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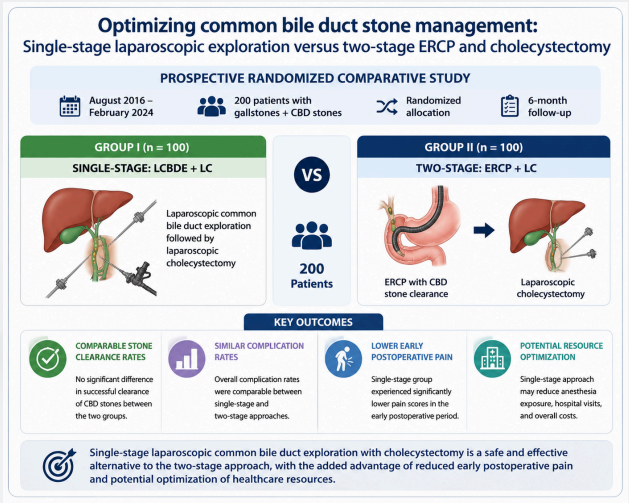

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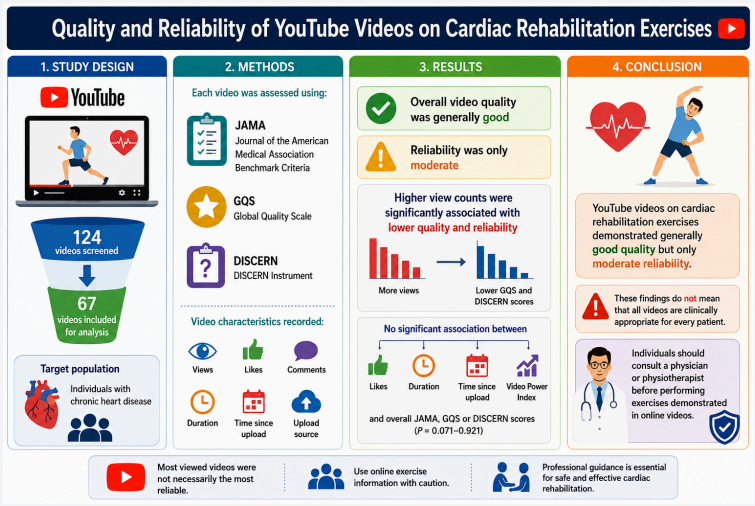

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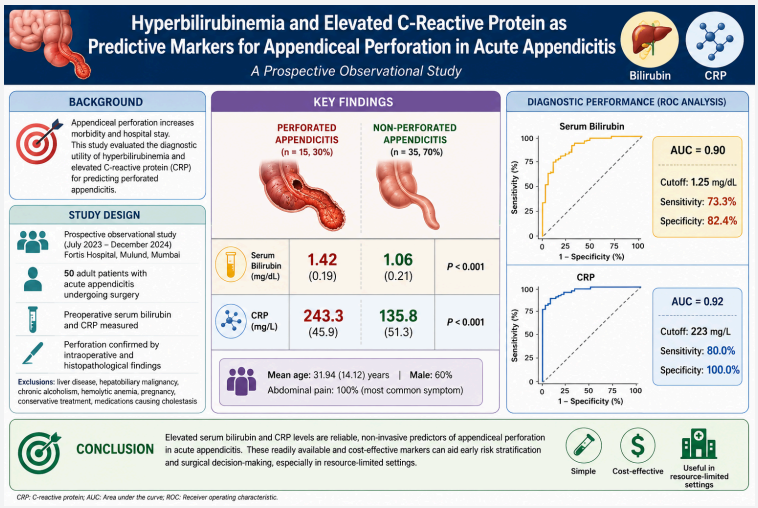

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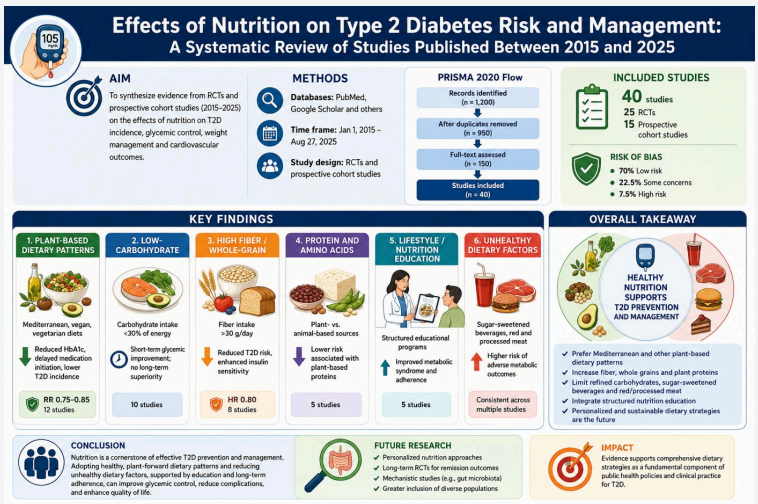

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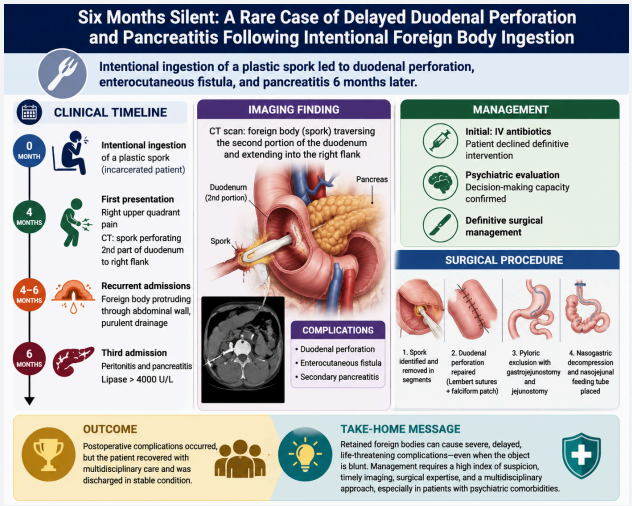

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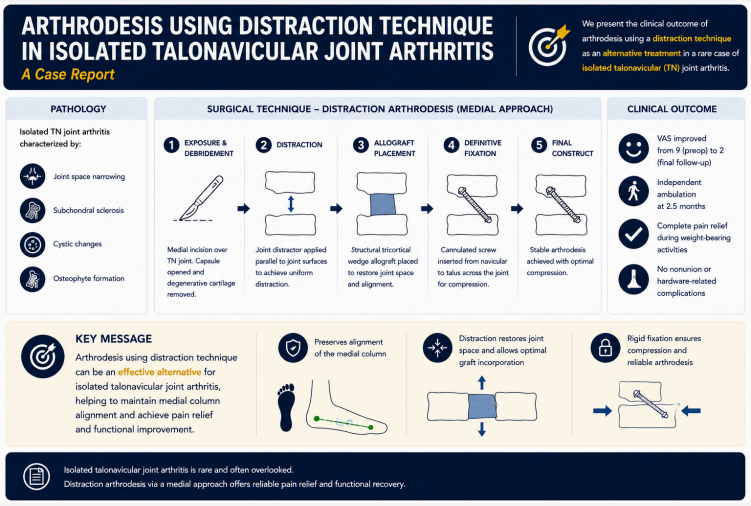

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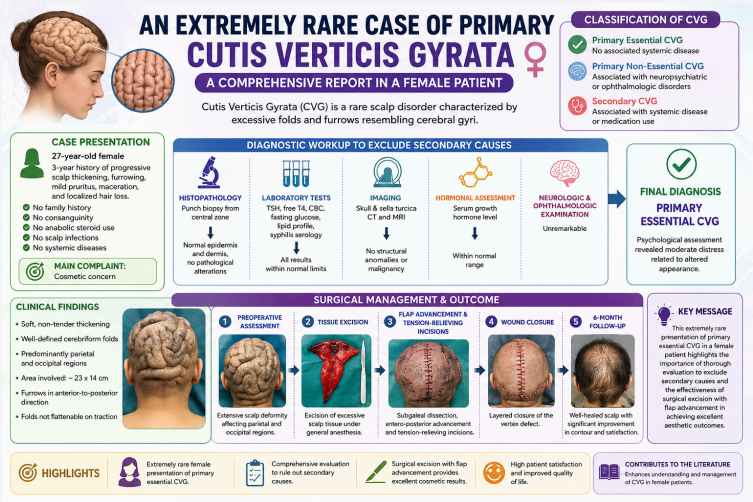

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Optimizing common bile duct stone management: Single-stage laparoscopic exploration versus two-stage ERCP and cholecystectomy

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Ethics Committee Approval
The study was approved by the Sohag University Ethics Committee in January 2016. All participants provided verbal and written informed consent. Written informed consent for publication of intraoperative images was obtained from all patients.
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
No conflict of interest was declared by the authors.

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Abstract

Background/Aim: Concomitant gallbladder and common bile duct (CBD) stones can be managed with a single-stage operative pathway, including laparoscopic CBD exploration (LCBDE) and laparoscopic cholecystectomy (LC), or with a two-stage strategy using preoperative endoscopic retrograde cholangiopancreatography (ERCP) followed by LC during the same admission. In this randomized controlled trial, we compared these strategies in terms of perioperative safety, overall effectiveness, and patient recovery experience.

Methods: A total of 200 patients with gallstones and CBD stones were enrolled between January 2016 and December 2024 and randomized using sealed opaque envelopes to Group I, single-stage LCBDE + LC (n = 100), or Group II, two-stage ERCP + LC (n = 100). The primary outcome was successful CBD stone clearance and gallbladder removal using the assigned approach without conversion. Secondary outcomes included postoperative pain, complications, hospital stay, retained CBD stones, and patient satisfaction. Data were analyzed using SPSS version 26, and statistical significance was defined as a two-tailed *P*-value <0.050.

Results: Baseline demographic characteristics were similar between groups. Mean CBD diameter and stone size were larger in Group I than in Group II [13.18 (2.01) mm vs. 10.94 (2.46) mm, P <0.001; and 6.29 (1.47) mm vs. 5.65 (1.69) mm, P = 0.005, respectively]. Mean operative time was comparable [138.3 (20.4) min vs. 140.85 (43.98) min, P = 0.600]. Intraoperative complication and conversion rates were low and comparable. Postoperative direct bilirubin levels were slightly higher in Group I [1.01 (0.08) mg/dL vs. 0.83 (0.06) mg/dL, P = 0.030]. Early pain scores at 24 h favored Group I [5.34 (1.02) vs. 6.30 (1.02), P <0.001], whereas day 3 pain scores were similar. Retained CBD stones were rare [3% vs. 0%, P = 0.246]. Hospital stay, overall complications, and patient satisfaction were comparable between groups.

Conclusion: Single-stage LCBDE + LC was as safe and effective as two-stage ERCP + LC and was associated with better early pain control and potential resource advantages through single-session treatment. Both strategies remain viable options, and the preferred approach should be guided by patient anatomy, local expertise, available resources, and institutional logistics.

Keywords: common bile duct stones, gallstones, laparoscopic cholecystectomy, endoscopic retrograde cholangiopancreatography, single-stage surgery, patient outcomes

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Introduction

Gallstones accompanied by common bile duct (CBD) stones are found in approximately 10-15% of patients undergoing cholecystectomy and continue to pose a practical challenge for biliary surgeons. Two main management strategies are commonly practiced: a single-stage operative route in which laparoscopic common bile duct exploration is performed together with laparoscopic cholecystectomy (LCBDE + LC), and a two-stage pathway involving preoperative endoscopic retrograde cholangiopancreatography (ERCP) followed by LC. Systematic reviews and randomized trials report broadly comparable overall success and safety for the two strategies, but important trade-offs exist, notably the risk of post-ERCP pancreatitis with ERCP-first strategies versus bile leakage and ductal injury risk after transcholedochal exploration. Outcomes are strongly influenced by case selection, stone burden, duct anatomy, and local operator expertise [1-9].

Randomized trials and meta-analyses also suggest that single-stage approaches may reduce the need for multiple procedures and, in some systems, shorten the total hospital stay and lower cumulative resource use when surgical expertise and instrumentation, such as choledochoscopy, are available [2-8]. However, heterogeneity in trial methods, variable experience with LCBDE, and differing health system logistics limit the generalizability of the evidence [10-16]. Additional meta-analytic and comparative reports have reached similar conclusions [17, 18].

Given the relative paucity of randomized, patient-centered data from our region and the need to examine both clinical and patient-reported endpoints, we conducted a randomized trial at a tertiary university center to compare single-stage LCBDE + LC with two-stage ERCP + LC with respect to intraoperative and postoperative outcomes, retained stones, pain, and patient satisfaction.

Materials and methods

Study design and setting

This randomized controlled trial was conducted at the Department of General Surgery, Sohag University Hospital, from January 2016 to December 2024. Ethical approval was granted by the Sohag University Ethics Committee in January 2016, before patient enrollment. All procedures were performed in accordance with the principles of the Declaration of Helsinki.

Participants

Eligible participants were men and women 16 to 70 years of age with gallbladder stones confirmed by imaging and radiologic or clinical evidence of CBD stones. Patients were excluded if they had acute cholecystitis, acute pancreatitis, uncorrectable coagulopathy, end-stage renal or severe cardiac disease, liver cirrhosis, intrahepatic biliary pathology, hepatic mass, hepatic abscess, hepatic neoplasm, recurrent choledocholithiasis, or malignant biliary or pancreatic tumors.

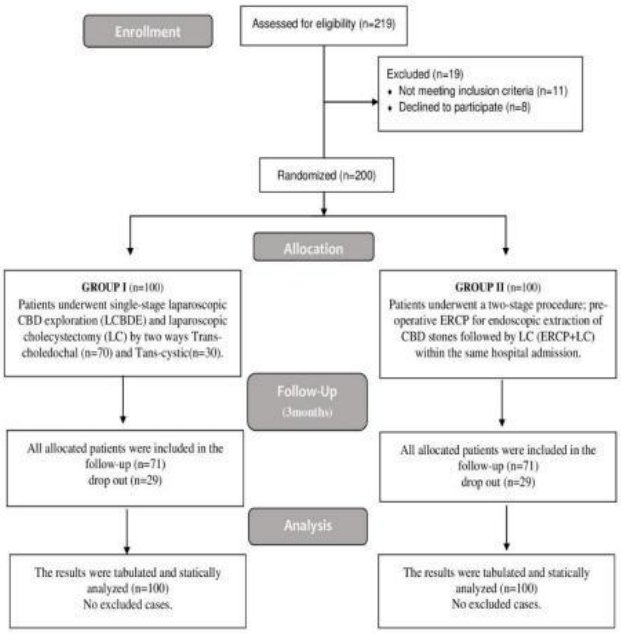
Sample size and power

A total of 200 patients, with 100 patients in each group, were included. The sample size was determined pragmatically based on the hospital annual case volume and provided approximately 80% power to detect a clinically relevant 15% difference in the primary outcome at an alpha level of 0.05.

Randomization and allocation

Eligible patients were randomized in a 1:1 ratio to Group I, single-stage LCBDE + LC (n = 100), or Group II, two-stage ERCP + LC during the same admission (n = 100). Randomization followed a computer-generated sequence prepared by an independent statistician who had no role in patient recruitment or data evaluation. The allocation sequence was concealed in sequentially numbered sealed opaque envelopes prepared by the study coordinator. The operating team opened envelopes sequentially immediately before the procedure to maintain allocation concealment. Neither the enrolling investigator nor the outcome assessor had access to the randomization list before allocation. Participant enrollment, allocation, follow-up, and analysis are summarized in Figure 1.

Figure 1. CONSORT flowchart of enrolled patients.



Preoperative assessment and imaging

All patients underwent clinical evaluation, baseline laboratory testing including liver function tests, and magnetic resonance cholangiopancreatography (MRCP) to determine CBD diameter, stone number, stone size, and stone location. Demographic and comorbidity data were recorded.

Interventions

Patients in Group I underwent single-stage laparoscopic common bile duct exploration followed by laparoscopic cholecystectomy, with exploration performed through either the transcystic or transcholedochal approach (Figures 2-4). Patients in Group II underwent ERCP with endoscopic sphincterotomy and stone extraction, followed by LC during the same admission (Figures 5-7). All LCBDE procedures were performed by surgeons experienced in laparoscopic biliary surgery, each with experience of more than 50 cases, while ERCP procedures were performed by senior endoscopists with more than five years of experience in therapeutic biliary interventions.

Figure 2. A: Introduction of the choledochoscope; B: visualization of a CBD stone.

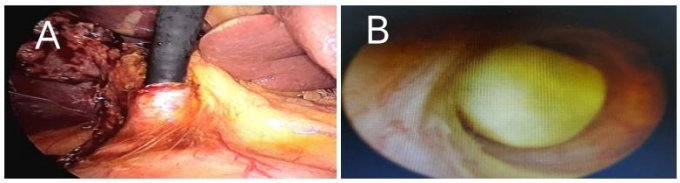


Figure 3. A: Stone extraction by flushing with saline; B: stone extraction with a Dormia basket.

