT-based malignant score as weighted CT-based malignancy score as an exploratory secondary analysis. Three CT features were included: asymmetrical thickening, heterogeneous enhancement, and wall thickness ≥15 mm. Asymmetrical thickening was assigned 2 points (the strongest individual association with malignant histology). Heterogeneous enhancement and wall thickness ≥15 mm was assigned 1 point each. The total score ranged from 0 to 4 as a result the score was higher in cases with malignant histology. Median score was 3.5 in the malignant group and 1.0 in the benign group, ($p=0.003$). A score of ≥3 was selected as the high-risk threshold. This cut-off provided 90.0% sensitivity and 62.5% specificity for malignant histology. In univariable logistic regression, each one-point raised in the score was associated with greater odds of malignancy. In patient with colon cancer, Colvin et al. [28] reported sensitivity of 100% and specificity of 95.7%. Additionally, Stermer et al. [29] and Nicholson et al. [30] provided insights into diagnostic accuracy for BWT and pathologies differentiation. A meta-analyses and systematic reviews by Sallinen et al. [31] and Andeweg et al. [32] recorded variation in diagnostic accuracy rates and the requirement for standardized detection protocols to enhancing the effectiveness of MDCT scan across diverse GIT diseases or conditions.

■ CONCLUSIONS

On CT, asymmetrical BWT is the strongest predictor of malignancy, demonstrating 100% sensitivity, 100% NPV, and 89.3% overall accuracy. Wall thickness >10 mm and heterogeneous contrast enhancement were more common in malignant lesions but showed only moderate diagnostic performance and are not independently significant predictors. The exploratory weighted CT malignancy score (0–4), based on asymmetrical thickening, heterogeneous enhancement, and wall thickness ≥15 mm, effectively differentiated malignant from benign lesions. A score ≥3 identified high-risk lesions with

high sensitivity, moderate specificity, and high 82.1% accuracy. Overall, CT is a valuable tool for predicting malignant BWT, particularly when asymmetrical thickening is present.

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Anatomical Variation of Cystic Duct Insertion: A Retrospective MRCP Study in Iraq

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Abstract

Introduction. The insertion of the cystic duct (CD) to the common bile duct (CBD) is a very important subject Owing to its significant clinical, and interventional relevance. The importance of the iatrogenic injuries during cystic duct procedures is raising the importance of the knowledge about the anatomical variations.
Purpose. The current study focuses on the radio-anatomical variation at the insertion point of the CD to CBD in Iraqi population, focusing on the prevalence of these variations.
Materials and methods. The retrospective cross-sectional study investigated the radio-anatomical variation in CD insertion into the CBD in an Iraqi population, assessed using magnetic resonance cholangiopancreatography (MRCP). The study included 200 patients (77 males, 123 females), primarily aged 51–70 years, presented with epigastric pain with or without hepatobiliary symptoms.
Results. The majority of cases (96%) demonstrated the CD insertion into the postero-lateral border of the CBD, at the junction of the upper third with the lower two thirds. This prevalence as notably higher than reported in studies from other countries. Other variations identified included upper third insertion (1.5%), lower third insertion (0.5%), pure posterior insertion (1%), anterior insertion (0.5%), medial border insertion (1%) and parallel course before the confluence (0.5%).
Conclusions. These findings provide valuable, regionally specific anatomical data, underscoring the high prevalence of the normal posterolateral CD insertion in the Iraqi population and critically, the absence of a direct link between anatomical variation and stone formation in this specific cohort. This enhanced the specific understanding of biliary anatomy is crucial for surgical planning and the accurate interpretation of imaging studies, potentially minimizing complications during intervention procedures.
Keywords: cystic duct, gall bladder, common hepatic duct, common bile duct, radio-anatomical variation

■ INTRODUCTION

The cystic duct (CD) typically measures 2–4 cm in length and 1–5 mm in diameter, connecting the neck of the gallbladder to the common hepatic duct (CHD) to form the CBD. The point at which the CD joins the CHD can vary. In most cases, it enters the CHD from the lateral aspect on the right side, usually at the junction of the upper one-third and lower two-thirds of the CHD. Variations in the insertion of the CD have been widely described in the literature and are categorized based on the length, course, and site of insertion. Some of these anatomical variations are clinically significant and include:

- low insertion of the CD,
- a parallel course of the CD alongside the CHD,
- anterior or posterior spiral courses with medial insertion,
- absent or short cystic duct (length <5 mm),
- aberrant drainage of the CD into the right hepatic duct,
- aberrant or accessory intrahepatic ducts draining into the CD, and
- presence of a double cystic duct [1].

The insertion of the CD into the CBD is a topic of significant clinical and interventional relevance. Given the high volume of medical and surgical procedures involving this region, there is a clear need to reevaluate the prevalence of its various anatomical variations. Understanding these variations within a specific population is crucial for effective surgical planning, as it plays a vital role in minimizing complications that may arise during procedures such as cholecystectomy, endoscopic retrograde cholangiopancreatography (ERCP) for stone removal or CBD dilatation, liver transplantation, and other diagnostic interventions. As such, precise anatomical knowledge of this complex area is essential for improving patient outcomes and procedural safety [1].

The importance of the iatrogenic injuries during cystic duct procedures is raising the importance of the knowledge about the anatomical variations [2]. Some studies have reported that only 51% of cases exhibit the normal insertion of the CD into the CHD [1], others underestimate the clinical importance saying that it accounts for only 18–23% [3].

Awareness of these variations can reduce the risk of bile ducts injuries during interventional procedures [2], imaging before the operation, or surgical procedure particularly MRCP considered vital for identifying these variations [4].

MRCP is a very good non-invasive tool for revealing imaging and to visualize detailed biliary anatomy. High-resolution cross-sectional, sagittal, two dimensional (2D) and three dimensional (3D) images with excellent detailed anatomy which is comparable to ERCP (endoscopic retrograde cholangiopancreatography) or intraoperative cholangiograms [5].

Many studies considered these aberrant insertions as a case reported studies awing to its rare discoveries [3, 6].

Aims of the study: The current study focuses on the radio-anatomical variation at the insertion point of the CD to CBD in Iraqi population, focusing on the prevalence of these variations.

■ PURPOSE OF THE STUDY

The current study focuses on the radio-anatomical variation at the insertion point of the CD to CBD in Iraqi population, focusing on the prevalence of these variations.

