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Conceptual issues of terminology and term selection for surgery in patients with acute obstructive calculous cholecystitis

The aim of the work: to develop modern terminology issues and the selection of terms for laparoscopic cholecystectomy based on the assessment of the stages of the inflammatory process, general clinical and local morphological criteria of acute obstructive calculous cholecystitis.

Materials and Methods. Data of 408 patients with acute cholecystitis were analyzed. Patients were categorized into groups based on the duration of the disease: up to 3 days, 3–5 days, and 6–10 days from the onset of the first biliary colic episode. The staging of acute cholecystitis was assessed depending on the duration of cystic duct obstruction and comorbid pathology. Based on these findings, the optimal timing of laparoscopic cholecystectomy was proposed and confirmed by morphological studies of the removed gallbladders within the corresponding surgical timeframes as well as data from the correlation analysis of acute cholecystitis factors.

Results. It was proven that profound hemodynamic disturbances and prolonged inflammation played a key role in the pathogenesis of remodeling structural components of the gallbladder. These findings justify the choice of early laparoscopic cholecystectomy (within 12–24 hours) after the diagnosis is established.

Conclusions. The developed model of acute “surgical” cholecystitis based on acute obstructive calculous cholecystitis will significantly improve the outcomes of laparoscopic cholecystectomy at various postoperative periods.

Key words: obstructive calculous cholecystitis; timing of surgery; laparoscopic cholecystectomy.

Problem Statement and Analysis of Recent Research and Publications. Acute cholecystitis (AC) remains one of the most common surgical diseases, leading to a significant number of hospitalizations and surgical interventions [1, 2]. The success of treatment largely depends on timely and accurate diagnosis as well as the appropriate surgical strategy [3, 4]. Therefore, it is essential to refine the terminology of acute cholecystitis based on pathomorphological and clinical criteria, ensuring that the diagnostic algorithm focuses on identifying acute “surgical” cholecystitis, predicting the course of pain attacks, and determining the indications and timing for surgery. Given this, the terminology and optimal timing of surgical intervention in AC are particularly relevant [5].

However, despite significant advances in surgical techniques and the development of new minimally invasive treatment methods, there is still no standardized approach to the terminology of various aspects of acute cholecystitis [6]. The lack of clear criteria for selecting optimal surgical timing in AC can lead to errors in treatment strategies and an increased risk of complications [7]. According to Kimura et al., 90–95 % of patients with acute calculous

cholecystitis initially experience biliary colic [7]. It should subsequently be considered as a progressive inflammation of the gallbladder, caused by prolonged acute obstruction of the cystic duct by a stone, leading to increased intravesical pressure, which is a key pathological factor in acute obstructive calculous cholecystitis [8].

Thus, we believe that acute cholecystitis serves as a model for defining conceptual issues related to terminology and the timing of early laparoscopic cholecystectomy, depending on the staging of acute cholecystitis progression.

The aim of the work: to develop modern terminology issues and optimal surgical timing for laparoscopic cholecystectomy, based on an assessment of the staging of the inflammatory process, general clinical factors, and local morphological criteria of acute obstructive calculous cholecystitis.

Materials and Methods. We analyzed the treatment outcomes of 408 patients with acute cholecystitis, categorized based on the staging of acute cholecystitis and age.

The summary of patients distribution based on AC stage, depending on age, is presented in Table 1.

Table 1. Patients distribution based on the stage of acute cholecystitis and age.

Stage of Acute Cholecystitis	25–44 years	44–60 years	60–75 years	75–90 Years	Total	Percentage (%)
Cystic duct disobstruction within 12 hours	20	30	26	9	85	20.83
Cystic duct obstruction up to 3 days	39	53	17	4	113	27.70
Cystic duct obstruction for 3–5 days	43	65	19	5	132	32.35
Cystic duct obstruction for 6–10 days	27	38	10	3	78	19.12
Total	129	186	72	21	408	100

To verify the diagnosis of acute obstructive calculous cholecystitis, ultrasound examination of the gallbladder was performed in 125 patients.

The correlation analysis was performed and correlation relationships between the factors of acute cholecystitis were established. Statistical analysis was performed using Microsoft Excel. The significance level (alpha) was set at 0.05.

