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Application of one-stage surgical tactics treatment of acute cholecystitis in combination with choledocholithiasis

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Abstract---Introduction: Concrements of the common bile duct (choledocholithiasis) occur from 8% to 20% in patients with acute cholecystitis. This pathology requires simultaneous correction of the pathology of the gallbladder and the common bile duct. Methods: We retrospectively analyzed the case histories of 135 patients who underwent endoscopic retrograde cholangio pancreatography, endoscopic papillosphincterotomy, choledocholithoextraction followed by laparoscopic cholecystectomy + CHEST + LCE) for acute cholecystitis in combination with choledocholithiasis in the period from January 2016 to March 2021. Patients who underwent simultaneous treatment (ERCP + EPST + CLE + LCE under one anesthesia) were assigned to the OS group (n = 63), patients who underwent two-stage treatment (ERCP + EPST + CLE and LCE on the 3-4th day during one hospitalization) were assigned to the TS group (n = 72). All endoscopic procedures in both groups were performed by the same endoscopist using the same technique. Result: There were significant differences between the groups in terms of the duration of anesthesia, the dynamics of the decrease in the blood serum of the total bilirubin and the leukocytes range at the postoperative period, the frequency of postoperative complications and the duration of the average hospitalization in favor of one-stage treatment. Conclusions:

One-time treatment tactic is safe and optimal for the treatment of acute cholecystitis combined with choledocholithiasis, characterized by a short hospital stay, a low rate of episodes of acute cholecystitis and recholedocholithiasis, which often occur with two-stage (TS) treatment tactics.

Keywords---diagnostics, endoscopic procedures, acute cholecystitis, choledocholithiasis, surgical treatment.

Introduction

Common bile duct calculi (CBD) occur in patients with acute cholecystitis with a frequency of 8% to 20% [1,2]. Despite the fact that the problem of acute cholecystitis in combination with choledocholithiasis is being studied by many foreign researchers, until now there is no evidence regarding a safe time interval between endoscopic and laparoscopic interventions. According to Allen N. et al., if after resolution of choledocholithiasis radical cholecystectomy is not performed, then the frequency of subsequent complications of cholelithiasis varies from 11 to 47% [3]. Considering the widespread use of cholelithiasis and its complications with choledocholithiasis, an increase in the number of surgical interventions, as well as the widespread introduction of new technologies, the urgency of further study and optimization of treatment tactics and determination of the effectiveness of modern minimally invasive operations is obvious. With prolonged course of intraductal biliary hypertension caused by concretions of the CBD, the risk of developing cholangitis is extremely high. This circumstance, in turn, can lead to a rapid deterioration in the patient's condition, and death can occur in a short time. Therefore, this pathology requires solving the problem simultaneously from the side of the gallbladder and the common bile duct [4].

Optimizing the costs of the healthcare system in our country is one of the most pressing problems. One effective method of reducing costs is to reduce the length of a patient's hospital stay. Implementation of one-stage (OS) treatment tactics - endoscopic retrograde cholangiopancreatography, endoscopic papillosphincterotomy, choledocholitholithectomy followed by laparoscopic cholecystectomy (ERCP + EPST + CLE + LCE) under one anesthesia can be one of the optimal methods for reducing the duration of choledochaemia and the frequency of recurrent inpatient treatment reducing costs for this category of patients. Several European studies have shown satisfactory results with one-stage ERCP + EPST + CLE + LCE compared with traditional two-stage (TS) treatment (ERCP + PEPT + CLE + LCE after 1-3 months) [5-7].

The aim of the current study was to compare the effectiveness of the use of a one-stage treatment method with a two-stage treatment for acute cholecystitis, combined with choledocholithiasis.

Methods and materials

The work is based on the analysis of the results of surgical treatment of 135 patients with acute cholecystitis in combination with choledocholithiasis, who

were treated at the City Clinical Hospital No. 4 of the city of Almaty for the period from January 2016 to March 2021.

The study protocol was approved by the Ethics Commission of the NJSC "KazNMU named after S.D. Asfendiyarov" (protocol No. 13 of November 25, 2020). All patients gave informed voluntary consent for examination and treatment in accordance with the Declaration of Helsinki.

Inclusion criteria were age over 16 years, bile duct stones up to 15 mm in size, acute cholecystitis (without gallbladder perforation), no suspicion of the presence or confirmed malignant neoplasms of the pancreatobiliary zone and no contraindications for laparoscopic cholecystectomy, physical status of patients according to the classification of the American Society of Anesthesiologist (ASA) I, II, III.

Exclusion criteria were age up to 16 years, late pregnancy, gallbladder cancer, shriveled gallbladder, diffuse peritonitis, gallbladder perforation, ASA IV-V. Patients who failed to successfully complete ERCP + EPST were also excluded. The indications for ERCP + EPST were carefully assessed for each patient after consultation with the endoscopist, surgeon and anesthesiologist before the procedure, i.e. this category of patients requires a multidisciplinary approach to treatment. All patients were operated on urgently.