MATERIALS AND METHODS

The study was conducted Ghazi Alaharriri Hospital for Specialized Surgeries in the period from 12 of October 2024 to the 1st of June 2025. Totally, 200 sequential MRCP studies were reviewed by radiologist.

Exclusion Criteria

- Patients with major anatomical disturbances like those with previous major surgeries in the peritoneal cavity.
- Traumas.
- Large tumors.
- Extensive infection.
- Previous cholecystectomy.
- Artifacts.
- Children.

MRCP was performed using 1.5 Tesla MRI unit (Siemens, Erlangen, Germany) utilizing a phased array body coil. The sequences which were preferred for the best information on the biliary tree's anatomy were as follows: axial 2D breath-hold half-Fourier acquisition single-shot turbo spin-echo (HASTE) sequence, 3D respiratory-triggered heavily T2-weighted fast spin-echo (FSE) sequence in the coronal oblique plane, and coronal maximum intensity projection (MIP) reformat. MRCP images were reviewed in a picture archiving communication system (PACS) by an expert radiologist.

Demographic information, the course, together with the insertion site of the cystic duct were recorded in a data gathering form. The data were processed statistically using SPSS version 26 program.

RESULTS

Table 1 showed the gender distribution of the cases regarding age and gender. The data reflects the demographic distribution of a sample population based on gender and age. Of the total 200 individuals surveyed, 38.5% (77) were male and 61.5% (123) were female, indicating a higher proportion of females in the group. In terms of age, the majority of participants (71.5%) were between 51 and 70 years old, totaling 143 individuals. Those aged 31 to 50 made up 16.5% (33), while the smallest group, individuals aged 70 and above, accounted for 12% (24) of the sample.

Table 1
Distribution of the studied sample

	No.	%
Gender		
Male	77	38.5
Female	123	61.5
Age group		
31–50	33	16.5
51–70	143	71.5
≥70	24	12

Table 2 show the prevalence of insertion of the CD into the CBD. The data presents the prevalence of various anatomical variations in the insertion of the cystic duct (CD) into the common bile duct (CBD). The most prevalent variation, observed in 95% (0.96) of cases, was a combined pattern involving the junction of the upper and middle third insertion along with a posterolateral border insertion. Other, less common variations included upper third insertion (1.5%), posterior border insertion (1%), medial border insertion (1%), lower third insertion (0.5%), anterior border insertion (0.5%), and confluence insertion parallel to the CBD (0.5%). Additionally, associated gallstone discovery was reported in 12.5% (0.125) of the cases, highlighting a not insignificant clinical correlation.

There were 6 females who showed aberrant CD insertion while only 2 male patients were presented with variation while only 2 males presented with variation as shown in Table 3. The most common anatomical variation – junction of the upper and middle third with posterolateral border insertion – was observed in 192 cases, comprising 73 males and 119 females. Upper third insertion occurred in three cases (two males and one female), while lower third insertion and posterior border insertion were each observed in one female. Similarly, anterior border insertion and medial border insertion were each found in one female, while confluence insertion parallel to the CBD was noted in one male. These findings suggest that the predominant variation is consistent across genders, while the rarer anatomical variations occurred almost exclusively in females.

We studied the stone association with the insertion of the CD to the CBD and we found that 25 cases 12.5% of the studied sample presented with stone. However, all the cases

Table 2
Prevalence of the different variations found in the current study

Variations	Prevalence	%
Upper third insertion of the CD to the CBD	0.015	1.5
Junction of the upper and middle third insertion of the CD to the CBD + Posterior lateral border insertion	0.96	95
Lower third insertion of the CD to the CBD	0.005	0.5
Posterior border insertion	0.01	1
Anterior border insertion	0.005	0.5
Medial border insertion	0.01	1
Confluence insertion parallel to CBD	0.005	0.5
Associated stone discovery	0.125	12.5

Table 3
The relationship between the insertion direction of CD-CBD with sex

Gender	Upper third insertion*	Junction of the upper third with the middle third+ Postero-lateral insertion	Lower third insertion	Posterior boarder insertion	Anterior border insertion	Medial border insertion*	Confluence insertion parallel to CBD*
Male	2	73	0	0	0	0	1
Female	1	119	1	1	1	1	0
Total	**3**	**192**	**1**	**1**	**1**	**1**	**1**

were associated with the normal posterolateral insertion at the junction of the upper third with the lower two thirds. The stone discovery was related to the gender and age. Most of cases 44% belonged to age 51–70 years, followed by those older than 70 years (24%). In relation to gender, males were consisted 52% whereas females were 48%.

■ DISCUSSION

In the current study it includes 200 cases (77 male 123 females) all presented with epigastric pain with or without hepatobiliary symptoms (Table 1) most of the cases were females this agreed by many studies [7–10] the study sample were divided into many age groups (Table 2), which showed that the majority of cases presented at the age group between 51–70 years old this also agreed by many worldwide studies [10, 11] in the current study there was a focus on the normal and abnormal insertion of the CD to the CBD, this was obtained by MRCP studies, with a comparison to other studies to reveal the prevalence of the normal together with the abnormal insertion, to judge the results obtained in the Iraqi population with results obtained from other populations.

Most cases had the insertion of the CD to the CBD were at the junction of the upper third with the lower two thirds being entered to the CBD at the posterolateral part of the CBD. These results found in 119 females and 73 males making a total of 192 case (96%), these results agreed by many other studies [11], which showed that 70.5% has that type of insertion, while Taghavi et al. [12] showed that 77% of cases had this type of insertion which considered as the normal type. It was only seen in 40% in a study carried out in Turki [13]. In Nepal, it was 47.6% according to a study carried by Sudeep et al. [14].

In Egypt, authors showed a percentage of 51.5% so in this study the normal posterolateral insertion or what has been called the right sided insertion was higher than most of other studies [9].

However, the percentage was noticed to be high in Iran as mentioned above, this may represent an important result as Iran shows many geographical and ethnical characteristics with Iraq. In contrary, Turkey, which also a close neighbor to Iraq, shows lower percentage of normal CD insertion. Upper third insertion found in 1.5% of cases while it was 5.5% in Siri Lanka [11] again it is only 2.8% in Iran [12] while it was 6.5% in Egypt [9]. It was 14.7 in Turki [13].

The lower third insertion was only 0.5% in the current study while it was 2.8% in Iran [12] it was 6.6% in Siri Lanka [11], 1.6% in Egypt [9]. Yu et al. reported a case of low medial insertion, this give an impression that it is so rare [15].