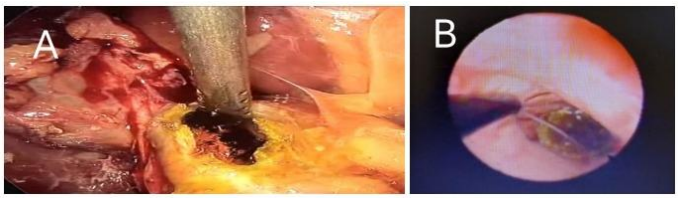


Figure 4. A: Primary closure of the CBD; B: T-tube insertion.

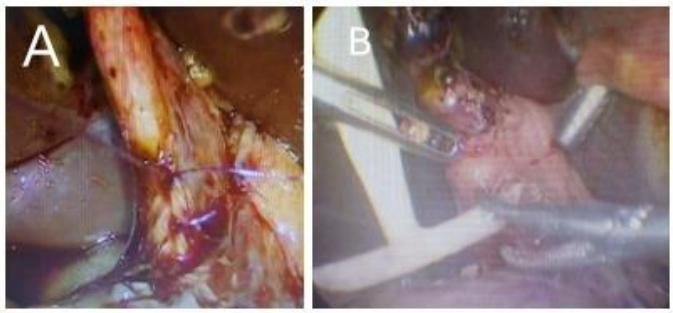


Figure 5. A: ERCP showing multiple CBD stones; B: endoscopic sphincterotomy.

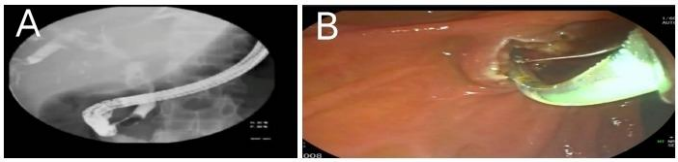


Figure 6. A: Stone extraction by basket; B: extraction of multiple stones by balloon.

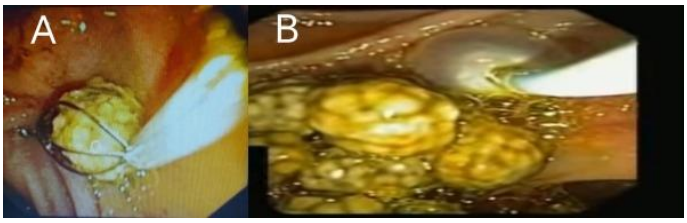
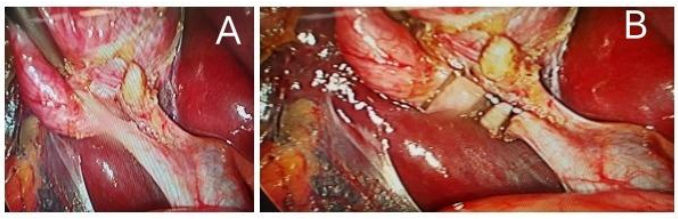


Figure 7. Laparoscopic cholecystectomy.



Outcome measures

The primary outcome was successful removal of both CBD stones and the gallbladder using the intended approach without conversion. Secondary outcomes included operative time, intraoperative and postoperative complications, conversion rate, postoperative pain assessed using the visual analog scale (VAS) on postoperative days 1 and 3, length of hospital stay, retained CBD stones, and patient satisfaction scores. Retained CBD stones were defined as stones undetected intraoperatively but diagnosed within six months postoperatively by ultrasonography or MRCP. Follow-up imaging was routinely obtained at 3 and 6 months after surgery or earlier in patients who developed recurrent symptoms. To estimate resource utilization, the number of anesthesia sessions and the total duration of hospital stay were recorded for each patient.

Statistical analysis

Statistical analysis was performed using SPSS software, version 26. The distribution of continuous data was examined for normality using the Shapiro-Wilk test. Parametric data were summarized as mean (SD) and compared using the unpaired Student t-test. Nonparametric variables were summarized as median (IQR). Categorical variables were compared using the chi-square test or Fisher exact test, as appropriate. A prespecified multivariable analysis was not performed; therefore, potential confounding by baseline differences, particularly the larger CBD diameter in Group I, cannot be fully excluded. Statistical significance was set at P <0.050. The study could not be prospectively registered because of institutional restrictions; however, the design and reporting followed CONSORT recommendations.

Results

Patient population

A total of 200 patients with concomitant gallbladder and CBD stones were enrolled and randomly assigned to two groups, with 100 patients in each group. All randomized patients were included in the final analysis according to the intention-to-treat principle (Figure 1).

Baseline characteristics

Baseline demographic characteristics were comparable between the two groups, except for CBD diameter and stone size (Table 1). Mean age was 43.16 (12.66) years in Group I and 41.52 (9.54) years in Group II (P = 0.302). Female patients accounted for 58% and 68% of Groups I and II, respectively (P = 0.143). The prevalence of comorbid conditions was similar between the groups, including diabetes mellitus and hypertension (Table 1).

Table 1. Demographic and preoperative data (n = 200).

Variable	Group I (n = 100)	Group II (n = 100)	*P*-value
Age (years), mean (SD)	43.16 (12.66)	41.52 (9.54)	0.302
Range (years)	19-68	18-68	NA
Male sex, n (%)	42 (42%)	32 (32%)	0.143
Female sex, n (%)	58 (58%)	68 (68%)	0.143
Preoperative jaundice, n (%)	88 (88%)	86 (86%)	0.674
Total bilirubin (mg/dL), mean (SD)	2.80 (0.36)	2.75 (0.56)	0.820
Direct bilirubin (mg/dL), mean (SD)	2.33 (0.28)	2.24 (0.49)	0.641
Diabetes mellitus, n (%)	21 (21%)	12 (12%)	0.219
Hypertension, n (%)	9 (9%)	15 (15%)	0.345
No comorbidity, n (%)	62 (62%)	62 (62%)	1.000

SD: standard deviation, n: number, %: percent, NA: not applicable.

Preoperative assessment

Clinical jaundice was present in 88% and 86% of patients in Groups I and II, respectively (P = 0.674). Preoperative laboratory parameters were comparable, including total bilirubin [2.80 (0.36) mg/dL vs. 2.75 (0.56) mg/dL, P = 0.820] and direct bilirubin [2.33 (0.28) mg/dL vs. 2.24 (0.49) mg/dL, P = 0.641]. MRCP revealed a significantly larger mean CBD diameter in Group I than in Group II [13.18 (2.01) mm vs. 10.94 (2.46) mm, P <0.001]. Mean stone size was also larger in the single-stage group [6.29 (1.47) mm vs. 5.65 (1.69) mm, P = 0.005]. The number and anatomical distribution of stones were comparable between the groups (Table 2).

Table 2. MRCP findings.

Variable	Group I (n = 100)	Group II (n = 100)	*P*-value
CBD diameter (mm), mean (SD)	13.18 (2.01)	10.94 (2.46)	<0.001*
Range (mm)	10-23	8-17	NA
Single stone, n (%)	92 (92%)	90 (90%)	0.621
Multiple stones, n (%)	8 (8%)	10 (10%)	0.621
Stone size (mm), mean (SD)	6.29 (1.47)	5.65 (1.69)	0.005*
Proximal site, n (%)	18 (18%)	28 (28%)	0.178
Distal site, n (%)	74 (74%)	62 (62%)	0.178
Both sites, n (%)	8 (8%)	10 (10%)	0.178

MRCP: magnetic resonance cholangiopancreatography, CBD: common bile duct, SD: standard deviation, mm: millimeter, n: number, %: percent, NA: not applicable. *P <0.050 was considered statistically significant.

Intraoperative findings

Mean operative time did not differ significantly between the two strategies [138.3 (20.4) min in Group I vs. 140.85 (43.98) min in Group II, P = 0.600]. Intraoperative bleeding occurred in 4% of patients in Group I and 3% in Group II (P = 0.542). No biliary or duodenal injury was observed. Conversion to open surgery was required in three patients in each group (3% vs. 3%, P = 1.000) (Table 3).

Postoperative outcomes

Postoperative jaundice occurred in 4% of patients in Group I and 10% of patients in Group II (P = 0.096). Although total bilirubin levels decreased postoperatively in both groups, early postoperative direct bilirubin was statistically higher in Group I [1.01 (0.08) mg/dL vs. 0.83 (0.06) mg/dL, P = 0.030]; however, the absolute difference was clinically minimal. Wound infection occurred in 3% of patients in each group. Postoperative pancreatitis developed in two patients in Group I and three patients in Group II (P = 0.732). Minor bile leakage was observed in two patients (2%) in Group I, with no cases in Group II (P = 0.532). Retained CBD stones were detected in three patients (3%) in the single-stage group, whereas no retained stones were identified in the two-stage group (P = 0.246) (Table 3).

Hospital stay and patient-reported outcomes

Mean length of hospital stay was comparable between the groups [6.8 (2.08) days in Group I vs. 7.18 (2.28) days in Group II, P = 0.219]. At 24 h postoperatively, pain scores assessed using the VAS were significantly lower in Group I [5.34 (1.02) vs. 6.30 (1.02), P <0.001], whereas pain scores were similar between the groups on postoperative day 3 [1.42 (0.39) vs. 1.52 (0.56), P = 0.468]. Overall patient satisfaction was high and did not differ significantly between the two strategies (78% vs. 75%, P = 0.843). No in-hospital mortality was observed (Table 3).

Table 3. Operative and postoperative outcomes.

Variable	Group I (n = 100)	Group II (n = 100)	*P*-value
Operative time (min), mean (SD)	138.3 (20.4)	140.85 (43.98)	0.600
Range (min)	105-180	90-360	NA
Intraoperative bleeding, n (%)	4 (4%)	3 (3%)	0.542
Biliary injury, n (%)	0 (0%)	0 (0%)	NA
Conversion to open surgery, n (%)	3 (3%)	3 (3%)	1.000
Postoperative jaundice, n (%)	4 (4%)	10 (10%)	0.096
Postoperative total bilirubin (mg/dL), mean (SD)	1.39 (0.13)	1.23 (0.21)	0.063
Postoperative direct bilirubin (mg/dL), mean (SD)	1.01 (0.08)	0.83 (0.06)	0.030*
Wound infection, n (%)	3 (3%)	3 (3%)	1.000
Pancreatitis, n (%)	2 (2%)	3 (3%)	0.732
Bile leakage, n (%)	2 (2%)	0 (0%)	0.532
VAS at 24 h, mean (SD)	5.34 (1.02)	6.30 (1.02)	<0.001*
VAS on day 3, mean (SD)	1.42 (0.39)	1.52 (0.56)	0.468
Hospital stay (days), mean (SD)	6.8 (2.08)	7.18 (2.28)	0.219
Retained CBD stones, n (%)	3 (3%)	0 (0%)	0.246
Very satisfied, n (%)	78 (78%)	75 (75%)	0.843

Min: minutes, CBD: common bile duct, SD: standard deviation, VAS: visual analog scale, n: number, %: percent, NA: not applicable. *P <0.050 was considered statistically significant.

Exploratory analysis and resource utilization

After adjustment for baseline CBD diameter and stone size in an exploratory post-hoc analysis, no statistically significant differences were observed in clearance or conversion rates. Stone clearance was achieved in 97% of patients in Group I (95% CI, 93-99%) and 98% of patients in Group II (95% CI, 94-100%). The single-stage approach required one anesthesia session and fewer procedural exposures, reflecting its potential advantages in resource utilization. Follow-up beyond six months was unavailable for approximately 30% of patients, limiting the assessment of long-term recurrence and late complications.

Discussion

The management of concomitant gallbladder and CBD stones remains controversial. Single-stage LCBDE with cholecystectomy offers definitive treatment during a single hospital admission, whereas a two-stage strategy using preoperative ERCP followed by LC remains widely adopted because of endoscopic availability and procedural familiarity [2, 3, 19]. Randomized trials and meta-analyses have demonstrated comparable safety and ductal clearance between these approaches, while emphasizing distinct trade-offs, including post-ERCP pancreatitis, bile leakage after choledochotomy, and differences in resource utilization and hospital stay [1, 5-8]. This randomized trial contributes region-specific evidence from a tertiary university center and incorporates prospectively collected patient-centered outcomes.

Baseline biochemical parameters, including the presence of jaundice and serum bilirubin levels, were similar between the groups, consistent with previous randomized studies reporting comparable preintervention profiles [2-4, 11]. In contrast, preoperative MRCP revealed a significantly larger CBD diameter and slightly larger stone size in the single-stage group. These anatomical differences are clinically relevant because duct diameter and stone burden influence operative strategy, technical complexity, and the choice between transcystic and transcholedochal approaches. Prior observational studies and systematic reviews have identified these factors as key determinants of procedural difficulty and outcomes [7, 12, 14, 15].

Operative duration did not differ meaningfully between the two strategies in our cohort. This finding aligns with prior studies reporting comparable overall procedural times, as the longer operative component of a single-stage approach may be offset by eliminating a separate ERCP session, resulting in similar cumulative resource utilization [2, 3, 5-7]. Intraoperative complications and conversion rates were low and comparable between the groups, supporting the safety of both approaches when performed by experienced surgical and endoscopic teams [2, 4, 5, 11].

Postoperative complication rates were low in both arms, with no evident difference in pancreatitis or bile leakage. This is consistent with pooled evidence suggesting that ERCP carries a higher risk of pancreatitis, whereas choledochotomy-based approaches may increase the risk of bile leakage, with absolute risks strongly influenced by technique and operator experience [7, 8]. Although early postoperative direct bilirubin levels were modestly higher in the single-stage group, the absolute difference was small and of limited clinical relevance, likely reflecting

transient ductal edema or manipulation, as bilirubin levels declined in both groups.

Early postoperative pain scores favored the single-stage approach at 24 h, with convergence by postoperative day 3. This observation supports the hypothesis that avoiding a second invasive procedure may reduce early postoperative discomfort. Patient satisfaction was high and comparable between groups, indicating that overall procedural success and convenience were likely important drivers of patient-reported outcomes [3, 5, 6]. Retained CBD stones were infrequent, occurring in a small proportion of patients in the single-stage group and in none of the patients in the two-stage group. Previous meta-analyses have reported slightly higher immediate clearance rates with ERCP in some settings, particularly where routine choledochoscopy is unavailable; however, centers with established LCBDE expertise often achieve comparable clearance rates [1, 7-9].

Although a formal cost-effectiveness analysis was beyond the scope of this study, the single-stage approach consolidated management into a single anesthesia exposure and hospital admission, suggesting potential advantages in resource utilization. Health-economic evaluations in different healthcare systems have reported reduced cumulative costs with single-session strategies, although these findings vary depending on local infrastructure, reimbursement models, and the availability of expertise [16, 19, 20].

Despite randomized allocation, baseline imbalances in CBD diameter and stone size were observed between the groups. This may reflect chance variation or subtle referral and triage factors and represents a potential source of residual confounding, particularly regarding technical difficulty and the risk of retained stones. Although overall outcomes remained comparable, these imbalances should be considered when interpreting the results. Future multicenter trials incorporating stratified randomization by duct diameter and stone burden, as well as multivariable adjustment, are warranted to further validate these findings.

Limitations

As a single-center randomized trial, this study has several limitations. The relatively small number of uncommon complications limited the statistical power to detect small differences in effect. In addition, prespecified multivariable adjustment for baseline imbalances was not performed; therefore, residual confounding, particularly due to the larger CBD diameter in Group I, cannot be completely excluded. Finally, the lack of long-term follow-up and the absence of a formal cost-effectiveness analysis restricted the evaluation of late recurrence and economic outcomes.

Future directions

Future research should focus on multicenter randomized trials with stratified randomization according to CBD diameter and stone size, combined with standardized intraoperative clearance protocols. Incorporating formal health-economic evaluations and extended follow-up would allow a more robust assessment of recurrence rates and overall cost-effectiveness. Comparative evaluation of transcystic versus transcholedochal LCBDE and laparoscopic-endoscopic rendezvous approaches may further refine procedural selection. Integrating such evidence into regional surgical pathways could optimize care delivery and resource utilization.

Conclusion

Single-stage LCBDE + LC and two-stage ERCP + LC demonstrated comparable short-term safety and efficacy. The single-stage approach reduced early postoperative pain and avoided the need for a second procedure in many cases. The optimal management approach should consider patient anatomy, available surgical and endoscopic expertise, and patient preferences regarding single-session versus staged care. Broader multicenter trials, including economic evaluations, are needed to refine evidence-based decision-making.

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Quality and reliability of YouTube videos on cardiac rehabilitation exercises

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Ethics Committee Approval
Ethical approval was not required because this study used only publicly available, anonymous YouTube data and did not involve human participants, patient records, personal identifiers, or any intervention. All procedures complied with user privacy principles and the YouTube Terms of Service.