Results. Pathophysiology of acute cholecystitis is described elsewhere [9]. As a result of biliary colic, if cystic duct disobstruction occurs within 10–12 hours with effective conservative treatment, the stone migrates from the neck of the gallbladder to the body (Stage 1). Simultaneously, intravesical hypertension decreases, causing the gallbladder to relax. The gallbladder wall remains thin, and clinically, the gallbladder does not palpable, and the pain episode is absent (Fig. 1).

If a stone remains impacted in the cystic duct for an extended period and bile flow does not resume within 10–12 hours after ineffective conservative treatment, the second stage of acute cholecystitis develops. This stage is characterized by progressive intraluminal hypertension, vascular stasis with gallbladder wall ischemia, accompanied by edema and wall thickening, leading to an enlarged gallbladder (alteration phase). This, in turn, intensifies pain, lasting up to three days from the onset of the first attack and is classified as acute edematous cholecystitis (Fig. 2). This has been confirmed by morphological studies of gallbladders removed at specific surgical timeframes (Fig. 3).

If bile flow is not restored within 3–5 days, the third stage of acute cholecystitis develops. This stage is marked by progressive intraluminal hypertension, fluid secretion (exudation phase), vascular stasis with worsening ischemia, gallbladder wall destruction, perivesical infiltration, and the onset of bacterobilia (necrotizing cholecystitis, confirmed by morphological examination of the gallbladder wall) (Fig. 4).

Microscopic examination of the mucosa revealed epithelial desquamation and destruction of the apical villi. The serous membrane showed fibrinous deposits.

These changes were associated with necrosis of the mucosal and muscular layers, confirming necrotizing cholecystitis (Fig. 5). By days 6–10, bacterobilia

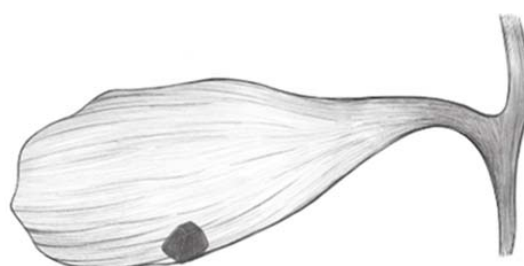


Fig. 1. Migration of the stone from the gallbladder neck to the body.



Fig. 2. Stone impaction in the cystic duct.

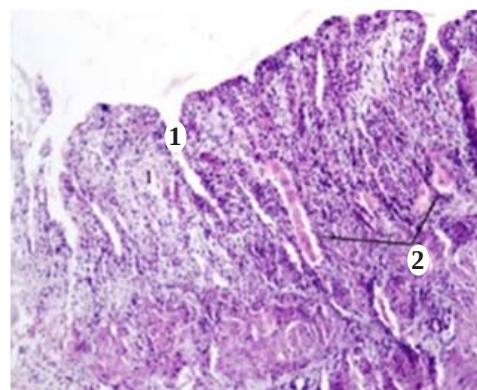


Fig. 3. Gallbladder mucosa two days after the first attack of cholecystitis. Findings: 1 – edema and diffuse leukocytic; 2 – congestion of the vascular bed. Infiltration of villi. Staining: Hematoxylin and eosin. ×200 [9].

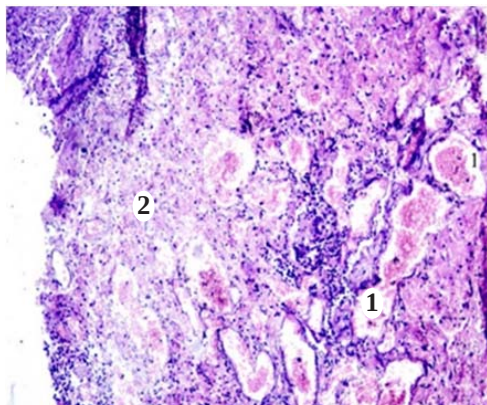


Fig. 4. Gallbladder wall fragment four days after the first cholecystitis attack.

Findings: 1 – dilation and congestion of blood vessels, red blood cell sludging, 2 – diffuse hemorrhagic and leukocytic infiltration. Staining: Hematoxylin and eosin. $\times 200$ [9]. Diagnosis: Necrotizing cholecystitis.