Another variations include the directional insertion of the CD to CBD Table 3 in which the pure posterior border insertion found in 1% of cases, a percentage of 3.8% mentioned by Siri-Lanka study [11], while it was as high as 14.29% in Nepal [14].

Anterior insertion in the current study was 0.5%, while it was 7.6% in Iranian study [12], 2.7% was found in Siri Lanka [11].

Medial border insertion was found in 1% of cases in this study while it was 7.6% in Iran [12] it was as high as 24.3% in Turkish study [13] 2.2% of cases showed medial insertion in the Siri Lanka study [11]. Yu et al. reported a case of medial insertion [15] in this case report the CD duct inserted medial and just proximal to the ampula, in our study one case was inserted after a parallel course to the CBD to the confluence (0.5%). While 6.6% of cases in the Siri Lanka study showed a parallel course [11], again a nearby results was found in the Iranian study which showed 1% of cases had a parallel course [12].

Table 4
Summary of the comparison of the results of the current study with other studies

The anatomical variations	Current study	Taghavi et al. [12]	Taştemur et al. [13]	Sudeep et al. [14]	Rathnayaka et al. [11]	Gündüz et al. [9]
Insertion at the junction of the upper one third with the lower two thirds of CBD	96% (normal)	Agreed 77%	Disagreed 40%	Disagreed 47.6	Agreed 70.5%	Agreed 51.5%
Upper third insertion	1.5%	2.8%	0	0	5.5%	6.5%
Posterior border insertion	1%	0	0	14.29%	3.8%	0
Anterior insertion	0.5%	7.5%	0	0	2.7%	0
Medial border insertion	1%	7.6%	24.3%	0	2.2%	0
Parallel course	0.5%	1%	0		6.6%	
Association of stones to anatomical variation	0%	0	High association	0	0	High association

The association of stone to the abnormal CD – CBD insertion was 0% in the current study although there were many cases of normal insertion associated with stone which conclude up to 12.5%, while other studies like the Egyptian [9], Turkish [13] demonstrated a statistically significant association between anatomical variations in the insertion of the CD into the CBD and the occurrence of biliary stone formation, suggesting that certain insertion patterns may predispose patients to stone development.

In the current study, the most common anatomical variation observed was the insertion of the cystic duct at the junction of the upper one-third and lower two-thirds of the CBD, seen in 96% of cases. This finding was in agreement with the results reported by Sudeep et al. (47.6%), Rathnayaka et al. (70.5%), and Gündüz et al. (51.5%), though at varying frequencies. However, it disagreed with Taghavi et al. (77%) and Taştemur et al. (40%), who reported significantly lower incidences of this insertion pattern. Other variations, such as upper third insertion, posterior border insertion, anterior insertion, and medial border insertion, were found in lower percentages in the current study, ranging from 0.5% to 1.5%, whereas some studies, particularly Taştemur et al., reported higher incidences – for example, a 24.3% occurrence of medial border insertion. A parallel course of the cystic duct was rare in all studies, with the highest frequency reported by Rathnayaka et al. (6.6%). Regarding the association between anatomical variations and gallstones, the current study, along with most others, found no such relationship, except for Taştemur et al. and Gündüz et al., who reported a high association. Overall, while the current study supports the predominance of the normal cystic duct insertion pattern, the presence of significant variation across studies suggests possible regional, demographic, or methodological differences (Table 4).

■ CONCLUSIONS

The most prevalent type of CD insertion into the CBD observed in the current study was the posterolateral insertion, with a notably high frequency (95%) in the Iraqi population. Findings indicated that most aberrant cases are concentrated in the age group from 51 to 70 years. Other observed variations included upper third insertion, lower third insertion, pure posterior border insertion, anterior insertion, medial border insertion, and a parallel course of the CD. These findings offer valuable, region-specific anatomical

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data – particularly highlighting the predominance of the normal posterolateral insertion pattern. Although stone formation was documented, no significant association was found between the presence of stones and any particular anatomical variation in this study. This contributes to a more nuanced understanding of biliary anatomy within the Iraqi cohort and may have important implications for surgical planning, risk assessment, and the accurate interpretation of imaging studies.

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Endoscopic Stenting Versus Emergency Surgery for Malignant Colonic Obstruction: Comparative Short-Term Outcomes from a Prospective Real-World Cohort

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Abstract

Introduction. Acute malignant colonic obstruction is a very serious complication of colorectal cancer that often demands urgent decompression, yet clinical practice remains debated on what initial treatment is best. It is generally accompanied by a major burden of morbidity and the need for stoma formation. Endoscopic self-expanding metal stents (SEMS) have been introduced as an alternative to emergency surgery, but prospective real-world data comparing short-term outcomes remain limited.
Purpose. To evaluate short-term clinical outcomes of endoscopic stenting compared with emergency surgery in patients presenting with acute malignant colonic obstruction in a real-world context.
Materials and methods. Eighty-four consecutive adult patients with acute malignant colonic obstruction were included in this prospective comparative cohort study at a tertiary teaching hospital providing specialised colorectal and emergency surgical services. In accordance with routine multidisciplinary clinical decision-making, patients underwent either endoscopic SEMS placement (n=42) or emergency surgery (n=42). The main outcome was clinical success within 72 hours, defined as resolution of obstruction without the need for urgent reintervention. Secondary outcomes were early complications, stoma formation, length of hospital stay, time to initiation of systemic therapy, and 30-day mortality.
Results. Within 72 hours clinical success was 90.5% of patients treated with SEMS and in 83.3% of emergency surgery patients (p=0.28). Early complications were less common in the SEMS group (9.5% vs. 23.8%, p=0.04). Stoma formation occurred significantly less frequently after SEMS placement (14.3% vs. 42.9%, p=0.002). Patients treated with SEMS had a shorter median hospital stay (5 [IQR 4–7] days vs. 9 [IQR 7–12] days; p<0.001) and were able to start systemic therapy earlier (14.2±4.6 vs. 21.5±6.3 days; p<0.001). Thirty-day mortality was low and did not differ significantly between groups (2.4% vs. 7.1%, p=0.31).