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No conflict of interest was declared by the authors.

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Abstract

Background/Aim: YouTube is widely used by patients and caregivers seeking exercise-related health information; however, the scientific accuracy and clinical reliability of this content remain uncertain. This study aimed to evaluate the quality and reliability of YouTube videos on cardiac rehabilitation exercises for individuals with chronic heart disease.
Methods: A total of 124 YouTube videos were initially screened, and 67 videos that met the inclusion criteria were analyzed. Video characteristics, including duration, time since upload, views, likes, dislikes, comments, and upload source, were recorded. Each video was assessed using the Journal of the American Medical Association benchmark criteria, the Global Quality Scale, and the DISCERN score.
Results: The analyzed videos had a mean (SD) view count of 26,720.92 (68,307.01), comment count of 2.79 (7.68), like count of 149.74 (529.59), and dislike count of 0 (0). The total number of views was significantly correlated with the Global Quality Scale score (r = -0.368; *P* = 0.002) and the DISCERN score (r = -0.279; *P* = 0.022). Likes, time since upload, video power index, and video duration were not significantly correlated with overall DISCERN, Global Quality Scale, or Journal of the American Medical Association scores (*P* = 0.071-0.921).
Conclusion: YouTube videos on cardiac rehabilitation exercises demonstrated generally good quality but only moderate reliability. Nevertheless, these findings do not mean that all videos are clinically appropriate for every patient. Individuals should consult a physician or physiotherapist before performing exercises demonstrated in online videos.

Keywords: cardiac rehabilitation, exercise videos, YouTube, digital health, quality and reliability

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Introduction

Cardiac exercise plays a central role in the secondary prevention of cardiovascular events and in the reduction of modifiable risk factors. Cardiac rehabilitation (CR), a multidisciplinary intervention targeting these risks in patients with chronic heart disease, has been shown to reduce mortality and hospitalization rates [1].

Despite its clinical benefits, participation in center-based CR programs remains limited. Common barriers include transportation difficulties, restricted access to facilities, lack of motivation, and inadequate social support. In response to these challenges, recent evidence supports the effectiveness and feasibility of home-based CR as an alternative to traditional center-based programs [2].

In parallel with the widespread use of smartphones, internet-based health information seeking has also increased. Patients frequently consult online resources to learn about their conditions and available treatment options [3]. According to YouTube statistics from 2022, daily views of exercise videos containing terms such as “no-equipment” or “at-home” increased nearly fourfold after the onset of the COVID-19 pandemic [4].

Previous studies have evaluated the quality and reliability of YouTube videos across various health domains, including chronic disease education [5], surgical interventions [6], invasive procedures [7], and musculoskeletal disorders and related therapeutic exercises [8]. Although online platforms are increasingly used for patient education, video content is not subject to peer review or standardized quality control. Consequently, the accuracy, reliability, and scientific validity of health-related videos often remain uncertain [6, 9].

Although YouTube enforces strict copyright policies, it does not apply the same level of scrutiny or quality control to the medical content uploaded to its platform. Given the growing problem of online health misinformation, evaluating the reliability of disease-specific information on widely used platforms is essential [6]. To date, no study has examined the quality and reliability of YouTube exercise videos specifically targeting patients with chronic heart disease. Therefore, the present study aimed to assess the quality and reliability of cardiac rehabilitation exercise videos available on YouTube.

Materials and methods

This study was designed as an observational, cross-sectional content analysis. During January and February 2024, video content available on YouTube (www.youtube.com) was searched using the keywords “cardiac rehabilitation”, “exercises for cardiac patients”, “exercise for heart disease”, and “cardiac physical therapy”. A total of 124 videos were identified through these searches. Two physiotherapists, one academician (reviewer 1, R1) and one clinician (reviewer 2, R2), each with 10 years of professional experience, independently evaluated the videos. The mean scores of the two independent raters were used in the analysis. Because the aim of the study was not to measure inter-rater agreement, inter-rater reliability statistics, such as the intraclass correlation coefficient or kappa, were not calculated.

The inclusion criteria were as follows: the video had to be posted on YouTube, presented in English, and appear on the search page using the predefined keywords. Videos were excluded if they were not in English, lasted longer than 60 minutes or shorter than 1 minute, had no sound, contained irrelevant content, consisted solely of music, or included advertising material. After all videos were watched in full, the 67 most-viewed videos that met the inclusion criteria were selected for final analysis.

For each of the 67 videos, the following characteristics were recorded: total number of views, comments, likes, dislikes, days since upload, video power index (VPI), and duration in minutes. This methodological approach has been used in similar studies [10-12]. To assess video popularity, VPI was calculated. First, the like ratio (likes × 100 / [likes + dislikes]) and view ratio (number of views / days) were determined. The VPI was then calculated using the following formula: like ratio × view ratio / 100 [9, 13]. Videos were further assessed according to the Journal of the American Medical Association (JAMA) benchmark criteria, the Global Quality Scale (GQS), and the DISCERN score.

Video reliability

Reliability was evaluated using the JAMA benchmark criteria, which assess content across four domains: authorship, attribution, disclosure, and currency. Each criterion present is awarded 1 point, producing a total score from 0 to 4. A score of 1 indicates insufficient information about the video source, scores of 2-3 indicate partially sufficient information, and a score of 4 indicates completely sufficient information [14-16].

Video quality

Video quality was evaluated using the GQS and DISCERN scales. The GQS assesses online content using five items and produces scores from 1 to 5. Videos scoring 1-2 are classified as low quality, a score of 3 indicates moderate quality, and scores of 4-5 indicate high quality [17, 18]. The DISCERN tool includes three sections and 16 items: eight items assessing information reliability, seven items assessing treatment information, and one item assessing overall information quality. Scores range from a minimum of 16 to a maximum of 80 points [19].

This study was conducted using publicly available and anonymous YouTube data. No personal information was collected, and all procedures adhered to user privacy and the YouTube Terms of Service. Therefore, ethics committee approval was not required [12, 18, 20-23].

Statistical analysis

All data were analyzed using SPSS software (version 21; IBM Corp., Armonk, NY, USA). Normality was assessed using the Kolmogorov-Smirnov test. Descriptive statistics were presented as mean (SD), median, minimum, maximum, and percentage values. Because the data were not normally distributed, Mann-Whitney U and Kruskal-Wallis tests were used for intergroup comparisons. Spearman correlation analysis was used to evaluate relationships between parameters. $P < 0.05$ was considered statistically significant.

Results

The analyzed videos had a mean (SD) of 26,720.92 (68,307.01) views, 2.79 (7.68) comments, and 149.74 (529.59) likes, with no dislikes. Videos had been uploaded for a mean (SD) of 1,218.26 (431.74) days. The mean (SD) VPI was 11.79 (39.28), and the mean (SD) video duration was 26.84 (14.94) minutes. In

the quality assessments, the mean (SD) DISCERN score was 52.13 (5.48) (R1: 51.28 [6.26]; R2: 52.98 [6.86]), the mean (SD) GQS score was 3.64 (0.68) (R1: 3.73 [1.16]; R2: 3.55 [0.68]), and the mean (SD) JAMA score was 2.21 (0.47) (R1: 2.20 [0.50]; R2: 2.22 [0.57]) (Table 1).

Analysis of content creators showed that most videos were produced by personal trainers (52.2%), followed by exercise physiologists (26.9%), physiotherapists (13.4%), and physicians (7.5%). GQS scores were predominantly high (52.2%) (Table 2).

Table 1. Descriptive characteristics of videos

	Mean	SD	Median	Minimum	Maximum
Total number of views	26,720.92	68,307.01	1,271	110	388,000
Total number of comments	2.79	7.68	0	0	44
Number of likes	149.74	529.59	6	0	3,500
Number of dislikes	0	0	0	0	0
Time since upload (day)	1,218.26	431.74	1,257	240	2,920
VPI	11.79	39.28	0.64	0	278.65
Video duration (minute)	26.84	14.94	22.29	4.48	58
Overall DISCERN score	52.13	5.48	53	32	62
R1 DISCERN score	51.28	6.26	53	27	62
R2 DISCERN score	52.98	6.86	53	35	70
Overall GQS score	3.64	0.68	4	2	5
R1 GQS score	3.73	1.16	4	1	5
R2 GQS score	3.55	0.68	4	2	5
Overall JAMA score	2.21	0.47	2	1	4
R1 JAMA score	2.20	0.50	2	1	4
R2 JAMA score	2.22	0.57	2	2	4

VPI: video power index, R1: reviewer 1, R2: reviewer 2, GQS: Global Quality Scale, JAMA: Journal of the American Medical Association.

Table 2. Evaluation of content creators

Variable	Category	n = 67	%
Content creator	Physician	5	7.5
Content creator	Exercise physiologist	18	26.9
Content creator	Physiotherapist	9	13.4
Content creator	Personal trainer	35	52.2
GQS score	Low	9	13.4
GQS score	Moderate	23	34.3
GQS score	High	35	52.2

GQS: Global Quality Scale, n: number of videos, %: percentage.

Physiotherapists' videos had the highest number of views and likes, with 79,250 (15,991.18) views and 696.66 (1,331.13) likes, followed by exercise physiologists and other creator groups. Physicians' videos had been on the platform the longest, with 1,455 (753.88) days since upload, whereas exercise physiologists were the newest contributors, with 1,025.55 (291.26) days since upload. VPI was highest for physiotherapists (48.12 [96.56]) and lowest for exercise physiologists (3.38 [10.87]). Video duration was longest for personal trainers (32.01 [16.17] minutes) and shortest for physicians (16.95 [18.52] minutes). DISCERN and GQS scores were highest for physiotherapists, whereas JAMA scores were highest for physicians, with minor differences between reviewers (Table 3).

Table 4 shows video characteristics according to GQS-based video quality. Low-quality videos had the highest mean number of views (88,471.11 [65,511.83]), whereas high-quality videos had the highest mean number of likes (198.57 [713.81]). The DISCERN score was also highest among high-quality videos (overall: 54.68 [2.64]; R1: 54.34 [2.48]; R2: 55.02 [4.28]). JAMA scores were higher among moderate-quality videos. The oldest content consisted of high-quality videos (1,336.62 [372.80] days), whereas the newest content belonged to moderate-quality videos. Video duration was longest for low-quality videos and shortest for moderate-quality videos.

Table 3. Video characteristics according to content creators

	Physician	Exercise physiologist	Physiotherapist	Personal trainer
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
Total number of views	29,089.4 (32,482.81)	1,395.05 (3,188.53)	79,250 (15,991.18)	25,899.83 (48,468.19)
Number of likes	275.8 (273.10)	21.27 (59.67)	696.66 (1,331.13)	57.17 (133.75)
Time since upload (day)	1,455 (753.88)	1,025.55 (291.26)	1,248 (728.08)	1,275.91 (310.29)
VPI	23.28 (25.07)	3.38 (10.87)	48.12 (96.56)	5.14 (14.73)
Video duration (minute)	16.95 (18.52)	22.83 (9.06)	20.26 (11.06)	32.01 (16.17)
Mean DISCERN score	50.4 (6.97)	52.86 (4.77)	55.55 (3.52)	51.12 (5.78)
R1 DISCERN score	42.80 (9.62)	52.66 (3.94)	55 (3.52)	50.6 (6.04)
R2 DISCERN score	58 (10.22)	53.05 (5.96)	55.22 (6.11)	51.65 (6.75)
Overall GQS score	2.90 (0.54)	3.91 (0.46)	4.05 (0.39)	3.5 (0.73)
R1 GQS score	1.80 (0.83)	4.22 (0.54)	4.22 (1.09)	3.62 (1.16)
R2 GQS score	4 (1)	3.61 (0.60)	3.88 (0.60)	3.37 (0.64)
Overall JAMA score	2.50 (1)	2.13 (0.41)	2.27 (0.44)	2.2 (0.40)
R1 JAMA score	2.2 (1.09)	2.11 (0.32)	2.22 (0.44)	2.25 (0.50)
R2 JAMA score	2.80 (1.09)	2.16 (0.51)	2.33 (0.70)	2.14 (0.42)

VPI: video power index, R1: reviewer 1, R2: reviewer 2, GQS: Global Quality Scale, JAMA: Journal of the American Medical Association, SD: standard deviation.

Table 4. Video characteristics according to video quality

	Low quality	Moderate quality	High quality
	Mean (SD)	**Mean (SD)**	**Mean (SD)**
Total number of views	88,471.11 (65,511.83)	7,200.82 (11,871.44)	23,669.80 (81,728.33)
Number of likes	89 (221.46)	99.21 (167.76)	198.57 (713.81)
Time since upload (day)	1,231.33 (73.25)	1,033.04 (533.14)	1336.62 (372.80)
VPI	8.04 (20.02)	10.71 (20.06)	13.47 (51.31)
Video duration (minute)	38.11 (20.55)	19.27 (10.40)	28.92 (13.68)
Overall DISCERN score	42.88 (4.87)	51.86 (5.04)	54.68 (2.64)
R1 DISCERN score	40.33 (6.85)	50.91 (5.18)	54.34 (2.48)
R2 DISCERN score	45.44 (6.54)	52.82 (8.20)	55.02 (4.28)
Overall GQS score	2.38 (0.22)	3.30 (0.24)	4.18 (0.24)
R1 GQS score	1.88 (0.60)	3.21 (0.85)	4.54 (0.56)
R2 GQS score	2.88 (0.33)	3.39 (0.83)	3.82 (0.45)
Overall JAMA score	1.88 (0.22)	2.39 (0.58)	2.18 (0.38)
R1 JAMA score	1.77 (0.44)	2.34 (0.57)	2.22 (0.42)
R2 JAMA score	2 (0)	2.43 (0.78)	2.14 (0.42)

VPI: video power index, R1: reviewer 1, R2: reviewer 2, GQS: Global Quality Scale, JAMA: Journal of the American Medical Association, SD: standard deviation.

Significant differences by video quality were observed for total views (P = 0.008), time since upload (P = 0.030), video duration (P = 0.002), overall DISCERN score (P < 0.001), R1 DISCERN score (P < 0.001), R2 DISCERN score (P < 0.001), overall GQS score (P < 0.001), R1 GQS score (P < 0.001), R2 GQS score (P < 0.001), overall JAMA score (P = 0.019), and R1 JAMA score (P = 0.014). Significant differences by content creator were observed for total views (P = 0.046), likes (P = 0.005), VPI (P = 0.016), video duration (P = 0.021), R1 DISCERN score (P = 0.001), overall GQS score (P = 0.002), and R1 GQS score (P < 0.001). Intergroup comparisons of video characteristics by video quality and content creator are presented in Table 5.

The total number of views had a statistically significant negative correlation with the overall DISCERN score (r = -0.279; P = 0.022) and the overall GQS score (r = -0.368; P = 0.002). The number of likes, time since upload, VPI, and video duration were

not significantly correlated with overall DISCERN, GQS, or JAMA scores (P = 0.071-0.921) (Table 6).

Table 5. Intergroup comparison of video characteristics by video quality and content creators

	Video quality (low = 1, moderate = 2, high = 3)			Content creator (physicians = 1, exercise physiologists = 2, physiotherapists = 3, personal trainers = 4)		
	H	***P***	**Group(s) with difference**	**H**	***P***	**Group(s) with difference**
Total number of views	5.251	0.008	1, 2; 1, 3	2.818	0.046	2, 3
Number of likes	0.306	0.737	-	4.672	0.005	2, 3; 3, 4
Time since upload	3.719	0.030	2, 3	2.006	0.122	-
VPI	0.079	0.924	-	3.730	0.016	2, 3; 3, 4
Video duration (minute)	6.896	0.002	1, 2; 2, 3	3.491	0.021	2, 3
Overall DISCERN score	32.347	<0.001	1, 2; 1, 3; 2, 3	1.906	0.138	-
R1 DISCERN score	38.309	<0.001	1, 2; 1, 3; 2, 3	6.360	0.001	1, 2; 1, 3; 1, 4
R2 DISCERN score	8.606	<0.001	1, 2; 1, 3	1.699	0.176	-
Overall GQS score	228.146	<0.001	1, 2; 1, 3; 2, 3	5.437	0.002	1, 2; 1, 3
R1 GQS score	64.761	<0.001	1, 2; 1, 3; 2, 3	8.423	<0.001	1, 2; 1, 3; 1, 4
R2 GQS score	9.911	<0.001	1, 2; 1, 3; 2, 3	2.480	0.069	-
Overall JAMA score	4.219	0.019	1, 2; 2, 3	0.827	0.484	-
R1 JAMA score	4.561	0.014	1, 2; 2, 3	0.319	0.812	-
R2 JAMA score	2.735	0.073	-	2.205	0.096	-

VPI: video power index, R1: reviewer 1, R2: reviewer 2, GQS: Global Quality Scale, JAMA: Journal of the American Medical Association. $P < 0.05$ was considered statistically significant.