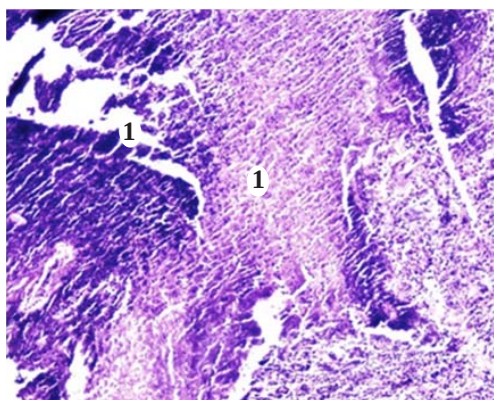


Fig. 5. Gallbladder wall fragment five days after the first cholecystitis attack.

Findings: 1 – purulent-necrotic changes in the mucosal and muscle layers. Staining: Hematoxylin and eosin. $\times 200$ [9].

develops, progressing to acute (complicated) destructive purulent cholecystitis, manifesting as empyema, phlegmon, gangrene, gallbladder wall perforation, perivesical abscess, and localized peritonitis.

Microscopic histological analysis confirms that in the early stages of cholecystitis, acute inflammation of different morphological types (both non-destructive and destructive) occurs in the gallbladder wall. These findings substantiate and validate the hypothesis of a pathomorphological classification of acute cholecystitis [10]:

- Edematous cholecystitis: First stage (2–4 days);
- Necrotizing cholecystitis: Second stage (3–5 days);

– Purulent cholecystitis: Third stage (7–10 days).

As seen in Table 1, out of 408 patients, within the first three days after an acute attack, 113 patients (27.7 %) were admitted; between 3–5 days – 132 patients (32.35 %) were hospitalized; and between 6–10 days – 78 patients (19.12 %) were admitted. Analysis of biliary colic episodes showed that 85 patients (20.83 %) experienced gallbladder decompression within 10–12 hours of effective conservative therapy, leading to clinical improvement and resolution of pain. These patients declined surgery and were discharged for outpatient monitoring under general practitioner supervision. Within one year of follow-up, 24 patients (28.33 %) underwent surgery during a recurrent pain episode, 17 patients (19.80 %) underwent elective surgery to prevent complications, 51.87 % of patients were not operated on as no recurrent pain episodes were observed within the short-term follow-up period. The largest group of patients (32.35 %) was admitted between 3–5 days after the first onset.

When analyzing the age distribution of patients according to the WHO age classification, we found that 186 patients (45.59 %) were aged 44–60 years. Among them, 65 patients (34.95 %) were admitted between 3–5 days after their first onset. Additionally, 93 patients (22.79 %) were aged 60 years or older.

Given these findings, we developed a surgical urgency model for laparoscopic cholecystectomy based on the pathomorphological staging of acute cholecystitis, emphasizing that surgical timing should be determined from the moment of diagnosis, rather than from symptom onset or hospital admission (Table 2).

Key findings from Table 2: 11.45 % of patients underwent surgery within 6 hours of diagnosis, 73.73 % of patients underwent surgery within 12 hours of diagnosis. Only 14.82 % of patients underwent delayed surgery (24–48 hours). Notably, only 3.7 % of patients with severe purulent obstructive cholecystitis (6–10 days) underwent delayed surgery, which we consider a tactical error, as these patients had complicated purulent cholecystitis and should have undergone earlier intervention.

The correlation analysis was performed and correlation relationships between the factors of acute cholecystitis were established (Table 3).

Discussion. The diagnosis of “acute cholecystitis” represents a critical surgical condition, encompassing both mild and severe attacks that can lead to complications. It is essential to refine the terminology of acute cholecystitis based on pathomorphological and clinical criteria, enabling: identification of “surgical” acute cholecystitis to predict the course of

Table 2. Timing of laparoscopic cholecystectomy based on acute cholecystitis stage and comorbidities

Cholecystitis Stage (First Attack)		Surgery Timing from Diagnosis, n (%)		
		Within 6 Hours (Urgent)	Within 12 Hours (Emergency)	Within 24–48 Hours (Delayed)
Up to 3 Days (n=113)	Without comorbidities	0(0)	78 (24.15)	0(0)
	With comorbidities	0(0)	22 (6.8)	13 (4.02)
3–5 Days (n=132)	Without comorbidities	0(0)	109 (33.8)	0(0)
	With comorbidities	0(0)	0(0)	23 (7.1)
6–10 Days (n=78)	Without comorbidities	37 (11.45)	0(0)	0(0)
	With comorbidities	0(0)	29 (8.98)	12 (3.7)