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Conclusions. In routine clinical practice, endoscopic stenting of malignant colonic obstruction is associated with fewer early complications, lower rates of stoma formation, shorter hospitalization, and earlier initiation of systemic therapy compared to emergency surgery. SEMS may represent a suitable treatment option for selected patients with acute malignant colonic obstruction.
Keywords: malignant colonic obstruction, self-expanding metal stents, emergency colorectal surgery, stoma formation, cohort study

■ INTRODUCTION

Malignant colonic obstruction (MCO) is a significant and potentially fatal complication of colorectal cancer and represents a substantial proportion of emergency colorectal admissions. Patients usually present with abdominal distension, pain, vomiting, and inability to defecate or pass flatus, predominantly in the setting of advanced disease. Historically, treatment has relied on emergency surgery, often involving bowel resection or creation of a diverting stoma. However, emergency surgery in this group is associated with high morbidity and mortality, prolonged length of hospital stay and a high rate of permanent stoma formation, particularly among elderly patients and those with significant comorbidities [1–3].

Self-expanding metal stents (SEMS) have been in clinical use for the past two decades as an alternative treatment modality for malignant colonic obstruction [4–6]. SEMS may be used for palliation or as a bridge to definitive surgery, providing decompression of the obstructed colon and, in selected patients, avoiding the need for emergency operation. Several studies have demonstrated high technical and clinical success rates with SEMS placement, as well as lower stoma rates and shorter hospital stays compared with emergency surgery [5–8]. These short-term advantages may be particularly important for patients who require prompt initiation of systemic therapy.

Although these are potential advantages, the role of SEMS is controversial. Procedure-related issues, and especially perforation, and long-term oncological results have been emphasized in both randomised trials and observational studies [9–11]. Consequently, guidelines have been rather cautious, with a focus on appropriate patient selection and operator expertise [12, 13]. Importantly, much of the available evidence is derived from highly selected patient populations or specialised tertiary teaching hospitals and may not be reflective of daily clinical work. In practice limited real-world comparisons between SEMS and emergency surgery in the acute setting are available, particularly in healthcare systems where emergency management has to be influenced by resources and institutional conditions as well other factors related to the patients [14, 15]. Treatment decision-making is frequently based on multidisciplinary consensus, not on protocol-based data-driven decision making in practice, indicating the importance of real-world comparative evidence.

■ PURPOSE OF THE STUDY

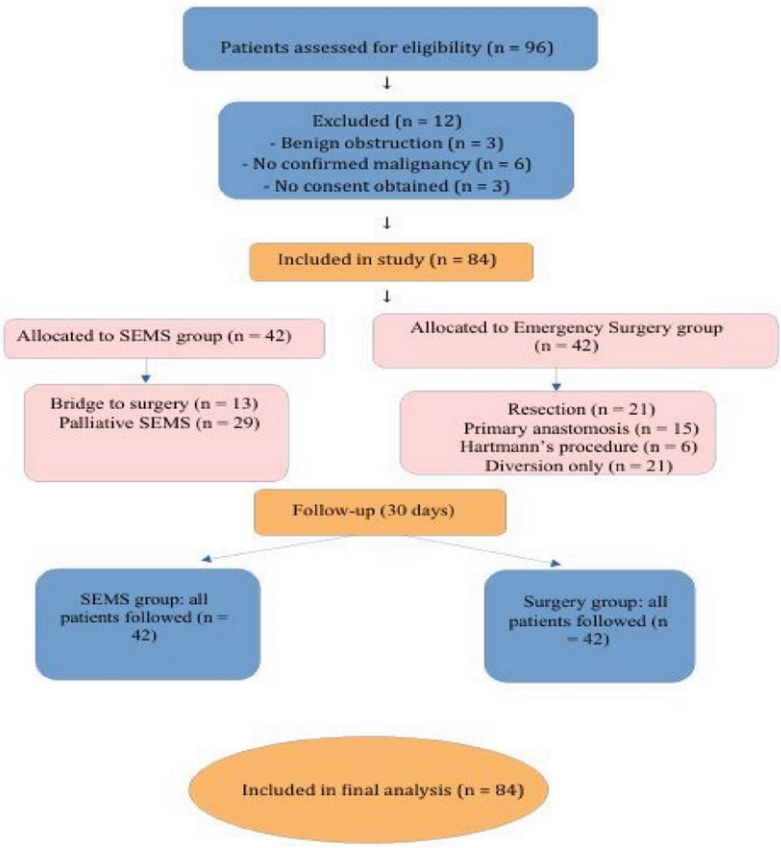
To evaluate short-term clinical outcomes of endoscopic stenting compared with emergency surgery in patients presenting with acute malignant colonic obstruction in a real-world context.

■ MATERIALS AND METHODS

This was a prospective cohort study performed between February 2024 and July 2025 at a tertiary hospital offering specialty colorectal and emergency surgical services. A total of 84 adult patients with acute malignant colonic obstruction were enrolled. The study was designed to reflect real-world clinical practice, and the treatment options were determined by multidisciplinary clinical discretion.

The primary outcomes of interest were early clinical success, procedure-related complications, stoma formation, length of hospital stay (LOS), time to initiation of systemic therapy, and short-term mortality. This cohort study has been reported in line with the STROCSS guidelines [16].

Adult patients presenting with acute malignant colonic obstruction were managed according to local institutional protocol. The research protocol was approved by the Ethical Committee of the College of Medicine, and written informed consent was obtained from all participants before enrolment. Based on their initial management, the patients were classified in two groups; endoscopic self-expanding metal stent (SEMS) insertion (n=42), and surgery (n=42). (Figure).



Flow diagram of patient inclusion, allocation, and follow-up

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Eligibility Criteria

All adult patients (over 18 years of age) who presented to hospital during our study period with presentations of acute malignant large bowel obstruction, the initial treatment strategy of SEMS or emergency surgery was analyzed for inclusion. The diagnosis was made according to an overall clinical examination and based on abdominal CT findings. Each case was evaluated individually, and the management strategy was determined by a multidisciplinary team, including colorectal surgeons, gastroenterologists, and anaesthesiologists. Treatment decisions were not randomized but based on individual clinical assessment and tumor details, along with the practicality of endoscopic stenting. This is in accordance with routine emergency clinical practice in which the allocation of treatment can be individualized and focused on patient stability and technical feasibility. Patients with hemodynamic instability, suspected perforation, diffuse peritonitis, or septic shock were considered unsuitable candidates for SEMS placement and were treated with emergency surgery. Clinical stability of patients and left-sided obstructing tumors that could be managed safely by a guidewire were included as candidates for SEMS placement. Patients were excluded if the obstruction was due to a benign cause, if the diagnosis of malignancy was not confirmed, or if informed consent could not be obtained from the patient or their legal representative.