Table 6. Correlations between video characteristics and overall mean quality and reliability scores

Variable	Coefficient	DISCERN score	GQS score	JAMA score
Total number of views	r	-0.279*	-0.368**	0.222
Total number of views	*P*	0.022	0.002	0.071
Number of likes	r	0.108	-0.026	0.178
Number of likes	*P*	0.384	0.834	0.148
Time since upload	r	0.157	0.176	-0.172
Time since upload	*P*	0.203	0.155	0.163
VPI	r	0.105	-0.012	0.186
VPI	*P*	0.399	0.921	0.132
Video duration	r	0.077	0.142	-0.123
Video duration	*P*	0.537	0.253	0.322

VPI: video power index, GQS: Global Quality Scale, JAMA: Journal of the American Medical Association, r: correlation coefficient. *$P < 0.05$, **$P < 0.01$.

Discussion

The findings of this study indicate that YouTube videos on cardiac rehabilitation exercises show considerable variation in source reliability and content quality. The internet has become a major source of health information, particularly for chronic diseases, underscoring the growing importance of e-health literacy [24]. YouTube, one of the most widely used video-sharing platforms worldwide, hosts many videos addressing the etiopathogenesis, prevention, diagnosis, and treatment of various diseases. Although YouTube provides free access to video content, it lacks a standardized mechanism for monitoring the quality, accuracy, and reliability of the medical information presented.

Keelan et al. [25] published the first study evaluating YouTube videos in 2007, focusing on vaccination-related content. Since then, numerous studies have examined the quality of YouTube videos on different diseases [26].

The number of views is widely accepted as a key indicator of video popularity. Users can also engage with content by liking or disliking videos and leaving comments. Previous orthopedic studies reported mean view counts of 50,477.9 for posterior cruciate ligament videos, 30,131.6 for kyphosis videos, 71,152 for scoliosis videos, and 150,977.4 for carpal tunnel syndrome videos [27-30]. These findings highlight the broad popularity of YouTube content. In line with this pattern, cardiac rehabilitation exercise videos attracted substantial interest, suggesting wide reach and visibility. However, inflated view counts and likes may sometimes reflect purchased engagement rather than genuine user interaction.

Our analysis showed that high-quality videos were primarily uploaded by health-related professionals, particularly physiotherapists and exercise physiologists. Similarly, other studies have reported that high-quality videos often originate from professional or academic sources, whereas low-quality videos are frequently produced by advertisers, non-profit organizations, or independent users [20, 31, 32]. These findings emphasize the importance of evaluating video sources when using YouTube for health information. Healthcare professionals and institutions should be encouraged to create accurate, unbiased, and educational content. Patients should also be educated about the relevance of upload source when seeking health-related information online.

In a study of YouTube videos related to ankylosing spondylitis exercises, 48.2% of videos were rated as high quality, 17.9% as moderate quality, and 33.9% as low quality, with DISCERN scores showing significant associations with dislike counts. The authors concluded that YouTube is an important platform for accessing high-quality exercise-related videos [23]. In contrast, an analysis of fibromyalgia exercise videos reported that most patient-directed content was low quality (66.7%) or moderate quality (27.0%), whereas videos directed at healthcare professionals were generally of higher quality [33]. This pattern supports the view that reliable health information is more often produced by academic or professional sources. To further improve content quality, video providers should include references and clear source information, allowing patients to access more comprehensive and trustworthy health resources.

In the present study, total view count was negatively correlated with DISCERN and GQS scores. This finding suggests that popularity alone should not be interpreted as a marker of quality or reliability. Therefore, patients and clinicians should approach highly viewed health-related videos cautiously and evaluate whether the content source, references, and clinical messages are appropriate [34].

This study has several limitations. First, video quality was assessed using the GQS and DISCERN tools, which include subjective components. Second, videos were analyzed at a single time point, although YouTube is a dynamic platform where content changes continuously. Third, only English-language videos were included. Fourth, search results may have been influenced by geographic location and previous search history. Fifth, inter-rater agreement was not statistically assessed, which should be considered when interpreting the results. The YouTube

searches were conducted using a standard account without controlling for search personalization factors such as browser history, location settings, or algorithm-based recommendations. As a result, search results may vary across users and time points, which may limit the reproducibility of the study.

In conclusion, YouTube videos on cardiac rehabilitation exercises demonstrated moderate reliability and good overall quality, with substantial user engagement. However, view counts and likes should not be assumed to indicate clinical reliability. To improve e-health literacy, public education initiatives and reliable online resources should be developed by healthcare institutions. Regulatory authorities should also evaluate whether online content, particularly on platforms such as YouTube, is accurate, beneficial, and free from misleading information. Stronger strategies and policies are needed to filter erroneous content and ensure that patients have access to safe and scientifically sound health information.

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Hyperbilirubinemia and elevated C-reactive protein as predictive markers for appendiceal perforation in acute appendicitis: A prospective observational study

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Ethics Committee Approval
Ethical approval was obtained from the Institutional Academic Ethics Committee (approval number: ECR/531/Inst/MH/2014/RR-19; date: June 12, 2023). Informed consent was obtained from all participants.
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
No conflict of interest was declared by the authors.

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Abstract

Background/Aim: Appendiceal perforation is a serious complication of acute appendicitis and contributes substantially to postoperative morbidity and prolonged hospital stay. Although imaging supports diagnosis, access may be limited in resource-constrained settings. This study evaluated the diagnostic utility of hyperbilirubinemia and elevated C-reactive protein (CRP) as cost-effective and readily available biomarkers for predicting appendiceal perforation.

Methods: This prospective observational study was conducted at Fortis Hospital, Mulund, Mumbai, from July 2023 to December 2024. Fifty adult patients with acute appendicitis who provided informed consent and underwent surgical management were included. Patients with liver disease, hepatobiliary malignancy, chronic alcoholism, hemolytic anemia, pregnancy, conservative treatment, or medications causing cholestasis were excluded. Preoperative serum bilirubin and CRP levels were measured and correlated with intraoperative and histopathological findings.

Results: The mean age of the 50 enrolled patients was 31.94 (14.12) years, 30 (60%) were male, and 15 (30%) had perforated appendicitis. The mean serum bilirubin level was 1.42 (0.19) mg/dL in the perforation group and 1.06 (0.21) mg/dL in the non-perforation group ($P < 0.001$). The mean CRP level was significantly higher in the perforation group than in the non-perforation group [243.3 (45.9) mg/L vs. 135.8 (51.3) mg/L; $P < 0.001$]. Receiver operating characteristic curve analysis showed strong diagnostic performance, with an area under the curve of 0.90 for bilirubin and 0.92 for CRP.

Conclusion: Elevated serum bilirubin and CRP levels are reliable non-invasive markers for predicting perforated appendicitis and may be particularly valuable in settings where advanced imaging is unavailable.

Keywords: appendicitis, appendiceal perforation, hyperbilirubinemia, C-reactive protein, predictive biomarkers, general surgery

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Introduction

Acute appendicitis is a leading cause of emergency abdominal surgery. With a lifetime risk of approximately 7-10% [1], the disease imposes a substantial healthcare burden. Timely diagnosis and surgical intervention are essential to prevent complications such as gangrene, perforation, and intra-abdominal abscess, which increase morbidity, length of hospital stay, and healthcare costs [2]. Despite advances in diagnostic imaging, perforation may still occur, particularly in patients with atypical symptoms or delayed diagnosis. Papandria et al. [3] reported that the risk of perforation increased with delayed recognition and surgery. Therefore, reliable biochemical markers that can help stratify patients at high risk of complicated appendicitis remain clinically important.

C-reactive protein (CRP) is an acute-phase reactant produced mainly by the liver in response to inflammatory cytokine stimulation, and its level rises rapidly during bacterial and surgical infections [4]. Hyperbilirubinemia may also occur in severe appendiceal inflammation, particularly in the absence of hepatobiliary disease, because bacterial endotoxemia and inflammatory cholestasis can impair bile transport. Previous studies have evaluated the predictive value of bilirubin and CRP in acute appendicitis [5-9]. However, prospective data assessing the combined clinical utility of these markers in an Indian adult population remain limited. This study aimed to evaluate the diagnostic potential of hyperbilirubinemia and elevated CRP levels for predicting appendiceal perforation.

Materials and methods

Study design

This prospective observational study was conducted in the Department of General Surgery at Fortis Hospital, Mulund, Mumbai, and was prepared in accordance with the STROBE reporting principles. The study period was from July 2023 to December 2024. The participants comprised a convenience sample of 50 adult patients presenting with clinical signs of acute appendicitis and undergoing surgical management. Informed consent was obtained from all participants.

Diagnosis was supported by clinical examination and radiological imaging, including ultrasonography or computed tomography when clinically indicated. Intraoperative findings and histopathology reports confirmed the diagnosis. The inclusion criteria were age older than 18 years and acute appendicitis confirmed by intraoperative and histological evaluation. The exclusion criteria were liver dysfunction or hepatobiliary malignancy, chronic alcohol use or hemolytic anemia, pregnancy, conservative management of appendicitis, and use of medications associated with cholestasis.

Data collection and variables

Clinical symptoms, demographic data, laboratory values, including total serum bilirubin and CRP levels, and imaging findings were recorded. Blood samples were collected on admission and processed in the hospital laboratory. CRP was measured using immunoturbidimetry, and bilirubin was estimated using the diazo method. The primary outcome was the association of serum bilirubin and CRP levels with appendiceal perforation in acute appendicitis. The secondary outcome was the diagnostic accuracy of these markers.

Statistical analysis

Continuous data were expressed as mean (standard deviation) and compared using the unpaired t-test. Categorical data were expressed as numbers and percentages and compared using the chi-squared test or Fisher's exact test, as appropriate. Receiver operating characteristic (ROC) curves were plotted to assess diagnostic accuracy. A *P*-value less than 0.05 was considered statistically significant. Data were analyzed using GraphPad InStat v3.0.

Results

Demographics and clinical presentation

The mean age of the 50 patients was 31.94 (14.12) years. Most patients were in the 18-30-year age group, and 30 (60%) were male. Abdominal pain was the most common symptom and was present in all patients, followed by vomiting in 14 (28%), nausea in 10 (20%), fever in 8 (16%), and less frequent symptoms such as anorexia, bloating, and loose stools. On clinical examination, right lower-quadrant tenderness was the most consistent finding, whereas guarding and rebound tenderness were observed in a smaller proportion of patients.

Perforated appendicitis was observed in 15 (30%) patients based on intraoperative and histopathological findings. The remaining 35 (70%) patients had non-perforated appendicitis. Patients with appendiceal perforation had higher serum bilirubin and CRP levels than patients without perforation. Biomarker levels are summarized in Table 1. The mean serum bilirubin level was 1.42 (0.19) mg/dL in the perforation group and 1.06 (0.21) mg/dL in the non-perforation group ($P < 0.001$). The mean CRP level was 243.3 (45.9) mg/L in the perforation group and 135.8 (51.3) mg/L in the non-perforation group ($P < 0.001$).

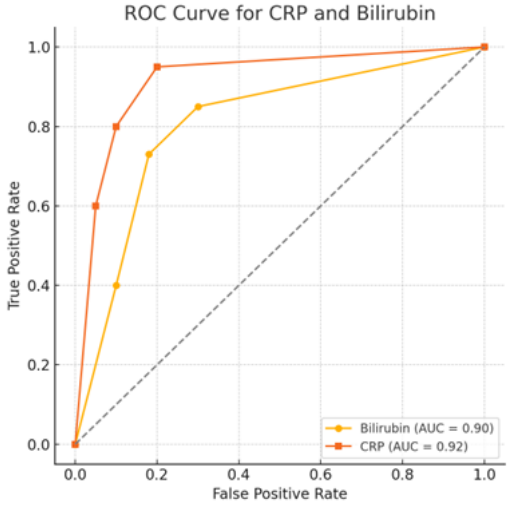
On ROC curve analysis, serum bilirubin showed an area under the curve (AUC) of 0.90. A cutoff value of 1.25 mg/dL yielded a sensitivity of 73.3% and a specificity of 82.4%. CRP showed an AUC of 0.92, and a cutoff value of 223 mg/L yielded a sensitivity of 80.0% and a specificity of 100.0% (Figure 1).

Table 1. Serum biomarker levels

Parameter	Perforated appendicitis	Non-perforated appendicitis	*P*-value
Mean serum bilirubin (mg/dL)	1.42 (0.19)	1.06 (0.21)	<0.001
Mean CRP (mg/L)	243.3 (45.9)	135.8 (51.3)	<0.001

CRP: C-reactive protein. $P < 0.05$ was considered statistically significant.

Figure 1: ROC curve for CRP and bilirubin



Discussion

The findings of this prospective observational study support the hypothesis that elevated serum bilirubin and CRP levels are significantly associated with appendiceal perforation in patients with acute appendicitis. This distinction is clinically important because perforated appendicitis increases the risk of sepsis, prolongs recovery, and may lead to complications such as intra-abdominal abscess and bowel obstruction [2]. In the present cohort, both biomarkers were higher in patients with perforated appendicitis than in those with non-perforated disease, and both showed strong diagnostic performance on ROC analysis.

The biological plausibility of hyperbilirubinemia in complicated appendicitis has been attributed to inflammatory and endotoxin-mediated impairment of hepatocellular bile transport in the absence of primary hepatobiliary disease [6-8]. Our findings are consistent with those of Pinate et al. [5], Nomura et al. [6], Akai et al. [7], and Eren et al. [8], who reported associations between elevated bilirubin, increased CRP, and complicated or severe appendicitis. The observed AUC values for bilirubin and CRP also align with prior diagnostic evidence suggesting that these markers can support clinical risk stratification, although they should not replace clinical judgment or imaging when imaging is available [9].

The practical value of serum bilirubin and CRP lies in their availability, low cost, and rapid measurement. In resource-limited settings where computed tomography may not be readily accessible, these markers may help identify patients who require closer observation, expedited imaging, or early operative prioritization. Their interpretation should nevertheless remain contextual and integrated with symptoms, physical examination, and radiological findings when available.

This study has limitations. It was a single-center study with a relatively small sample size, which may limit generalizability. The study did not evaluate other inflammatory markers, such as procalcitonin, neutrophil-to-lymphocyte ratio, or scoring systems, and no long-term follow-up of postoperative complications was performed. Future multicenter studies with larger samples should validate these findings and assess whether combinations of biochemical markers and clinical scoring systems can improve diagnostic accuracy for complicated appendicitis.

Conclusion

Serum bilirubin and CRP are significant predictors of appendiceal perforation in patients with acute appendicitis. Elevated levels of these markers should raise clinical suspicion and may support timely surgical decision-making. Their ease of measurement, availability, and low cost make them particularly valuable in rural or under-resourced healthcare settings.

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The effects of nutrition on type 2 diabetes risk and management: A systematic review of studies published between 2015 and 2025

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Ethics Committee Approval
Ethics committee approval was not required because this review did not involve human participants, animal experiments, patient-level data, or identifiable personal information. Informed consent was not applicable.

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No conflict of interest was declared by the authors.

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Abstract

Background/Aim: Type 2 diabetes is a major global metabolic disorder, and nutritional exposure is central to both prevention and long-term glycemic management. This systematic review evaluated the effects of dietary patterns, macronutrient composition, fiber intake, protein source, and lifestyle-based nutritional interventions on type 2 diabetes risk and management.

Methods: A literature search was performed in Google Scholar, Web of Science, PubMed, Scopus, and the Cochrane Library on August 27, 2025. The search used combinations of type 2 diabetes, nutrition, diet, dietary patterns, glycemic control, prevention, and management. English-language studies published between 2015 and 2025 were screened. Randomized trials, cohort studies, systematic reviews, and meta-analyses were considered eligible. Studies not directly related to type 2 diabetes or nutrition were excluded. Eligible evidence was synthesized narratively.

Results: A total of 1,200 records were initially identified, and 40 studies were included after screening and eligibility assessment. Mediterranean, plant-based, and fiber-rich dietary patterns were consistently associated with improved glycemic control, lower cardiometabolic risk, and reduced type 2 diabetes risk. Low-carbohydrate diets showed short-term benefits for hemoglobin A1c and body weight, although long-term sustainability and safety remained uncertain. Protein quality, particularly the balance between plant and animal protein sources, also appeared relevant to insulin resistance and metabolic outcomes. Lifestyle-based and digital interventions enhanced adherence but showed variable durability.

Conclusion: Nutrition is a cornerstone of type 2 diabetes prevention and management. Current evidence favors individualized, sustainable dietary strategies emphasizing overall diet quality, fiber-rich foods, plant-forward patterns, and integration with behavioral support rather than reliance on a single universal diet model.

Keywords: type 2 diabetes, nutrition, dietary patterns, glycemic control, prevention

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Introduction

Type 2 diabetes (T2D) is one of the most important metabolic and public health challenges worldwide. Recent global estimates show that the total diabetes burden has increased substantially, and projections indicate that the number of people living with diabetes will continue to rise over the coming decades, with T2D accounting for most cases [1, 2]. This increasing burden is driven by population aging, urbanization, excess adiposity, sedentary behavior, and dietary patterns characterized by high energy density and low nutritional quality [3, 4].