Table 3. Correlation analysis of acute cholecystitis factors

Factors	WBS	Gangrenous	Perivesical infiltrate	Empyema	Abscess
WBS		0.271447	0.300345	0.378238	0.1868
gangrenous	0.27145		0.363891	0.348576	0.42188
perivesical infiltrate	0.30035	0.363891		0.330015	0.24834
empyema	0.37824	0.348576	0.330015		0.11253
Abscess	0.1868	0.421879	0.248338	0.112528	

an attack, determination of surgical indications and urgency, prioritizing minimally invasive laparoscopic techniques for gallbladder diseases.

We align with Moshe Shein (2010) [13] who stated: “You cannot diagnose acute cholecystitis if the gallbladder is not tense.” Cystic duct obstruction leads to increased intraluminal pressure and gallbladder distension, making it tense and painful. Our research confirms that cystic duct obstruction is the pathogenic trigger of acute obstructive calculous cholecystitis.

As for inflammatory staging and surgical urgency, based on obstruction duration, we identified three pathomorphological stages of acute cholecystitis:

1. Alteration Phase (up to 3 days) – Edematous Cholecystitis
2. Exudation Phase (3–5 days) – Necrotic Cholecystitis
3. Suppuration Phase (6–10 days) – Purulent Cholecystitis

Thus, the term “acute obstructive calculous cholecystitis” is clinically justified and pathophysiologically accurate.

As for surgical timing in relation to age and comorbidities, we would like to make following statements. Historically, age and comorbidities were considered contraindications for urgent surgery. However, our findings contradict this notion:

- Neither age nor comorbidities should prevent

early emergency surgery in cases of acute obstructive calculous cholecystitis if cystic duct deobstruction does not occur.

- Delaying surgery in these patients leads to progression of the purulent-necrotic process, increasing morbidity and mortality.

A prospective study [11] compared: early laparoscopic cholecystectomy (<24 hours from admission) vs. delayed laparoscopic cholecystectomy (6–12 weeks after conservative treatment). Results showed that delayed surgery was accompanied by technical difficulties in 25–46.5% of cases. The inflammatory process progresses from the proliferation stage (4–12 days), through the connective tissue maturation stage (after the third week), to a mature scar in the remodeling stage (6–12 months). Theoretically, such a fibrotic scar is irreversible, leading to altered syntopy, which is an important source of classical iatrogenic injury to the common bile duct [12]. Thus, we have developed timeframes for performing surgery from the moment of diagnosis at different stages of the inflammatory process in cases of an obstructed gallbladder. Based on general pathological timelines, it is theoretically expected that within 24 hours after the symptom onset, all patients will exhibit local and systemic inflammation. It can be assumed that performing cholecystectomy at the early stage of the disease

may prevent complications associated with cholecystitis during surgery, especially in cases progressing to a severe form.

According to some researchers, the timing should not be based on symptom onset but rather on diagnosis confirmation of acute obstructive calculous cholecystitis, as linking early cholecystectomy to symptom onset is not always possible due to the subjective perception of signs and symptoms. Therefore, the clinical question of when to perform laparoscopic cholecystectomy remains unanswered. Given this, we have developed an urgency scale for laparoscopic cholecystectomy based on the pathomorphological staging of acute cholecystitis, not from the onset of symptoms or hospital admission, but from the moment of diagnosis.

We support Moshe Shein's opinion [13] that early laparoscopic cholecystectomy allows for easier dissection within the edematous plane. Contrary to the expectation that the inflammatory process in the gallbladder subsides, allowing perivisceral inflammation to "mature" into organized adhesions, this actually complicates dissection. Therefore, the severity of inflammation, rather than the disease duration, plays a decisive role in the difficulty of performing laparoscopic cholecystectomy [14].