Preprocedural Workup and Baseline Data

All patients underwent a standard preprocedural assessment, including medical history, physical examination, and laboratory investigations (complete blood count, serum electrolytes, and coagulation profile). Contrast-enhanced computed tomography (CT) of the abdomen and pelvis was performed to confirm the diagnosis and assess tumor location and disease burden. Baseline demographic and clinical characteristics, including age, sex, comorbidities, tumor site, American Society of Anesthesiologists (ASA) classification, and Eastern Cooperative Oncology Group (ECOG) performance status, were prospectively recorded.

Intervention Procedures

SEMS Placement

SEMS placement was used either as a bridge to elective surgery in patients with potentially resectable disease or as palliative decompression in patients with advanced or metastatic disease unsuitable for curative surgery.

Stent insertion was performed by gastroenterologists experienced in therapeutic endoscopy and colonic stenting. After identifying the obstructing tumor, a guidewire was advanced across the narrowed segment. Once this was successfully achieved, a self-expanding metallic stent of appropriate size was deployed across the lesion to relieve the obstruction.

Successful stent placement was confirmed by immediate decompression seen endoscopically and on imaging. No SEMS failures due to unsuccessful decompression were observed, and no crossover between treatment groups occurred.

After the procedure, patients were closely monitored for early complications such as perforation, bleeding, or stent migration, as per our hospital clinical protocol. Complications were recorded and classified according to the Clavien – Dindo classification system.

Surgical Management

Patients allocated to surgery underwent emergency operation under general anaesthesia following standard colorectal surgical practice. The operative strategy was individualized based on intraoperative findings, patient stability, tumor location, and bowel viability. Surgical procedures included colonic resection with primary anastomosis, Hartmann's procedure, or diverting loop colostomy when immediate decompression was required and resection was not feasible.

The primary goal of surgery was to promptly relieve the obstruction while achieving safe postoperative oncological management. All patients received routine perioperative care according to our institutional guidelines, including antibiotic prophylaxis, thromboprophylaxis, and close postoperative monitoring.

Outcome Measures

The main outcome was clinical success within 72 hours. Clinical success was defined as the resolution of obstructive symptoms with bowel function restored and no requirement for urgent reintervention during the index admission. This evaluation was determined within 72 hours of intervention, as this time period represents the early clinical response period frequently used to assess initial decompression effectiveness in acute malignant colonic obstruction [5-7]. Secondary outcomes included early complications, stoma formation, length of stay, time to systemic therapy initiation, and 30-day mortality.

Follow-Up

Patients were followed from the time of the intervention until discharge and then for 30 days after the procedure. Follow-up was performed through outpatient visits and review of electronic medical records to capture early outcomes and any procedure-related complications.

Statistical Analysis

Categorical variables were expressed as numbers and percentages and compared using the chi-square test or Fisher's exact test, as appropriate. Continuous variables were assessed for normality and presented as mean±standard deviation for normally distributed data or median with interquartile range (IQR) for non-normally distributed data. Comparisons between groups were performed using Student's t-test or the Mann – Whitney U test, as appropriate. All statistical tests were two-tailed, and a p value <0.05 was considered statistically significant. Effect sizes are reported as odds ratios (ORs) with 95% confidence intervals (CIs) for categorical outcomes. Statistical analyses were conducted using standard statistical software.

■ RESULTS

Baseline Patient Characteristics

A total of 84 subjects were included, with 42 in each group. Baseline demographic and clinical statistics in the SEMS and emergency surgery were comparable between the two groups and no difference was found to be significant between the two groups (Table 1). The mean age was 61.2±10.5 years in the SEMS group and 62.8±11.1 years in the surgery group (p=0.48). 54.8% SEMS, and 52.4% Surgery group were male patients. SEMS patients

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Table 1
Baseline demographics and clinical characteristics of patients

Characteristic	SEMS (n=42)	Surgery (n=42)	p-value
Age, mean±SD (years)	61.2±10.5	62.8±11.1	0.48
Male, n (%)	23 (54.8%)	22 (52.4%)	0.82
Tumor location (left-sided), n (%)	30 (71.4%)	29 (69.0%)	0.79
ASA class III–IV, n (%)	12 (28.6%)	13 (31.0%)	0.81
Comorbidities, n (%)	18 (42.9%)	19 (45.2%)	0.83

had left-sided tumors in 71.4% and surgery patients in 69.0%. ASA class III–IV and baseline comorbidities were similarly distributed between groups (p>0.05 for all comparisons).

Management Strategy and Treatment Pathways

In the SEMS group (n=42), treatment intent was determined according to multidisciplinary evaluation and tumour stage.

- SEMS as bridge to surgery: 13 patients (30.9%).
- SEMS as definitive palliative decompression: 29 patients (69.1%).

Among patients treated with SEMS as a bridge to surgery, elective oncologic resection was subsequently performed after clinical stabilization during the same treatment course.

In the emergency surgery group (n=42), operative management was individualized based on intraoperative findings, patient stability, and tumour characteristics.

Surgical procedures included:

- Resection with primary anastomosis: 15 patients (35.7%)
- Hartmann's procedure: 6 patients (14.3%)
- Diverting loop colostomy without resection: 21 patients (50%)

Procedural Outcomes

Technical success of SEMS placement was achieved in 40 patients (95.2%). Clinical success within 72 hours occurred in 38 patients (90.5%) in the SEMS group and in 35 patients (83.3%) in the surgery group (p=0.28) with OR 1.89 (95% CI 0.49–7.25). Early complications occurred less frequently in the SEMS group than the surgery group (9.5% vs. 23.8%, p=0.04; OR 0.34, 95% CI 0.10–1.15) (Table 2).