Nutrition has a direct role in glucose homeostasis, insulin sensitivity, body weight regulation, lipid metabolism, and systemic inflammation. Dietary approaches such as Mediterranean, plant-based, high-fiber, low-glycemic-index, and carbohydrate-modified diets have been investigated for both prevention and management of T2D [5-8]. However, the comparative interpretation of these approaches remains difficult because studies differ in design, intervention intensity, follow-up duration, baseline metabolic risk, and adherence support.

Beyond individual macronutrients, contemporary diabetes nutrition science increasingly emphasizes dietary patterns, food quality, behavioral adherence, cultural suitability, and long-term sustainability. Therefore, a broad synthesis of current evidence is useful for clinicians, dietitians, and researchers. This systematic review aimed to summarize evidence published between 2015 and 2025 regarding the effects of nutrition on T2D risk and management.

Materials and methods

Study design

This review was designed as a systematic literature review with narrative synthesis. The reporting structure was refined to improve transparency and consistency with common biomedical reporting principles. Because of heterogeneity in study design, population characteristics, dietary interventions, and outcomes, no quantitative meta-analysis was performed.

Search strategy

A literature search was performed in Google Scholar, Web of Science, PubMed, Scopus, and the Cochrane Library on August 27, 2025. Search terms included combinations of type 2 diabetes, nutrition, diet, dietary patterns, dietary intervention, glycemic control, prevention, management, hemoglobin A1c, insulin resistance, Mediterranean diet, plant-based diet, low-carbohydrate diet, fiber, and protein. The search was limited to studies published in English between January 1, 2015, and August 27, 2025.

Inclusion and exclusion criteria

Randomized controlled trials, prospective cohort studies, systematic reviews, and meta-analyses evaluating the relationship between nutrition and T2D prevention or management were included. Eligible studies reported outcomes related to incident T2D, hemoglobin A1c, fasting plasma glucose, insulin resistance, body weight, cardiometabolic risk factors, adherence, or diabetes-related lifestyle management. Studies were excluded if they were not directly related to T2D, did not evaluate a nutritional exposure or intervention, were not available in English, were animal or laboratory-only studies, or were published outside the defined time window unless they were used as foundational background evidence.

Study selection and risk of bias assessment

Records were screened by title and abstract, followed by full-text evaluation for potentially eligible studies. Studies were grouped thematically according to dietary patterns, carbohydrate modification, fiber and whole grains, protein source and amino acid profile, and lifestyle or digital nutritional support. The submitted manuscript stated that risk of bias was evaluated using the Cochrane risk-of-bias approach for randomized trials and the Newcastle-Ottawa Scale for observational studies; however, individual domain-level ratings were not provided in the submitted file.

Statistical analysis

A descriptive narrative synthesis was performed. No pooled effect estimates, hypothesis tests, or new inferential statistics were calculated. Therefore, P-values were not applicable to the review synthesis.

Ethical considerations

This review was based exclusively on previously published literature and did not involve human participants, animal experiments, patient-level data, or identifiable information. Therefore, ethics committee approval and informed consent were not required.

Results

Study selection

The search identified 1,200 records. After removal of duplicates and title-and-abstract screening, 150 full-text reports were assessed for eligibility. Forty studies met the inclusion criteria and were included in the final synthesis. The study selection process is shown in Figure 1.

Figure 1. PRISMA 2020 flow diagram of the study selection process (initial records identified: 1200; studies included: 40).

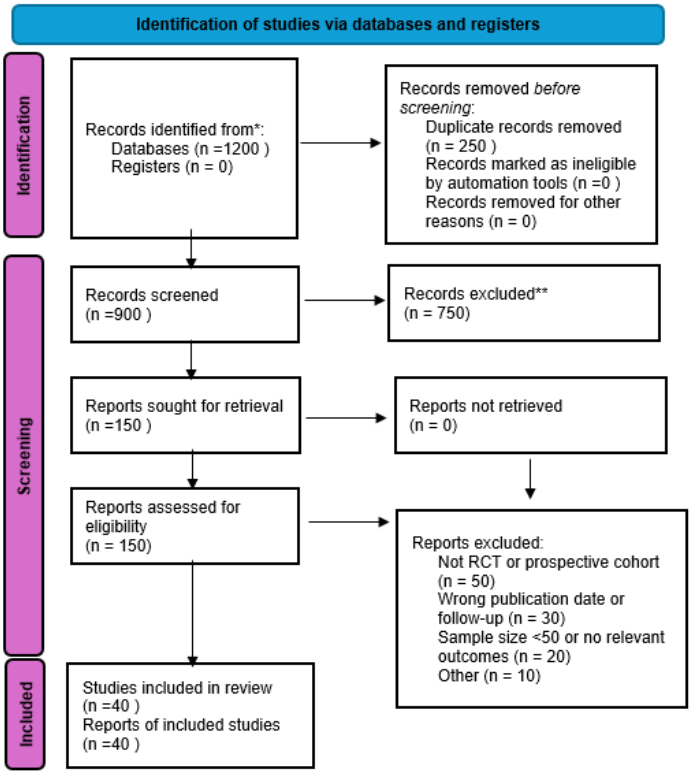

Table 1. Summary of principal findings by nutritional domain.

Nutritional domain	Evidence base and outcomes	Principal findings and clinical interpretation	References
Dietary patterns	12 studies; T2D risk, HbA1c, body weight, and cardiometabolic markers.	Mediterranean, plant-based, and overall high-quality dietary patterns were generally associated with better glycemic and cardiometabolic profiles. This was the most consistent and clinically applicable evidence domain; adherence and food quality remain central.	[5-15]
Low-carbohydrate and macronutrient composition	8 studies; HbA1c, body weight, lipids, and remission-related outcomes.	Low-carbohydrate approaches showed short-term metabolic benefits, but long-term superiority was less consistent. They may be useful for selected patients when medication adjustment and clinical monitoring are available.	[7, 16-22]
High-fiber and whole-grain intake	6 studies; T2D incidence, postprandial glucose, and weight control.	Higher fiber and whole-grain intake were associated with lower T2D risk and improved metabolic responses. These data support recommending minimally processed, fiber-rich carbohydrate sources rather than broad carbohydrate avoidance.	[23-27]
Protein source and amino acid profile	5 studies; insulin resistance and metabolic risk.	Plant-forward protein patterns appeared more favorable than animal-heavy patterns in observational evidence; branched-chain amino acid signatures were linked to insulin resistance. Protein recommendations should consider kidney function, sarcopenia risk, weight goals, and cardiometabolic risk.	[28, 29]
Lifestyle-based and digital nutritional support	9 studies; adherence, body weight, HbA1c, and prevention outcomes.	Structured lifestyle programs and digital support tools improved adherence and self-management, although durability varied. These interventions appear most effective when integrated with behavioral counseling and ongoing follow-up.	[30-33]

HbA1c: hemoglobin A1c, T2D: type 2 diabetes.

Principal findings

The included evidence indicated that overall dietary pattern quality was more clinically relevant than any isolated nutrient. Mediterranean and plant-forward diets were associated with improved glycemic control, weight-related outcomes, and cardiometabolic risk profiles. Low-carbohydrate diets were associated with short-term improvements in hemoglobin A1c and body weight, but their long-term advantage over balanced dietary approaches was less consistent. High-fiber and whole-grain patterns were associated with lower T2D risk and improved postprandial metabolic responses. Protein source also appeared important, with plant-forward dietary patterns showing more favorable associations with insulin resistance than animal-heavy dietary patterns. Lifestyle-based programs and digital interventions improved adherence and self-management when supported by structured follow-up. The principal findings are summarized in Table 1.

Discussion

This systematic review supports the central role of nutrition in both prevention and management of T2D. The most consistent message across the included literature is that sustainable dietary patterns emphasizing whole foods, fiber-rich carbohydrates, unsaturated fats, and plant-forward choices are more clinically useful than rigid single-nutrient prescriptions. This interpretation is consistent with contemporary diabetes nutrition guidance, which emphasizes individualization, metabolic goals, patient preferences, comorbidities, and long-term adherence [8].

Mediterranean and plant-forward dietary patterns showed the most coherent benefits across glycemic and cardiometabolic outcomes. These patterns combine several favorable characteristics, including high intake of vegetables, legumes, whole grains, nuts, olive oil or other unsaturated fat sources, and relatively low intake of refined carbohydrates and ultra-processed foods. Their benefits are likely mediated through multiple mechanisms, including improved insulin sensitivity, reduced adiposity, lower systemic inflammation, and improved lipid profiles.

Low-carbohydrate dietary approaches may be useful for selected patients, particularly in the short term and when medication adjustment and clinical monitoring are available. However, long-term adherence, nutritional adequacy, lipid response, renal considerations, and patient acceptability should be considered before recommending highly restrictive approaches. The evidence does not support a single universal diet for all patients with T2D. Instead, it supports individualized dietary planning that prioritizes safety, feasibility, cultural acceptability, and durability.

Fiber and whole grains represent another important component of diabetes prevention and management. Higher intake of dietary fiber and whole-grain foods may improve satiety, reduce postprandial glycemic excursions, enhance gut microbiota-related metabolic pathways, and support weight control. These findings argue against broadly discouraging all carbohydrate sources and instead support differentiating high-quality, minimally processed carbohydrates from refined starches and added sugars.

Protein source and overall dietary context also deserve attention. Evidence linking branched-chain amino acid profiles, insulin resistance, and animal-heavy dietary patterns suggests that protein quality may influence metabolic risk. Nevertheless, protein recommendations should be individualized according to kidney function, age, sarcopenia risk, weight goals, and comorbid disease burden.

This review has limitations. The included studies were heterogeneous in design, follow-up duration, dietary definitions, adherence assessment, and outcome reporting. Some dietary categories overlapped, and several interventions combined diet with physical activity, behavioral support, or digital tools, limiting attribution of effects to diet alone. The submitted manuscript also did not provide detailed study-level risk-of-bias ratings, which limits the ability to judge the certainty of evidence across categories.

Despite these limitations, the overall evidence is clinically practical. Nutritional care for T2D should not be framed as a short-term diet prescription but as a long-term therapeutic strategy integrated with weight management, medication review, behavioral counseling, and cardiometabolic risk reduction.

Conclusion

Nutrition plays a decisive role in T2D prevention and management. The current evidence favors individualized, sustainable, high-quality dietary patterns rather than a single rigid diet model. Mediterranean, plant-forward, fiber-rich, and minimally processed dietary patterns appear most consistently beneficial, while carbohydrate-restricted approaches may be useful in selected patients with appropriate clinical monitoring. Future research should focus on long-term adherence, implementation in routine care, cultural adaptation, and patient-centered outcomes.

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Case report
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Six months silent: A rare case of delayed duodenal perforation and pancreatitis following intentional foreign body ingestion

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Informed Consent
Written informed consent was obtained from the patient for publication of this case report and the accompanying images. At the time consent was obtained, the patient had been evaluated by the psychiatric team and was deemed to have decision-making capacity.

Conflict of Interest
No conflict of interest was declared by the authors.

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Abstract

Foreign body ingestion is usually self-limited, with most objects passing spontaneously without complications. Rarely, however, retained foreign bodies may cause severe and delayed sequelae. We report the case of a 56-year-old incarcerated man who developed duodenal perforation, an enterocutaneous fistula, and secondary pancreatitis six months after intentional ingestion of a plastic spork. Imaging demonstrated a foreign body penetrating the second portion of the duodenum and extending into the abdominal wall. Definitive surgical management was delayed because of psychiatric illness and repeated refusal of care. After eventual consent was obtained, the patient underwent exploratory laparotomy with foreign body removal, duodenal repair, pyloric exclusion, and gastrointestinal diversion. Despite postoperative complications, he recovered with multidisciplinary management. This case highlights the potential for delayed, life-threatening complications from retained foreign bodies and underscores the ethical and clinical challenges encountered in patients with psychiatric comorbidities.

Keywords: foreign body ingestion, duodenal perforation, enterocutaneous fistula, pancreatitis, pyloric exclusion, case report, psychiatric comorbidity

Introduction

Foreign body ingestion is a common clinical problem, particularly among pediatric, incarcerated, and psychiatric populations. Most ingested foreign bodies pass spontaneously, approximately 10-20% require endoscopic retrieval, and fewer than 1% require surgical intervention because of complications such as perforation, obstruction, or hemorrhage [1-4]. Perforation, when it occurs, is most often associated with long or sharp-pointed objects and usually presents shortly after ingestion [1, 4, 5]. Delayed perforation caused by a blunt foreign body is exceptionally rare. We present a case of intentional ingestion of a plastic spork that resulted in delayed duodenal perforation, enterocutaneous fistula formation, and secondary pancreatitis six months after ingestion, highlighting the diagnostic, surgical, and ethical complexities of management.

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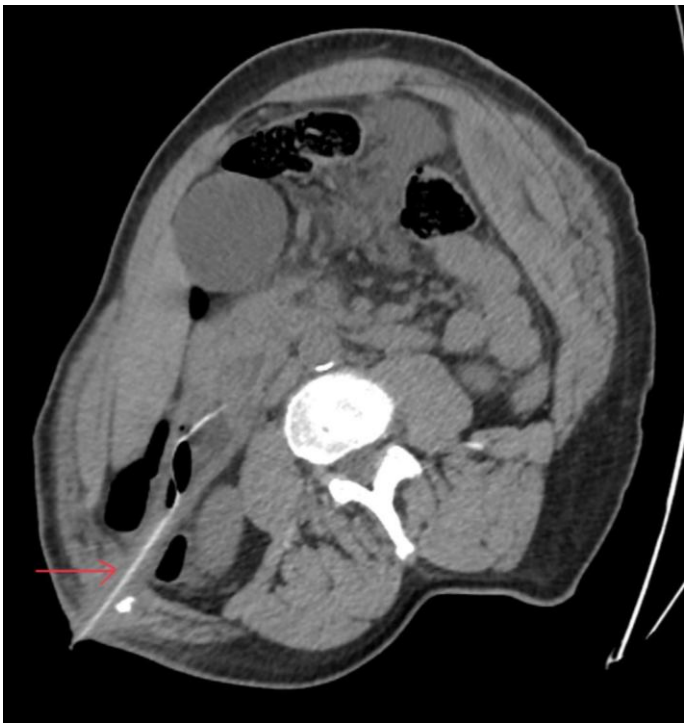
Case presentation

A 56-year-old incarcerated man with a medical history of hepatitis C, hypertension, lymphoma, and significant psychiatric illness presented with right upper quadrant and right flank pain four months after intentionally ingesting a plastic spork. Initial computed tomography (CT) demonstrated a foreign body traversing the second portion of the duodenum and extending into the right flank soft tissues, with localized inflammation and abscess formation consistent with an enterocutaneous fistula (Figure 1). The patient was treated with intravenous antibiotics; however, he declined definitive intervention and was discharged against medical advice.

Figure 1. CT image showing the spork extending from the duodenum to the right flank (arrow).



Over the subsequent two months, the patient was readmitted twice with worsening symptoms. During the second admission, the foreign body was visibly protruding through the right abdominal wall, with purulent drainage and surrounding erythema (Figure 2). During the third admission, he developed signs of peritonitis and laboratory evidence of pancreatitis, with lipase levels greater than 4000 U/L. Repeat imaging confirmed persistent duodenal perforation with inflammatory changes involving the pancreas.

After psychiatric evaluation confirmed decision-making capacity, the patient consented to surgery. Exploratory laparotomy revealed the plastic spork penetrating the second portion of the duodenum (Figure 3), in close proximity to the pancreas and inferior vena cava. Mobilization was achieved using Kocher and Cattell-Braasch maneuvers. The foreign body was dissected free and removed in segments. A 5.5-cm duodenal perforation was repaired with interrupted Lembert sutures and reinforced with a falciform ligament patch. Given the high risk of leak, pyloric exclusion was performed, along with gastrojejunostomy and jejunojejunostomy for diversion.

Postoperatively, the patient remained hemodynamically stable despite self-removal of the nasogastric tube on postoperative day 1. On postoperative day 4, bilious output was noted from the Jackson-Pratt drain and was successfully managed with octreotide. Bowel function returned on postoperative day 4, and the patient was discharged in stable condition on postoperative day 11 with appropriate psychiatric follow-up.

Figure 2. Spork protruding from the patient's abdomen.