According to the correlation analysis (Table 3), it was established that the correlation is most pronounced in patients with purulent cholecystitis. At the same time, the indicators of local destructive changes in the gallbladder wall with 6-10 day old neglected obturation calculous cholecystitis (gangrene, empyema, perivesical infiltrate, abscess) prevail. Perivesical infiltrate correlates with acute gangrenous cholecystitis ($r = 0.363891$, $p < 0.05$), empyema ($r = 0.330015$, $p < 0.05$). Empyema correlates with acute gangrenous cholecystitis ($r = 0.348576$, $p < 0.05$), leukocytosis ($r = 0.378238$, $p < 0.05$). Abscess correlates with acute gangrenous cholecystitis ($r = 0.421879$, $p < 0.05$). Leukocytosis correlates with empyema ($r = 0.378238$, $p < 0.05$), perivesical infiltrate ($r = 0.300345$, $p < 0.05$). Acute gangrenous cholecystitis correlates with

perivesical infiltrate ($r = 0.363891$, $p < 0.05$), empyema ($r = 0.348576$, $p < 0.05$), abscess ($r = 0.421879$, $p < 0.05$). The data of the correlation analysis confirmed the morpho-structural changes in the gallbladder wall at different stages of the inflammatory process, which justifies the choice of early terms of surgical intervention, namely: emergency (3-6 hours) – acute complicated purulent cholecystitis. This group includes patients with signs of complicated purulent cholecystitis, characterized by empyema, phlegmon, gangrene, gallbladder wall perforation, perivesical abscess, and localized peritonitis; urgent within 12 hours from the moment of diagnosis (necrotic cholecystitis), early delayed operations (24-48 hours).

For disease progression due to an obstructed cystic duct with ineffective conservative treatment, surgery is recommended within 12 hours of diagnosis, considering comorbid conditions and the patient's physiological status, regardless of the onset of symptoms. This group also includes patients with signs of necrotizing cholecystitis. Within 24 hours of diagnosing acute obstructive calculous cholecystitis, surgery is recommended in the absence of comorbid conditions and when conservative treatment is ineffective to prevent disease progression. In patients with comorbidities, surgery is advised within 24–48 hours following the diagnosis. When conservative therapy for acute obstructive cholecystitis is ineffective, surgical intervention is recommended.

Conclusions. The developed model of acute "surgical" cholecystitis and the timing of surgery based on pathomorphological data and correlation analysis will significantly improve the results of laparoscopic cholecystectomy.

A promising direction for further research - is the development of a mathematical model for assessing the severity of acute obstructive calculous cholecystitis, depending on different stages of the inflammatory process.

Conflict of interest. The authors declare that there is no conflict of interest.

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КОНЦЕПТУАЛЬНІ ПИТАННЯ ТЕРМІНОЛОГІЇ ТА ВИБОРУ ТЕРМІНІВ ОПЕРАЦІЇ У ХВОРИХ НА ГОСТРИЙ ОБТУРАЦІЙНИЙ КАЛЬКУЛЬОЗНИЙ ХОЛЕЦИСТИТ

Мета дослідження: розпрацювати сучасні питання термінології та вибору термінів лапароскопічної холецистектомії на основі оцінки стадійності запального процесу, загальних клінічних та локальних морфологічних критеріїв гострого обтураційного калькульозного холециститу.

Матеріали і методи. Проаналізовано результати 408-ми хворих на гострий холецистит. Виділено групи пацієнтів за давністю захворювання у терміни: до 3 діб, 3–5 діб, 6–10 діб із моменту першого нападу жовчної колики. Оцінено стадійність гострого холециститу залежно від тривалості обтурації міхурової протоки та супутньої патології. На цій основі запропоновані терміни виконання лапароскопічної холецистектомії підтверджують морфологічні дослідження видалених жовчних міхурів у відповідні терміни операції, а також дані кореляційного аналізу факторів гострого холециститу.

Результати. Доведено, що в патогенезі ремоделювання структурних компонентів жовчного міхура відіграють глибокі гемодинамічні розлади та пролонгація запального процесу, що обґрунтовують вибір ранніх термінів виконання лапароскопічної холецистектомії (у межах 12–24 год) після встановлення діагнозу.

Висновки. Розпрацьована модель гострого «хірургічного» холециститу на основі гострого обтураційного калькульозного холециститу суттєво покращить результати лапароскопічної холецистектомії у різні післяопераційні терміни.

Ключові слова: обтураційний калькульозний холецистит; терміни операції; лапароскопічна холецистектомія.