In the SEMS group, 4 patients experienced early complications (9.5%), of whom two perforations (4.8%) occurred, both classified as Clavien – Dindo Grade IIIb. These patients underwent urgent surgical management with tumour resection and stoma formation following prompt clinical and radiological diagnosis. In addition, two cases

Table 2
Procedural outcomes and early complications

Outcome	SEMS (n=42)	Surgery (n=42)	OR (95% CI)	p-value
Technical success, n (%)	40 (95.2%)	Not applicable	–	–
Clinical success within 72 h, n (%)	38 (90.5%)	35 (83.3%)	1.89 (0.49–7.25)	0.28
Early complications, n (%)	4 (9.5%)	10 (23.8%)	0.34 (0.10–1.15)	0.04

Table 3
Breakdown of complications by type and Clavien – Dindo grade

Complication	SEMS (n=42)	Surgery (n=42)	Clavien – Dindo grade
Perforation	2 (4.8%)	0	Grade IIIb
Bleeding (conservative)	2 (4.8%)	2 (4.8%)	Grade I–II
Wound infection	0	6 (14.3%)	Grade II
Anastomotic leak	0	2 (4.8%)	Grade IIIb

of minor bleeding (4.8%) were observed, both of which were managed conservatively and classified as Grade I–II. In the emergency surgery group, complications occurred in 10 patients (23.8%). These included six wound infections (14.3%), classified as Grade II, and two anastomotic leaks (4.8%), which occurred in patients undergoing resection with primary anastomosis and required reoperation (Grade IIIb). Minor bleeding was also observed in two patients (4.8%) and managed conservatively (Grade I–II). Overall, major complications (Clavien – Dindo Grade IIIb) were observed more frequently in the surgical group compared with the SEMS group (Table 3).

Complications were classified according to the Clavien – Dindo classification system. Minor bleeding was managed conservatively, wound infections required antibiotic therapy, and major complications such as perforation and anastomotic leak required surgical intervention.

Subgroup Analysis

A descriptive analysis was performed for the outcomes according to treatment intent within the SEMS group and emergency surgery group (Table 4). Due to the limited sample size, findings were interpreted descriptively without formal statistical comparison.

Within the SEMS group, patients treated as a bridge to surgery (n=13) achieved a clinical success rate of 92.3%, with only one reported complication (7.7%) and no mortality. In contrast, patients undergoing SEMS for palliative intent (n=29) had a clinical success rate of 89.7%, with slightly higher complication rates (10.3%) and one death (3.4%). Stoma formation was less frequent in the bridge-to-surgery subgroup compared to the palliative group.

In the surgical cohort, outcomes varied according to operative approach. Patients undergoing resection (primary anastomosis or Hartmann's procedure) experienced higher complication rates and longer hospital stays compared with those managed with diversion alone. Stoma formation was more frequent in both surgical subgroups compared with SEMS.

Table 4
Descriptive subgroup analysis of short-term outcomes according to treatment strategy

Outcome	SEMS Bridge (n=13)	SEMS Palliation (n=29)	Surgery – Resection (n=21)	Surgery – Diversion (n=21)
Clinical success	12 (92.3%)	26 (89.7%)	17 (81.0%)	18 (85.7%)
Early complications	1 (7.7%)	3 (10.3%)	7 (33.3%)	3 (14.3%)
Stoma formation	1 (7.7%)	5 (17.2%)	10 (47.6%)	8 (38.1%)
30-day mortality	0 (0%)	1 (3.4%)	2 (9.5%)	1 (4.8%)
Hospital stay (median days)	5 (4–6)	5 (4–7)	10 (8–13)	7 (6–10)

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Table 5
Stoma creation and 30-day mortality

Outcome	SEMS (n=42)	Surgery (n=42)	OR (95% CI)	p-value
Stoma creation (temporary or permanent), n (%)	6 (14.3%)	18 (42.9%)	0.22 (0.07-0.64)	0.002
30-day mortality, n (%)	1 (2.4%)	3 (7.1%)	0.32 (0.03-3.20)	0.31

Table 6
Length of hospital stay and time to systemic therapy

Outcome	SEMS (n=42)	Surgery (n=42)	p-value
Hospital stay, median (IQR), days	5 (4–7)	9 (7–12)	<0.001
Time to initiation of systemic therapy (mean±SD), days	14.2±4.6	21.5±6.3	<0.001

These descriptive findings suggest that treatment intent and operative strategy may influence short-term outcomes; however, given the limited sample size and absence of formal statistical comparison, these observations should be interpreted cautiously.

Stoma Formation and Mortality

Stoma formation was required in 6 patients (14.3%) in the SEMS group compared with 18 patients (42.9%) in the surgery group (p=0.002), indicating significantly lower likelihood of stoma formation following SEMS placement (OR 0.22, 95% CI 0.07-0.63)

Thirty-day mortality was low and did not differ significantly between groups, occurring in 1 patient (2.4%) in the SEMS group and 3 patients (7.1%) in the surgery group (p=0.31), with no statistical significant difference in mortality risk (OR 0.32, 95% CI 0.03–3.20) (Table 5).

Hospital Stay and Time to Therapy

Median length of hospital stay was shorter in the SEMS group (5 days, IQR 4–7) than in the surgery group (9 days, IQR 7–12; p<0.001). Time to initiation of systemic therapy was also shorter following SEMS placement (14.2±4.6 days) compared with emergency surgery (21.5±6.3 days; p<0.001) (Table 6).

■ DISCUSSION

This prospective comparative cohort study demonstrates that, in real-world clinical practice, endoscopic self-expanding metal stenting for acute malignant colonic obstruction is associated with more favourable outcomes and lower rates of early adverse events. SEMS placement was associated with fewer early complications, a substantially lower rate of stoma formation, shorter hospital stay and earlier initiation of systemic therapy. In contrast, short-term mortality was similar between the two treatment strategies.

The clinical success rate following SEMS placement in our study was comparable to that reported in previous randomized [5–7] and observational studies[8]. Although early clinical success did not differ significantly between SEMS and emergency surgery, outcomes tended to favour SEMS overall and were accompanied by a significantly lower complication rate. Notably, the reduction in early complications observed with SEMS in

our cohort is consistent with findings from recent meta-analyses, demonstrating reduced perioperative morbidity when stenting is used in appropriately selected patients [9, 10].

One of the notable findings of this study is the significantly lower rate of stoma formation in the SEMS group. Stoma formation remains one of the most important determinants of patient quality of life. These findings are consistent with previous studies showing higher rates of primary anastomosis and lower rates of permanent stoma following SEMS [11–13]. Prevention of inadvertent stomas in the acute stage can promote a faster return to normal bowel function and fewer reoperations, leading to better patient outcomes.