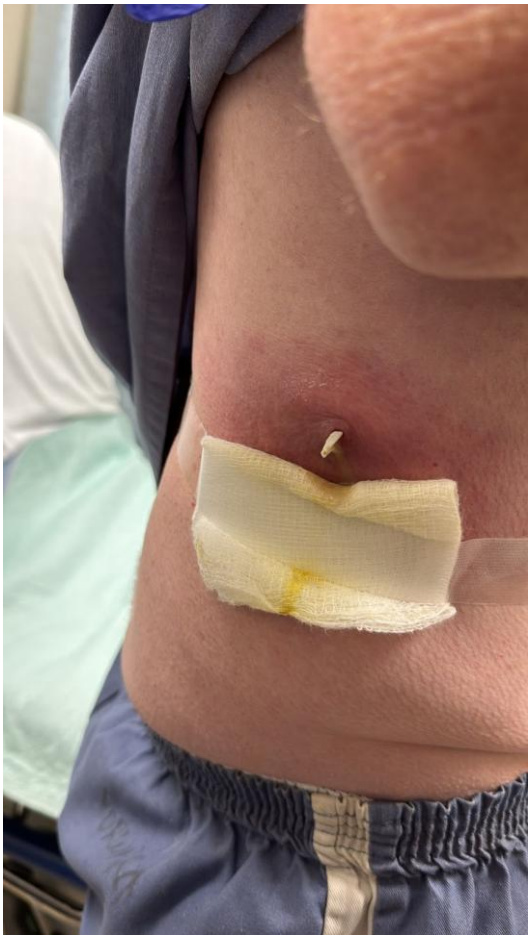
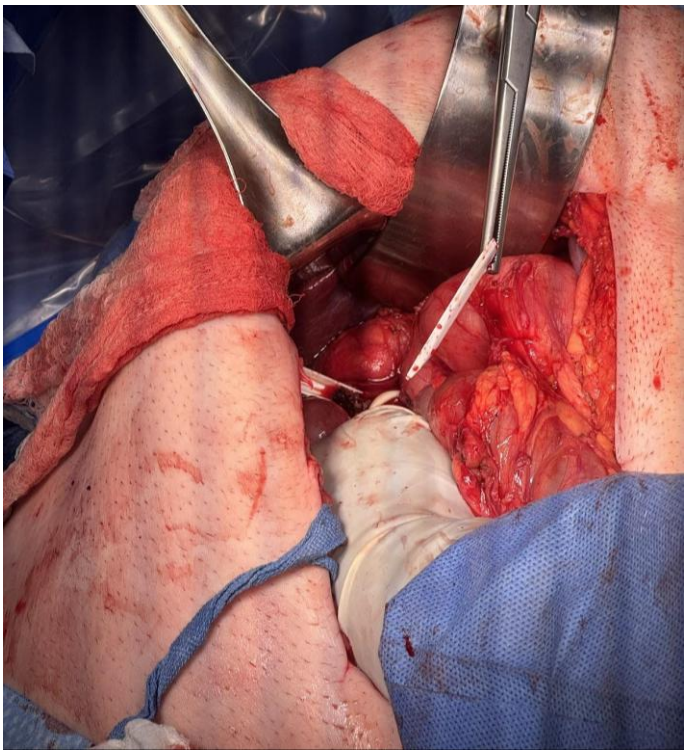


Figure 3. Exploratory laparotomy showing the spork perforating the second portion of the duodenum.



Discussion

This case represents a rare example of delayed duodenal perforation and secondary pancreatitis caused by a blunt plastic foreign body. The duodenum is particularly vulnerable to complications from foreign bodies because of its fixed retroperitoneal position, C-loop anatomy, and proximity to the pancreas [1, 4]. Clinically, both the site and duration of impaction influence presentation and associated complications. Yoo et al. [6] reported that age, sharp foreign bodies, esophageal location, and longer impaction duration were associated with adverse events after upper gastrointestinal foreign body ingestion. Although perforation is more commonly associated with sharp objects and earlier presentation, blunt objects retained for extended periods may still cause progressive tissue injury [2, 6]. Because blunt foreign body ingestion may initially be asymptomatic, evaluation and treatment may be delayed, increasing the risk of complications.

Secondary pancreatitis due to foreign body migration or local inflammatory extension is an uncommon complication after foreign body ingestion. Reported pancreatic complications have most often involved sharp foreign bodies, including toothpicks, fish bones, and needles [7-9]. In patients presenting with abdominal pain and unexplained pancreatitis, retained foreign body ingestion should be considered, particularly in high-risk populations. This case also illustrates the challenges posed by psychiatric comorbidity and refusal of care, emphasizing the importance of multidisciplinary collaboration involving surgery, psychiatry, ethics, and correctional health services.

Conclusion

This case highlights the potential for severe, delayed complications after retained foreign body ingestion, even months after the initial event. Early recognition and intervention are particularly important in patients with psychiatric comorbidities who may decline care. Management requires a multidisciplinary approach involving surgery, psychiatry, gastroenterology, and ethics. Despite substantial delays, definitive surgical intervention ultimately resulted in a favorable outcome.

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Arthrodesis using a distraction technique for isolated talonavicular joint arthritis

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Abstract

Isolated talonavicular (TN) joint arthritis is uncommon because the TN joint is typically affected together with other midfoot articulations. As a multiaxial component of the medial column, the TN joint plays a key role in stability during gait. TN arthrodesis is indicated in conditions such as post-traumatic arthritis, rheumatoid arthritis, posterior tibial tendon insufficiency, and structural foot deformities, with generally favorable clinical outcomes. We report a 52-year-old woman with rheumatoid arthritis who presented with severe dorsal right foot pain, most pronounced during the mid-stance phase of gait. Clinical and radiographic evaluation demonstrated isolated TN arthritis without subtalar or talocalcaneal involvement. Arthrodesis was performed using a distraction technique with a monolateral external fixator to maintain a neutral midfoot position and help prevent collapse of the medial arch. The patient experienced progressive pain relief and functional improvement during follow-up, with substantial reduction in pain and restoration of independent ambulation. This case suggests that external fixation with distraction may represent a useful alternative technique for isolated TN arthrodesis and warrants evaluation in larger series.

Keywords: talonavicular joint, arthrodesis, distraction

Introduction

The talonavicular (TN) joint is a multiaxial joint exposed to multidirectional forces and forms a key part of the medial column complex, contributing to stability throughout the gait cycle [1, 2]. Isolated TN arthritis without subtalar or talocalcaneal joint involvement is rare. TN arthrodesis has been described for post-traumatic arthritis, rheumatoid arthritis, posterior tibial tendon insufficiency, adult-acquired flatfoot, and juvenile pes calcaneovalgus, with generally favorable outcomes reported [3]. We present the clinical outcome of TN arthrodesis performed using a distraction technique with an external fixator in a patient with isolated TN arthritis as a potential alternative option for similar cases.

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Informed Consent
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Case presentation

A 52-year-old woman presented with pain over the dorsum of the right foot, particularly during the mid-stance phase of gait. Her symptoms had progressed over several months and resulted in marked difficulty with ambulation.

The patient had a known diagnosis of rheumatoid arthritis; however, she was not receiving regular follow-up or treatment. She reported no history of smoking or alcohol use. There was no known family history of chronic disease, although she noted that her mother had experienced symptoms suggestive of rheumatoid arthritis.

On examination, the patient was unable to walk plantigrade and required support for mobilization because of pain. Local tenderness was present over the TN joint. Distal neurovascular and motor examinations were normal. Preoperative radiographs (Figure 1) and computed tomography images (Figure 2) demonstrated advanced degenerative changes consistent with isolated arthrosis of the right TN joint. Based on the Larsen classification system using magnetic resonance imaging, the patient had grade 4 articular destruction [4]. No arthritic changes were identified in the subtalar or talocalcaneal joints.

Surgical technique

The patient was placed supine, and a tourniquet was applied to the operative limb. After standard sterile preparation and draping, antibiotic prophylaxis was administered. Under fluoroscopic guidance, the medial TN joint line was identified and marked. A curved, oblique incision of approximately 3 cm was made, and the skin, subcutaneous tissue, and joint capsule were incised to expose the joint. Degenerative cartilage and arthrotic changes were debrided using a burr.

A monolateral external fixator was then applied, with one Schanz screw inserted into the proximal first metatarsal and another into the calcaneus. After achieving distraction, allograft material was placed into the residual joint space. Finally, one cannulated screw was inserted across the TN joint to complete fixation. Postoperative radiographs demonstrated TN arthrodesis with the monolateral external fixator and cannulated screw (Figure 3), and fluoroscopic imaging confirmed proximal first metatarsal Schanz screw placement (Figure 4).

Rehabilitation and follow-up

Postoperative assessments were performed at 15, 30, 45, and 60 days. The external fixator was removed at the end of the first postoperative month, and active ankle range-of-motion exercises were initiated. The patient was mobilized with a walker without weight-bearing. At 6 weeks postoperatively, partial weight-bearing was permitted after clinical evaluation demonstrated a painless joint. After completion of the second postoperative month, full weight-bearing with support was allowed.

Across follow-up visits, the patient showed progressive reduction in pain and tenderness, with complete resolution of pain during weight-bearing by the final visit. The preoperative Visual Analog Scale score was 9 and decreased to 2 at the final follow-up. At presentation, the patient was wheelchair-dependent; by the end of treatment, she attended follow-up visits without a walker, and independent ambulation was achieved by 10 weeks postoperatively.

Figure 1. Preoperative radiographs showing degenerative arthritis of the talonavicular joint.

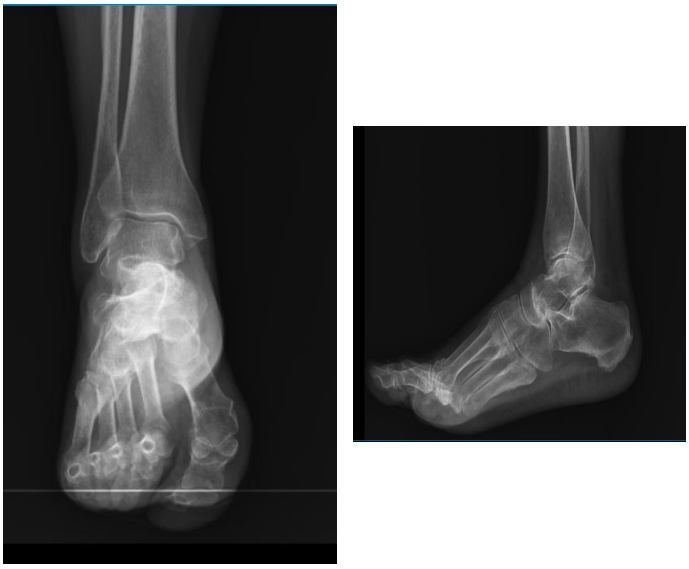


Figure 2. Preoperative computed tomography images demonstrating degenerative changes of the talonavicular joint.

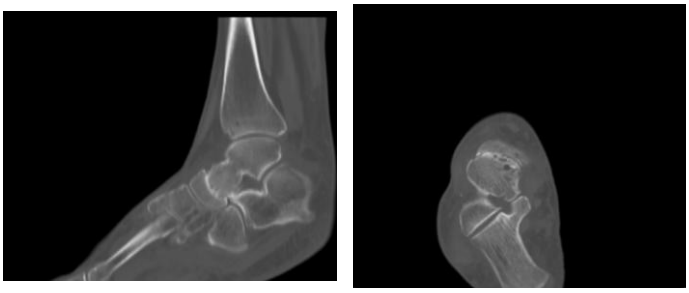


Figure 3. Postoperative radiographs showing talonavicular arthrodesis with a monolateral external fixator and a cannulated screw.

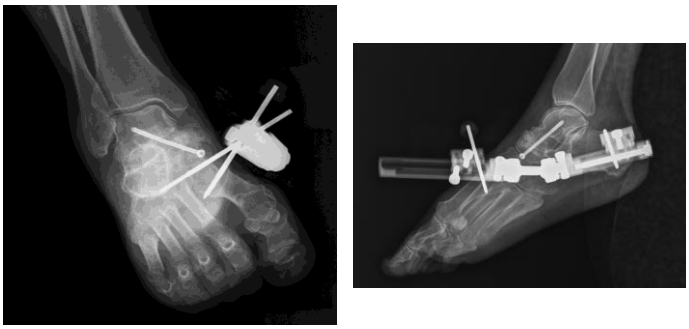
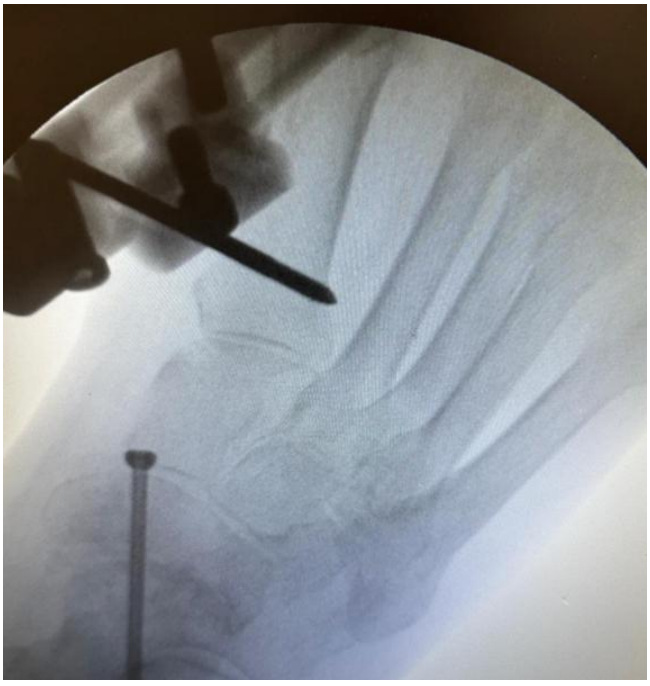


Figure 4. Schanz screw placement in the proximal first metatarsal.



Discussion

Isolated TN arthritis is uncommon in routine clinical practice. Although plate-and-screw constructs are frequently used for TN arthrodesis, current evidence has not demonstrated clear superiority of any single fixation method [5]. In this patient, we used a cannulated screw combined with a monolateral external fixator to distract the midfoot and maintain a neutral position. The rationale was to minimize the risk of medial arch collapse and potential graft subsidence by maintaining distraction during early healing.

This approach is more commonly described in the context of navicular fracture fixation; however, maintaining a neutral foot position may also be advantageous in isolated TN arthrosis by supporting alignment and preserving the medial longitudinal arch. Consistent with the broader literature, including comparative observations reported by Lu et al. [6], definitive superiority of one technique over another has not been established. Larger case series are needed to clarify the relative benefits and limitations of distraction-assisted TN arthrodesis compared with other fixation strategies.

The main limitations of this report are the single-patient design and the lack of long-term follow-up due to socioeconomic constraints. Further evaluation in larger cohorts with longer follow-up is required.

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A surgical bag retained for eight years: A case report

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The authors stated that the written consent was obtained from the patient presented with images in the study.

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Abstract

Retained surgical items, including sponges and other operative materials, can cause substantial harm beyond the perioperative period. We report the case of a 73-year-old woman in whom a surgical bag was retained for eight years after an open laparotomy performed in 2012. Abdominal pain and vomiting began two weeks after the original operation and continued intermittently throughout the eight-year period, leading to 36 imaging examinations. None of the reports raised concern for a retained surgical item. This case illustrates how retained surgical items may remain clinically occult despite recurrent symptoms and repeated imaging. It also highlights the importance of prevention, early suspicion, and inclusion of a retained surgical item in the differential diagnosis when postoperative abdominal symptoms persist, especially after technically complex surgery. The case is notable because the retained item was a large surgical bag and because of the prolonged interval before diagnosis.

Keywords: retained surgical item, case report, surgical safety, small bowel obstruction, foreign body

Introduction

A retained surgical item (RSI) refers to any surgical instrument or material used during an operation that is unintentionally left inside the patient afterward [1]. Although this preventable patient-safety event has been widely discussed, RSIs continue to occur despite established prevention strategies [2]. Most RSIs occur intra-abdominally and may cause pain, abscess, perforation, fistulation, bowel obstruction, or other complications [3].

Prevention remains the principal strategy for reducing RSI incidence. However, when an RSI has already occurred, timely clinical suspicion and detection are essential to limit further harm. This report describes the background, clinical presentation, investigation timeline, operative findings, and outcome of a patient with an RSI identified eight years after sigmoid colectomy for diverticular disease.

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Case presentation

Written informed consent was obtained from the patient before submission of this case report. The patient was a 73-year-old woman who presented to the emergency department (ED) in September 2020 with worsening right-sided abdominal pain. She had experienced recurrent abdominal symptoms and multiple hospital presentations over the preceding eight years. Her relevant medical history included sigmoid colectomy for diverticular disease in 2012, breast cancer treated with left mastectomy, non-Hodgkin lymphoma, and hysterectomy with bilateral oophorectomy. Her medication history was unremarkable, and she was independent and mobile.

On admission, clinical examination demonstrated right-sided abdominal tenderness, mild distention, and hypoactive bowel sounds. There were no signs of peritonism, and a midline laparotomy scar was visible. Digital rectal examination showed an empty rectum with no palpable mass. Blood tests revealed mild leukocytosis (13.38×10^9/L) with neutrophilia (9.37×10^9/L), while C-reactive protein was within the normal range (4.3 mg/L).