A reduced length of in-patient stay and earlier commencement of systemic therapy are other potential benefits of SEMS identified. Extended postoperative hospital stay after emergency surgery is frequently reported, and may be associated with postoperative complications, delayed recovery or stoma-related management. On the other hand, SEMS enables immediate decompression of the obstructed colon with faster clinical stabilisation and discharge. In patients with advanced disease, where delays in oncological treatment can harm overall outcome [14, 15], the earlier administration of systemic therapy in those receiving SEMS may be particularly pertinent. Although it has all these advantages, the position of SEMS in malignant colonic obstruction remains debated. Procedure-related perforation and its potential effect on oncological outcomes are a concern [17, 18], particularly in the context of randomised trials [19–21]. However, in this study, perforation after SEMS insertion was rare and managed with immediate surgical intervention, and this appears to be related to the careful selection of patients, as well as technical expertise. However, in the absence of long-term follow-up, the effect of SEMS-related complications, particularly perforation, on recurrence and survival cannot be evaluated. These findings are consistent with current ESGE and WSES guidelines, which recommend selective use of SEMS in carefully selected patients and emphasize the importance of experienced operators and multidisciplinary decision-making [22–25].

Key strengths of this study include the prospective real-world design, depicting routine clinical decision-making, as opposed to being protocol-driven allocation. Treatments were conducted at a tertiary hospital with specialized colorectal and emergency surgical services within a multidisciplinary framework, and this helped in generalising the outcomes. This pragmatic design addresses an important evidence gap, given that much of the existing evidence is derived from highly selected populations in specialised centres.

■ CONCLUSIONS

In this study, endoscopic self-expanding metal stenting for acute malignant colonic obstruction resulted in fewer early complications, a lower stoma rate, shorter hospital stay and earlier initiation of systemic therapy compared with emergency surgery. Short-term mortality was similar in both groups. These findings suggest that SEMS can be a safe and effective option in carefully selected patients and when performed in experienced centres with proper multidisciplinary follow-up. Further prospective studies with longer follow-up are needed to assess long-term oncological outcomes and help identify the best candidates.

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Foreign Bodies Inhalation: A Descriptive Study

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Abstract

Introduction. Foreign bodies (FBs) in the airway organs are infrequent and difficult to manage. The display differs according to size, location, and characteristics of the aspirated substance. Although rigid bronchoscopy is the preferred method for pediatric patients, the extraction of distally embedded FBs in adults has a high success rate with flexible bronchoscopy.
Purpose. To evaluate the effectiveness of flexible bronchoscopy for the removal of airway FBs.
Materials and methods. Retrospective research conducted from June (2022) to May (2024) involved the extraction of medical records from individuals who underwent bronchoscopy for airway foreign substances. The analysis included demographic information, location and type of FB, extraction process, auxiliary equipment utilized, and levels of achievement.
Results. Most participants were male (15, 75%), while females accounted for 5 (25%) cases. The ages of the patients ranged from 6 to 71 years. Cough was the most common presenting symptom and was reported in all the patients (20, 100%). Radiological findings revealed FB opacity in 17 patients (85%), collapse (atelectasis) in 10 patients (50%), and consolidation in 5 patients (25%). Flexible bronchoscopy was the predominant extraction method used in 18 patients (90%), while rigid bronchoscopy was performed in 2 patients (10%). The most common location of the foreign bodies was the right lower lobe bronchus (40%), followed by the bronchus intermedius (25%). Organic foreign bodies accounted for 65% of the cases, with nuts being the most common (30%). The overall success rate of bronchoscopic extraction was 95%, and hemoptysis occurred in one patient (5%) as the only reported complication.
Conclusions. Flexible bronchoscopy demonstrates excellent outcomes in the management of airway FBs and should be regarded as the primary approach in adults.
Keywords: bronchoscopy, airway foreign body, flexible bronchoscopy, rigid bronchoscopy

INTRODUCTION

Children are more likely to experience FB aspiration [1]. FB aspiration can also occur in adults, adolescents, and the elderly and can manifest as sudden, life-threatening respiratory failure or as the development of new symptoms such as dyspnea, wheezing, coughing, and hemoptysis [2]. Because they may not remember having a choking episode in the past, the elderly can experience diagnostic delays [3]. FBs can be classified as organic or inorganic. The prevalent radiological findings include the presence of an FB, persistent pneumonia, lung collapse, and localized hyperinflation or bronchiectasis [4]. Around 0.16–1.33% of adult bronchoscopy procedures involve the presence of an airway FB [5]. The location of the FB is determined by the patient's age and the size and shape of the aspirated substance. Rigid bronchoscopy was previously thought to be the best approach because of its larger working channel and superior airway control. Adults now utilize flexible bronchoscopy [5–8]. Flexible bronchoscopic-aided removal has been described [9–12].

PURPOSE OF THE STUDY

To evaluate the effectiveness of flexible bronchoscopy for the removal of airway FBs.

MATERIALS AND METHODS

Study Design and Setting

This retrospective study was conducted at the ENT clinic from the beginning of June (2022) to May (2024). We evaluated the medical records of patients who underwent bronchoscopy and extracted individuals with a diagnosis of airway FB for analysis.

Ethical Approval

The Medical Ethical Committee of The College of Medicine, University of Basrah approved this study (no. 4449 on 22/5/2022).

Data Collection

Demographic profile, duration of symptoms, and symptoms upon presentation were recorded. Chest radiological findings were identified using radiography and computed tomography (CT). Bronchoscopic data including type and site of FB, supplementary equipment utilized for FB extraction, and outcome of the procedure were noted.

Procedure

Flexible bronchoscopy was performed in a bronchoscopy facility under moderate sedation with fentanyl and/or midazolam. Lignocaine was administered during the procedure, and the posterior pharynx was anesthetized with a topical lignocaine spray. When diagnostic bronchoscopy is performed via the nasal route, the extraction approach is adjusted to the oral route.

A flexible bronchoscope was inserted and stabilized in the segment where the FB was lodged. By utilizing accessory equipment to grip the FB securely, it was guaranteed that it would not slide during the extraction. The three pieces of ancillary equipment used were the Olympus® Dormie Basket, Roth Net Airway FB removal endoscopic basket,

and Olympus® Rat Tooth Grasping Forceps. Subsequently, the bronchoscope and foreign objects were carefully removed one by one and passed through the throat, vocal cords, and trachea. General anesthesia with either rigid bronchoscopy or Laryngael Mask Airway was used if flexible bronchoscopy did not work. The technique was performed in the operating room if the patient required a rigid bronchoscopy.

To ensure that the airway was secured, the patient was intubated using a rigid tracheobronchoscope in conjunction with the installation of a laryngeal mask airway. Assuming that an LMA was implemented, a flexible bronchoscope was used to extract the FB. Non-optical forceps were used if rigid bronchoscopy was performed to extract the FB through a rigid barrel.

Statistics

Analyses were performed using IBM SPSS 26. Categorical variables are summarized as frequencies/percentages and ranges. The success rate of bronchoscopic extraction and the complication rates were calculated as percentages.

■ RESULTS

Table 1 presents the baseline characteristics of the study cohort. Most participants were male (15, 75%), while females accounted for 5 (25%) cases. The ages of the patients ranged from 6 to 71 years. Cough was the most common presenting symptom and was reported in all the patients (20, 100%). Radiological findings revealed FB opacity in 17 patients (85%), collapse (atelectasis) in 10 patients (50%), and consolidation in 5 patients (25%).

Table 2 summarizes the processes, locations, and auxiliary equipment used for the FB removal. Flexible bronchoscopy was the predominant extraction method used in 18 patients (90%), while rigid bronchoscopy was performed in 2 patients (10%). The most common location of the foreign bodies was the right lower lobe bronchus (40%), followed by the bronchus intermedius (25%). Organic foreign bodies accounted for 65% of the cases, with nuts being the most common (30%). The overall success rate of bronchoscopic extraction was 95%, and hemoptysis occurred in one patient (5%) as the only reported complication.

Table 1
Characteristics of the study population at baseline

Variables		No. (%)
Sex	Male	15 (75)
	Female	5 (25)
Age (years), range		6–71
Symptoms	Cough	20 (100)
	Dyspnea	12 (60)
	Hemoptysis	3 (15)
Radiology	FB opacity	17 (85)
	Collapse (atelectasis)	10 (50)
	Consolidation	5 (25)

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Table 2
Procedures for FB extraction

Parameter			No. (%)
Bronchoscopy		Flexible	18 (90)
		Rigid	2 (10)
Location of FBs		Lobe bronchus on the right (lower)	8 (40)
		Bronchus Intermedius	5 (25)
		Main bronchus (left)	4 (20)
		Lobe bronchus (upper)	1 (5)
		Segmental bronchus	2 (10)
FB classification	Organic	Nut	6 (30)
		Bone (fish and chicken)	3 (15)
		Blach gram	2 (10)
		Seed	2 (10)
	Inorganic type	Pen-cap	4 (20)
		Pin	1 (5)
		Tooth	1 (5)
		Push pin	1 (5)
Procedure efficacy		Overall success	19 (95)
		Rigid Bronchoscopy	2 (100)
		Flexible bronchoscopy	17 (94.4)
Complications		Hemoptysis	1 (5)

■ DISCUSSION

Adults and teenagers rarely experience airway obstruction caused by FBs. Consistent with previous studies, we documented a 94.4% success rate for flexible bronchoscopy-guided extraction [5, 13]. In adults, FBs are more likely to become stuck farther distally on the right side, as the right major bronchus has a greater diameter and shorter angle of convergence with the carina [8]. In our series, the most prevalent sites of lodgment were the right lower lobe and the bronchus intermedius. Usually, there are no signs of acute respiratory blockage associated with a distal blockage. The main indication was coughing up, and the typical radiological result was collapse. Many FBs are radiopaque. Some cases, especially those involving the elderly, may take longer to diagnose FB aspiration because they may not remember having a choking episode [11]. Patients with this condition may present with collapse, recurrent pneumonia, or bronchiectasis. Flexible bronchoscopy was used to confirm the diagnosis in such cases. Rigid bronchoscopy is the preferred method for removing centrally placed FBs, particularly in pediatric patients, because of its superior airway control and large working channel [1, 9, 10].

The FB also had sharp edges and a large granulation reaction, because the risk of bleeding was high. Rigid bronchoscopy provides greater control of hemostasis, as larger forceps and attachments can be employed throughout surgery. Relocation is also less likely to occur. Not all centers have the resources to perform rigid bronchoscopy, which requires general anesthesia. Currently, the gold standard for adults is flexible bronchoscopy, which is particularly useful when dealing with remote FBs. Reduced sedative needs,

accessibility (many centers provide it), and ease of execution are some of its benefits. In adults, flexible bronchoscopy works well [5]. Flexible bronchoscopy was insufficient to effectively grasp and extract the FB in two instances in this investigation. We conducted rigid bronchoscopy-guided extraction in two patients. Flexible bronchoscopy should be performed in every case in adulthood, unless it is contraindicated by conditions such as pulmonary failure, stridor, and cyanosis that require emergent airway management due to the elevated success rate of the procedure. The diagnosis, location of the FB, and planning of the removal procedure can be enhanced with the use of an initial evaluation bronchoscopy. The bronchoscopist's personal preference, type and location of the FB, and other factors all play a role in the auxiliary equipment selection process. The most common auxiliary tool used was a pair of forceps [5, 8].

In our country, only a handful of centers offer advanced bronchoscopy procedures. In the pediatric population, rigid bronchoscopy has been reported in two prospective studies on the extraction of airway FBs [9, 10]. An older patient with fish bone and a teenager with a push pin were the two patients in our earlier reports who underwent successful removal guided by flexible bronchoscopy [11, 12].

Pulmonologists should have a solid grasp of FB management strategies to enhance patient care, especially with the nationwide expansion of bronchoscopic services. Extraction of FBs from the airway is difficult and requires careful preparation, methodical technique selection, and most importantly, collaboration. It is recommended to have a minimum of two bronchoscopists with experience and a certified nurse throughout the surgery. The success of the procedure is ensured through continuous review and approach changes, in the event that one approach fails.

Early recognition of airway foreign-body aspiration and prompt bronchoscopic intervention can improve patient outcomes and reduce the risk of long-term pulmonary complications.

■ CONCLUSIONS

Flexible bronchoscopy is a highly effective and safe modality for the detection and removal of airway FBs, with a high success rate (95%) and minimal complications. In this study, most FBs were organic and located in the right bronchial tree. Given its high efficacy, low complication rate, and minimally invasive nature, flexible bronchoscopy should be considered the first-line therapeutic approach for airway FB extraction, with rigid bronchoscopy reserved for selected cases in which flexible bronchoscopy is unsuccessful or contraindicated.

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