The respiratory rate was 20 breaths/min, oxygen saturation was 93% on room air, blood pressure was 146/87 mmHg, heart rate was 87 beats/min, and temperature was 37.2 °C. Chest X-ray showed no pneumoperitoneum, and abdominal X-ray showed colonic fecal loading with a dilated bowel loop in the right lower quadrant. The overall clinical impression was subacute small-bowel obstruction.

A detailed timeline of the patient's ED attendances is presented in Table 1. In October 2012, she underwent elective sigmoid colectomy for diverticular disease and stricture. According to the postoperative letter, there were "extensive adhesions between the sigmoid colon and pelvic organs," as well as small-bowel adhesions and diverticular stricture. The operation was described as uneventful, postoperative recovery was described as remarkable, and no postoperative complications were reported. The patient was discharged five days later.

Table 1. Overview of emergency department admissions between the original surgery in 2012 and the admission described in this report

Date	Presenting complaint
October 26, 2012	Right-sided abdominal pain with vomiting. 15 episodes of loose stools. AXR showed "bowel sutures noted in the pelvis. No specific features."
May 24, 2013	Loose stools and cramping tender/non-guarding right-sided abdominal pain
August 2, 2013	Abdominal pain and 20 episodes of loose stools. Diagnosis of IBS/diverticulitis.
April 26, 2015	GP referral for abdominal pain
August 28, 2015	Upper abdominal pain (prompted endoscopy on March 15, 2016: stomach – gastritis, esophagus – hiatus hernia, duodenum normal)
March 29, 2016	Abdominal pain and vomiting; bowel movements 4–5 times per day
March 26, 2017	Colicky right-sided abdominal pain
December 27, 2017	Abdominal pain
July 22, 2018	Central abdominal pain
February 5, 2019	Central abdominal pain + vomiting
August 4, 2019	Epigastric pain
March 2–13, 2020	Right upper abdominal pain

AXR: abdominal X-ray, ED: emergency department, IBS: irritable bowel syndrome.

Over the next eight years, the patient had 12 hospital attendances for abdominal pain, vomiting, and, at times, loose stools. Imaging was performed on 36 occasions (Table 2), including 18 abdominal X-rays, six abdominal ultrasound scans, 10 computed tomography scans of the thorax, abdomen, and pelvis (CT-TAP), one computed tomography scan of the neck, thorax, abdomen, and pelvis (CT-NTAP), and one magnetic resonance imaging scan of the small bowel. Several reports described possible partial bowel obstruction or adhesions, but these findings were attributed to recurrent lymphoma or vascular small-bowel malformations that had remained unchanged over a prolonged period.

On two occasions, an abdominal mass was investigated but was not visualized on ultrasound. Imaging reports alternated between no abnormality detected and small-bowel loop distention. No report mentioned a foreign body, and an RSI was not included in the clinical differential diagnosis. During the same period, the patient also underwent two upper endoscopies, two colonoscopies, and flexible sigmoidoscopy, which demonstrated diverticulosis, gastritis, and a hiatus hernia (Table 3).

Table 3. Endoscopies performed between the original surgery in 2012 and removal of the retained surgical bag in 2020

Date	Investigation	Finding
January 4, 2013	Flexible sigmoidoscopy	Nil acute
September 3, 2013	Colonoscopy	Diverticulosis, ileitis
April 24, 2015	Upper endoscopy	Gastric ulcers
March 15, 2016	Upper endoscopy	Gastritis, hiatus hernia
March 10, 2017	Upper endoscopy and colonoscopy	No report available
December 17, 2020	Colonoscopy	Diverticulosis

The present report focuses on the final ED admission in this sequence of presentations. Eight days before bag retrieval, the patient presented for the thirteenth time with similar symptoms, including worsening right-sided abdominal pain, 18 episodes of vomiting during the previous 24 hours, and reduced bowel movements. Based on the clinical findings, the leading differential diagnosis was subacute bowel obstruction. She was admitted under the general surgical team, a Ryle's tube was inserted for decompression, and intravenous co-amoxiclav was started.

The next day, contrast-enhanced CT of the abdomen and pelvis was performed (Figures 1 and 2). The report described calcifications on the walls of small-bowel loops with prominent vessels, likely related to previous lymphoma treatment; dilated small-bowel loops; the impression of an internal twist or hernia; adhesions between small-bowel loops in the abnormal areas; and no perforation.

Four days later, symptoms persisted, and repeat CT of the abdomen and pelvis with oral contrast suggested subacute obstruction. Over the next two days, the patient remained clinically stable. Her abdominal pain improved, and the Ryle's tube was removed. She tolerated a soft diet for 24 hours after tube removal but subsequently began vomiting again. Eight days after admission, vomiting persisted without a clear cause. Repeat blood tests showed resolution of leukocytosis and neutrophilia, and C-reactive protein remained unremarkable. Because of persistent symptoms, the patient consented to post-laparotomy small-bowel adhesiolysis.

Table 2. Abdominal and thoracic imaging reports between the original surgery in 2012 and removal of the retained surgical item in 2020

Date of scan	Indication	Type of scan	Relevant findings
November 2, 2012	Abdominal pain, perforation?	AXR/CXR	Abdomen: Normal gas pattern. Chest: No free sub-phrenic gas.
December 18, 2012	Abdominal pain	AXR/CXR	Abdomen: No specific features. Bowel sutures noted in the pelvis. Chest: no abnormalities.
February 28, 2013	Abdominal pain	Abdomen US	No obvious gross abnormalities demonstrated in the liver, pancreas, aorta, gallbladder, CBD, spleen and kidneys.
May 27, 2013	Abdominal pain	AXR	Abdomen unremarkable.
August 2, 2013	Abdominal pain	AXR/CXR	Abdomen: Surgical sutures noted in the pelvis. Otherwise normal bowel gas pattern. Chest: No evidence of free subdiaphragmatic gas.
August 7, 2013	Abdominal pain	CT-TAP	No lung lesion or pleural fluid. Small simple liver cyst. The gallbladder, pancreas, spleen, adrenal glands and both kidneys are normal. The bowel loops are of normal size. Anastomosis is noted at the level of sigmoid colon. No significant abdominal lymphadenopathy or ascitic fluid is evident. Conclusion: no disease recurrence
November 23, 2013	Rule out pulmonary embolism on background of breast cancer	CT-TAP	No evidence of pulmonary embolism. No evidence of recurrent disease or metastases.
March 2, 2015	Abdominal mass (peri-umbilical)	US of anterior abdominal wall	Not well visualized with ultrasound. For CT to characterize mass.
March 11, 2015	Abdominal mass	CT-TAP	Previous hysterectomy and anterior resection noted, with sigmoid anastomosis. No mass lesion identified. "There is a slightly unusual enhancement pattern within a small bowel loop close the midline in the upper abdomen, with prominent mural vessels and mucosal enhancement. Similar changes were observed in the previous study dated August 7, 2013, so it is unlikely to be of any major significance." Small cyst noted posteriorly within the right lobe of the liver, with no evidence of metastatic disease.
April 26, 2015	Constipation	CXR/AXR	Chest: No abnormalities. Abdomen: Constipation. No evidence of acute obstruction, no free gas, no evidence of perforation. Previously reported mild vascular malformation in small intestine showing as coiled vessels in left upper quadrant.
August 28, 2015	Abdominal pain	AXR	Chest: No abnormalities, no free air. Abdomen: No evidence of intestinal obstruction or perforation.
August 28, 2015	Recurrence of lymphoma?	CT-TAP	Unusual enhancement in the wall of the small intestine most likely due to some vascular malformation within the wall of the small intestine, unchanged since the previous examination. Diverticulum in the second part of the duodenum is noted. Tiny cyst within the liver is insignificant. No evidence of recurrence of lymphoma.
March 29, 2016	Abdominal pain and vomiting	AXR	No free gas under the diaphragm, no evidence of perforation, obstruction or ileus.
March 31, 2016	Abdominal mass and loose stools	US of abdomen	Central mass felt clinically but no abnormality visualized.
January 26, 2017	Abdominal pain	AXR	Chest: no abnormality. Abdomen: colonic fecal loading. No free gas. Few slightly distended small bowel loops so acute abdomen cannot be excluded.
January 27, 2017	Right flank pain	US of urinary tract	Both kidneys grossly normal with no hydronephrosis. No other gross abnormalities.
October 6, 2017	Recurrence of lymphoma?	CT-TAP	No lymphoma. No change in the appearance of the previously reported vascular malformation in small bowel. No other new changes.
December 27, 2017	Left iliac fossa pain with nausea and vomiting	AXR	Few distended bowel loops, previous abdominal surgery noted. Acute abdomen cannot be confidently excluded.
December 27, 2017	Left iliac fossa pain with nausea and vomiting	CT-TAP with contrast	Evidence of previous resection anastomosis of the colon. No perforation but small amount of free fluid in abdomen and pelvis. Multiple prominent loops of small bowel. Distal ileum thick walled and mildly distended. Terminal ileum normal. Previously described small bowel abnormality with possible calcification. Mid-abdomen: multiple prominent loops around it with an impression of an adhesions or mass formation. Appears to be due to multiple loops of small bowel getting stuck to the abnormality in the bowel. Exact nature is unclear but could be due to previous treated lymphoma. Recurrence of lymphoma? Adhesions?
April 12, 2018	Abdominal pain with distension and vomiting	AXR	Abdomen: Fecal loading of the large bowel. Surgical sutures left hemi-pelvis. No evidence of obstruction. Chest: No free air under diaphragm, no acute changes.
April 12, 2018	Right upper quadrant pain	US of abdomen	No significant abnormality and no free fluid or evidence of perforation.
July 22, 2018	Central abdominal pain and vomiting	AXR	Abdomen: Fecal loading of the large bowel. Surgical sutures. Nil acute. Chest: Nil acute.
January 20, 2019	Abdominal pain and melena	AXR	Evidence of previous colectomy. No evidence of obstruction or perforation.
February 5, 2019	Abdominal pain and vomiting	AXR	Abdomen: No specific diagnostic features. Existing surgical clips noted. Chest: Possible aspergilloma right upper zone. No free sub-diaphragmatic gas.
February 7, 2019	Abdominal pain and vomiting	CT-TAP with contrast	Dilated small bowel loop with abnormal tortuous dilated vessels. Free fluid in abdomen, pelvis and around pancreas. Possible acute pancreatitis. Para-duodenal diverticulum in 2nd part of duodenum, slightly impressing lower part of common bile duct.
February 8, 2019	Abdominal pain, pancreatitis?	US of abdomen	Normal pancreas size. Pancreatic duct prominent but normal width. Gallbladder wall slightly thickened. Common bile duct dilated but no obvious intra-ductal calculi. Traces of free fluid around liver and spleen.
February 12, 2019	Abdominal pain and vomiting	AXR	A few small bowel loops are prominent. Colon is loaded with feces. No pneumoperitoneum. Postoperative changes noted in the pelvis.
March 2, 2020	Abdominal pain	AXR	Chest: Nil acute. No free air under diaphragm. Abdomen: No significant abnormality.
March 2, 2020	Abdominal pain and nausea	US of abdomen/pelvis	Liver demonstrates prominent intra-hepatic biliary ducts. Common bile duct dilated. Dilated fluid-filled bowel loops on right side of abdomen. No peristalsis seen.
March 3, 2020	Abdominal pain	CT-TAP	Nasogastric tube compressing stomach. Unusual mucosal venous enhancement in collapsed mid small bowel loops which appears to be due to a localized twist in the mesentery with a closed off obstruction with dilated bowel loops in the right flank. Similar changes with marked small bowel mucosal thickening observed on the previous study dated February 7, 2019. There is some associated distortion of the duodenum, which is the likely cause of the associated prominence of the pancreatic duct and distal common bile duct shown on previous CT and on recent ultrasound. No definite underlying calculi or pancreatic mass lesions. Small amount of fluid within the peritoneal cavity, most marked in the left upper quadrant around the spleen. Previous sigmoid resection noted. No abnormal lymphadenopathy. Old scarring noted in the right upper lung zone posteriorly, with moderate background centrilobular bullous change. There are small simple cysts in the right kidney.
March 6, 2020	Previously observed bowel obstruction. AXR to determine resolution.	AXR	Lower end of the nasogastric tube is inside the stomach. There are a few slightly distended bowel loops.

AXR: abdominal X-ray, CBD: common bile duct, CT: computed tomography, CT-(N)TAP: computed tomography of the (neck), thorax, abdomen, and pelvis, CXR: chest X-ray, MRI: magnetic resonance imaging, NG: nasogastric, US: ultrasound.

Table 2. Abdominal and thoracic imaging reports between the original surgery in 2012 and removal of the retained surgical item in 2020

Date of scan	Indication	Type of scan	Relevant findings
March 9, 2020	Previously described bowel obstruction March 3, 2020	CT-TAP with oral and IV contrast	Appearance of the small intestine described before same as on the previous examination (March 3, 2020). Several small bowel loops are seen in the middle of the abdomen with distended vessels within the in the wall. Some of the bowel loops are dilated and some are contracted. Edematous wall of the intestine particularly on the right side and in the complex area in the middle of the abdomen. The appearance of the bowel loops in the middle of the abdomen is longstanding. Contrast is noted in the large intestine; therefore, there is no evidence of complete small bowel obstruction. Slightly enlarged liver, tiny cyst in the liver, insignificant.
May 7, 2020	Abdominal pain	MRI small bowel study	Scan abandoned due to patient vomiting and losing control of bowels.
July 2, 2020	Abdominal pain	AXR	No significantly dilated bowel loops. No evidence of obstruction or perforation.
September 20, 2020	Abdominal pain	AXR	Abdomen: Colonic fecal loading. Dilated bowel loop in the right lower quadrant. Acute abdomen cannot be confidently assessed.
September 21, 2020	Abdominal pain, vomiting	CT abdomen, pelvis with contrast	Trace fluid in the abdomen and pelvis. Calcifications on the walls of the small bowel loops with prominent vessels likely due to previous lymphoma treatment. In comparison to the previous CT on March 3, 2020, there are some dilated loops of small bowel with impression of internal twist or hernia. Impression of adhesions between small bowel loops in these abnormal areas. Presence of subacute obstruction could not be excluded. No perforation.
September 25, 2020	Abdominal pain	CT of abdomen, pelvis with oral and IV contrast	Dilated small bowel loops in the abdomen on both sides. Abnormal loops in upper abdomen with thickening and calcifications as was described in previous CT. Impression of a kink in bowel loop in distal ileum as described previously. No perforation. Congestive changes in mesentery and trace free fluid. Slow transit of oral contrast.
September 30, 2020	Post-laparotomy	AXR	Chest: Nil acute. No free gas under diaphragm. Abdomen: Recent laparotomy. No significantly dilated bowel loops.
October 7, 2020	Post-laparotomy with ongoing high NG output.	CT	Previous sigmoid resection noted. Small amount of free fluid in abdomen with edematous peritoneal/mesenteric fat. Edematous wall of distal small intestine. No evidence of obstruction. Tiny liver and right kidney cysts insignificant. Pneumonia in the left lung base with small pleural effusion. Active infection in the right base with small pleural effusion. Hiatus hernia.

AXR: abdominal X-ray, CBD: common bile duct, CT: computed tomography, CT-(N)TAP: computed tomography of the (neck), thorax, abdomen, and pelvis, CXR: chest X-ray, MRI: magnetic resonance imaging, NG: nasogastric, US: ultrasound.

Figure 1. Transverse-plane CT scan performed on September 21, 2020, before the adhesiolysis procedure. Adhesions and dilated bowel loops can be seen, but there is no clear view of a foreign body.

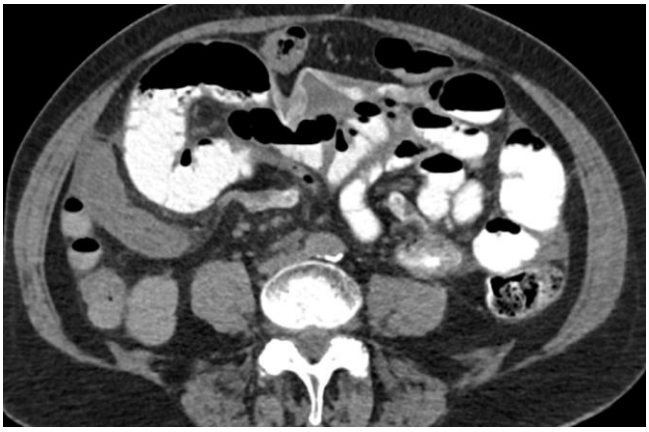
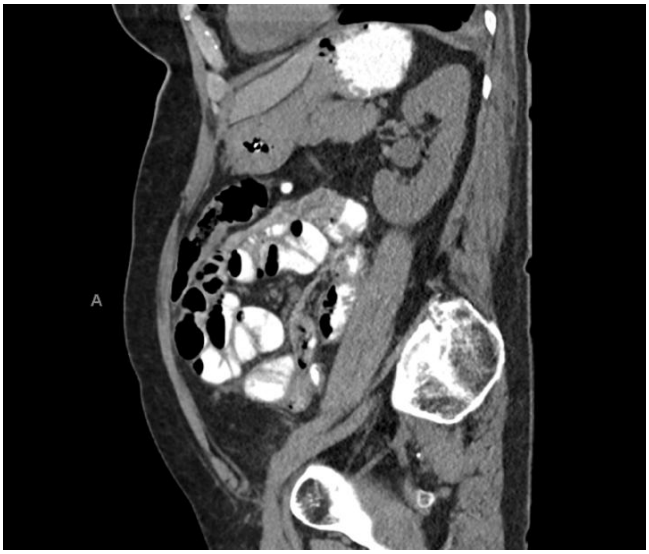


Figure 2. Sagittal-plane CT scan performed on September 21, 2020, before the adhesiolysis procedure. As in Figure 1, there is no clear evidence of a foreign body in the abdomen.



A midline incision was performed. Operative findings included extensive adhesions and a calcified mass surrounding the small bowel. After several hours of adhesiolysis, the calcified mass was mobilized anteriorly and to the left over the small bowel. The surgeon unexpectedly identified two laces, which were recognized as part of a Bogotá bag left from the laparotomy in 2012. The bag was removed after six hours of adhesiolysis (Figures 3 and 4). Postoperatively, the patient recovered well, with no further complications. Her repeated hospital presentations were attributed to the RSI, and she has had no further notable abdominal symptoms since the operation.

Figure 3. Surgically removed Bogotá bag on September 28, 2020. The bag had been retained from the original procedure in 2012 and shows the foreign material associated with the patient's symptoms over eight years.

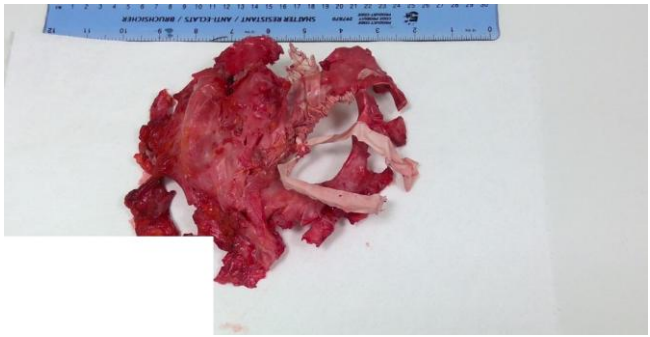


Figure 4. Image of an intact bag identical to the one surgically removed from the patient, illustrating the size of the surgical item retained in the abdominal cavity.

Discussion

Retained foreign bodies after surgery remain a major concern in clinical practice and are considered "never events". NHS England data cited by the Health Services Safety Investigations Body indicate that retained-swab incidents varied between 11 and 23 cases per year from 2015 to 2023 [4]. However, the actual burden is difficult to quantify because available data include only events that are both recognized and reported.

Cases similar to the present one have been described, including surgical sponges removed many years after the index operation [5]. Retained surgical items may also present with bowel obstruction, as occurred in the present case [6]. This report therefore provides an opportunity to discuss patient impact,

healthcare-system burden, prevention, and the need for timely suspicion and detection.

RSIs may cause serious complications, prolonged admissions, additional operations, and avoidable radiation exposure from repeated imaging [7]. These consequences also increase healthcare costs [8]. In the present case, repeated imaging was clinically understandable but cumulatively burdensome. Abdominal imaging may expose patients to more radiation than chest radiography; for example, an abdominal X-ray has been compared with several months of natural background radiation, and CT of the abdomen and pelvis may approximate several years of background radiation exposure depending on protocol and patient factors [9-11].

The patient's repeated ED attendances and admissions also suggest a substantial physical and psychological burden, which may be overlooked when RSI harm is described only in technical or medicolegal terms. Prevention remains the central strategy. Surgical counts and standardized perioperative safety processes must be maintained, because incomplete or incorrect counts have been associated with retained foreign bodies [12]. National Safety Standards for Invasive Procedures also emphasize systematic approaches to prevent retained foreign objects [13]. Nevertheless, ongoing events demonstrate that prevention must be reinforced by detection strategies when postoperative symptoms persist.

Detection after an RSI has occurred is challenging. In this case, the retained bag was not identified despite extensive imaging and multidisciplinary clinical discussion. Imaging has been described as central to the diagnosis of gossypiboma and other retained surgical materials [14]. However, this case demonstrates that imaging does not always yield a clear diagnosis, particularly when findings are attributed to alternative explanations such as adhesions, prior malignancy, or vascular changes.

Improving detection may require both technical and cognitive interventions. Imaging-based advances, including deep-learning models designed to detect retained surgical sponges, may support radiologic recognition in selected contexts [15]. However, technology alone is unlikely to solve the problem. Clinicians should maintain suspicion for RSI when a patient has persistent or unexplained postoperative abdominal symptoms, especially after complex or prolonged operations.

Risk factors reported for RSI include high body mass index, emergency surgery, unplanned changes during the operation, longer procedure duration, and incorrect or incomplete counts [16]. In the present case, the index operation was elective and no explicit count discrepancy was documented. However, the operation involved extensive adhesions and intra-abdominal complexity, which may have increased the practical risk of item retention. Persistent abdominal symptoms after intra-abdominal surgery should therefore prompt careful review of the operative history, count documentation, and prior imaging, with RSI included in the differential diagnosis when symptoms remain unexplained.

Overall, this case supports a dual approach: robust prevention during surgery and improved detection after surgery. Earlier consideration of RSI in patients with recurrent postoperative abdominal symptoms may reduce diagnostic delay, repeated imaging, and unnecessary morbidity.

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An extremely rare case of primary cutis verticis gyrata: A comprehensive report in a female patient

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The authors stated that the written consent was obtained from the patient presented with images in the study.

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Abstract

Cutis Verticis Gyrata (CVG) is an unusual scalp condition characterized by excessive skin growth, resulting in prominent folds and furrows that resemble the cerebral gyri of the brain cortex. The diagnosis and classification of CVG are primarily based on clinical findings. Complementary investigations are essential to rule out any potential underlying systemic or local pathologies. In this study, we present a case of Primary Essential CVG that gradually expanded across the occipital region and significantly affected the patient cosmetically. Female presentation of CVG is extremely rare in the literature; therefore, this case provides valuable insight into the presentation and management of this disorder in female patients. The primary purpose of this case report is to describe the clinical features, diagnostic process, and surgical intervention for CVG, and to contribute to the literature.

Keywords: Cutis verticis gyrata, vertex, benign lesion

Introduction

Cutis Verticis Gyrata (CVG), also known as *pachydermia verticis gyrata* or *cutis verticis plicata*, is a rare scalp skin disorder that includes redundant scalp skin, leading to deep grooves and ridges that imitate cerebral convolutions [1]. This condition can result from congenital or acquired reasons. Histopathological microscopic findings typically demonstrate benign cutaneous hypertrophy. Redundancy of the scalp skin, forming thick skin folds and grooves, is also commonly observed among the macroscopic findings of this condition [2]. CVG is classified into three main categories: Primary Essential CVG, Primary Non-Essential CVG, and Secondary CVG. Primary Essential CVG occurs without associated systemic conditions, whereas Primary Non-Essential CVG can be linked to underlying neuropsychiatric or ophthalmologic disorders. Secondary CVG is mostly connected to systemic diseases or the use of medication [3]. Understanding the pathogenesis of CVG remains a challenge, and further research is needed to clarify its etiology and genetic implications.

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Case presentation

A 27-year-old female patient with no significant medical history presented with progressive scalp thickening and furrowing over three years. Her primary complaint was cosmetic; however, she also reported mild pruritus, maceration, and localized hair loss. There were no similar conditions in her family history. She denied consanguinity, anabolic steroid use, scalp infections, or systemic diseases. Neurological and ophthalmological examinations were unremarkable.

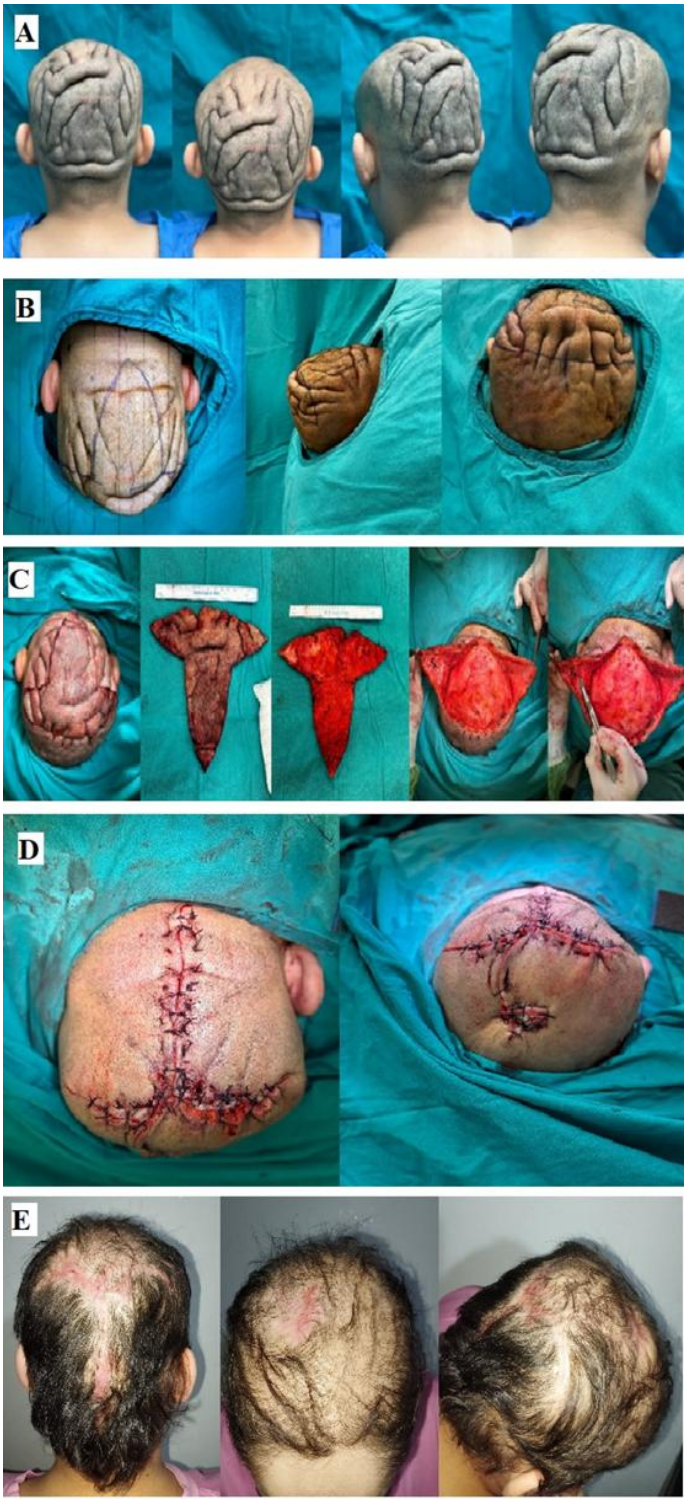
A punch biopsy was taken from the central zone of the scalp skin under local anesthesia. Histopathological evaluation revealed normal epidermal and dermal structures with no pathological alterations. Systemic assessments, including laboratory tests for thyroid function (TSH, free T4), complete blood count (CBC), fasting blood glucose, lipid profile, and syphilis serology, were within normal limits. Imaging studies, such as magnetic resonance imaging (MRI) and computed tomography (CT) scans, were conducted to exclude secondary causes related to structural anomalies or underlying malignancies, as well as to rule out conditions like acromegaly and pachydermoperiostosis. Skull and sella turcica CT and MRI showed no change. Serum growth hormone levels were within the normal range. On physical examination, the scalp exhibited soft, non-tender thickening with well-defined cerebriform folds predominantly affecting the parietal and occipital regions, covering an estimated 23 x 14 cm area. The furrows followed an anterior-to-posterior direction, with the central region demonstrating the greatest prominence. Manual traction failed to flatten the folds. Given these findings and the absence of any systemic condition, a diagnosis of Primary Essential CVG was established. A psychological assessment was conducted to evaluate the impact of the condition on the patient's mental well-being. It was observed that she had moderate distress associated with her altered appearance.

A written informed consent form was obtained from the patient for the use of her data and images in a scientific study.

Surgical Management

Considering the significant scalp deformity and the patient's aesthetic concerns, surgical intervention was planned. A total excision of the excessive scalp tissue was performed under general anesthesia with orotracheal intubation. The patient was positioned prone for optimal exposure of the occipital deformity. Following the skin tension assessment and excision marking, 0.4 mg epinephrine was infiltrated into the subgaleal and subcutaneous planes to minimize bleeding. A fleur-de-lis incision pattern was drawn, and tissue removal proceeded along the anteroposterior axis. Dissection was performed on the subgaleal plane and extended toward the parietal and occipital regions, taking care to preserve the occipital artery to maintain flap viability. Scoring techniques were applied to facilitate tension-free closure. Master sutures were placed centrally for primary closure. The final excised tissue measured 240 mm in length and 150 mm in width. A small rotational flap from the parietal region was utilized to assist in closure of the vertex defect. Closure was successfully achieved. Postoperative recovery was uneventful. The patient was closely monitored for potential complications such as wound dehiscence, infection, and hematoma formation. Postoperative follow-up at one, three, and six months revealed a well-healed surgical site without recurrence of scalp furrowing. The patient expressed significant satisfaction with the cosmetic outcome and reported no discomfort or functional impairment. The complete preoperative and postoperative course is presented in Figure 1. Long-term monitoring will continue to assess any potential recurrence or other concerns.

Figure 1: The patient's progress at all stages before and after surgery (A: Pre-operative imaging after hair shaving, B: Planning of fleur-delis incision line, C: Incisions, excision, flap elevation, and scalp skin scoring, D: Immediate post-operative photo after skin closure, E: Post-operative 3-month result)



Discussion

CVG was first described by Jean-Louis-Marc Alibert in 1837. The term "*cutis verticis gyrata*", which has been the accepted terminology ever since, was coined by Unna in 1907 [4]. Primary Essential CVG has no relation to any other abnormalities. Primary Non-Essential CVG may be associated with neuropsychiatric and ophthalmologic abnormalities [5]. Secondary CVG is mostly related to underlying diseases or causes such as inflammatory, neoplastic, metabolic conditions, and drug use (*i.e.*, growth hormone agonists) [6]. In particular, acromegaly and pachydermoperiosteosis (idiopathic hypertrophic osteoarthropathy) are disorders that often occur with secondary CVG. Turner syndrome, Klinefelter syndrome, and fragile X syndrome have been linked to primary non-essential CVG. The only known familial form of CVG is associated with primary pachyodermoperiostosis [7].

Cutis verticis gyrata is predominantly seen in men, with a reported prevalence of approximately 1 in 100,000 males and 0.026 in 100,000 females [1]. A hormonal basis for CVG has been proposed due to its male predominance and postpubertal onset of this disorder. However, the potential role of genetic transmission and the pathophysiology of CVG remain ambiguous. Primary Non-Essential CVG usually occurs in postpubertal men. It has often been associated with intellectual disability or neuropsychiatric disorders such as seizures and schizophrenia. The folds of Primary Non-Essential CVG are usually symmetrical and run in an anteroposterior direction, involving the vertex and occiput [8]. Histopathological imaging may be normal or may show thickened connective tissue with hypertrophy or hyperplasia of adnexal structures [7]. Contrary to Primary CVG, Secondary CVG is relatively more common and can occur at any age. The skin folds of Secondary CVG are usually more asymmetrical than those of Primary CVG, and they may extend to the forehead region. The CVG form secondary to neoplasms tends to present as a localized area of scalp furrowing, which can then progress to the entire scalp [8].

In many cases reported in the literature, the patients are male, and the incidence in female patients has been reported to be very low. In male patients, the lesion is usually single and measures 5-8 x 3-7 cm. In contrast, the lesion in our case measured 24 x 15 cm and occurred in a female patient. Furthermore, our research did not reveal any secondary underlying cause or findings suggestive of primary non-essential CVG. This shows that our case is particularly rare and unique.

Conclusion

This case reports a rare occurrence of Primary Essential CVG in a young female patient. Surgical excision resulted in an effective outcome, with a smooth postoperative recovery. This report emphasizes the importance of ruling out secondary causes and underscores the role of surgical intervention as a viable treatment option for patients with symptomatic or cosmetically concerning CVG. Further research is needed to enhance understanding of the genetic and pathological basis of CVG and to develop more targeted management strategies. Future studies should focus on long-term recurrence rates and functional outcomes.

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