Depending on the tactics of surgical treatment, the patients were divided into 2 groups. Patients with one-stage treatment tactics under one anesthesia (ERCP + EPST + CLE + LCE) assigned to the OS group (n = 63) were treated in the period 2018-2021, since the one-stage treatment was introduced in January 2018. two-stage tactics (ERCP + EPST + CDE and LCE on the 3rd or 4th day) were assigned to the TS group (n = 73). They were treated between 2016-2017.

Table 1 presents data on the main general and clinical indicators of the surveyed when divided into groups.

Table 1 Differences between the study groups by age, sex, duration of obstructive jaundice, forms of acute destructive cholecystitis

Parameter	One-stage surgery group (n = 63)	Two-stage surgery group (n = 72)	p value
Age, medium (min-max)	54.0 (23-88)	54.2 (26-84)	0.97
Sex (m/f)	19/44	17/55	0.25
Obstructive jaundice	48 (76.2%)	58 (80.6%)	0.30
Duration of jaundice (hour)	35.2±5.4	39.6±7.7	0.41
Duration of an attack of acute cholecystitis (hours)	49.6±11.2	46.0±13.0	0.57
Cholangitis	13 (20.6%)	7 (9.7%)	0.12
Number of calculi			
Single	26 (41.3%)	32 (44.4%)	0.27

Plural	37 (58.7%)	40 (55.6%)	
Calculus size (mm)	8.1±3.2	9.2±3.6	0.31
Clinical morphological form of acute cholecystitis			
Acute obstructive cholecystitis	48 (76.2%)	49 (68.1%)	0.45
Acute phlegmonous cholecystitis	13 (20.6%)	23 (31.9%)	
Acute gangrenous cholecystitis	2 (3.2%)	0	

Comparative analysis of the main group and the comparison group for the main clinical parameters did not reveal significant differences. The average age of patients in both groups was almost identical. When distributed by sex, there was a slightly higher relative number of men in the main group, with a general predominance of the number of women.

There were no significant differences in the number of cases of jaundice associated with obstruction of the biliary tract, the duration of the state of acute cholecystitis, the frequency of cholangitis.

In both groups, multiple calculus was more often observed, there were no significant differences in the frequency of such. The frequency of cholangitis was insignificantly higher in the study group.

The majority of patients in both groups were operated on for acute obstructive cholecystitis, acute phlegmonous cholecystitis was more frequent in the comparison group, but only in the main group there were cases of gangrenous cholecystitis (in 2 patients, 3.2%).

Thus, the surveyed groups were representative in all general and clinical characteristics. We believe that there was no significant effect of the revealed insignificant differences on treatment results.

The study process included comparison of laboratory parameters (total bilirubin level, alanine aminotransferase (ALT), aspartate aminotransferase (AST), amylase, leukocyte count in peripheral blood), duration of anesthesia, length of hospital stay. Early clinical outcomes and complications were determined.

Surgical tactics

The one-stage tactics of treatment of acute cholecystitis, which we use, combined with choledocholithiasis, have recently been widely introduced into the surgical practice of medical institutions in many countries, and their results are described in detail in a number of scientific studies [8-11]. But in the Republic of Kazakhstan, the first application of this tactic began with us in 2018 [12].

With this technique, ERCP + EPST + CLE are the first stage of the intervention. In order to prevent post-cannulation pancreatitis, an hour before the operation, patients are injected with a non-steroidal anti-inflammatory drug. In the operating room after preoperative preparation under total intravenous anesthesia

with artificial ventilation of the lungs, the patient in the prone position under the control of an electronic optical device (Siemens Siremobil Compact L) is performed ERCP + EPST (Pentax ED-3490TK), CLE using the Dormia basket. Intubation of the duodenoscope is performed in the descending part of the duodenum (Duodenum). The papillotome is inserted retrogradely into the large duodenal nipple (BDS). Further, with the help of a conductor, the catheterization of the common bile duct is assessed, after which the contrasting of the common bile duct and the detection of calculi are performed, then papillosphincterotomy is performed with the help of the papillotome, the middle of the cutting string is set at the BDS at 11-13 hours of its circumference. By pulling the handle, the cutting part approaches the anteroposterior wall of the BDS. Papillotomy is performed by a series of short current flows in a mixed mode of coagulation and cutting or only cutting, gradually removing the papillotome. Next, litho extraction is performed with the Dormia basket. After that, a revision of the bile ducts is performed with a Dormia basket or a balloon extractor. Upon completion, control contrasting of the biliary tract is carried out. In the absence of calculi, the contrast agent is aspirated and the bile ducts are flushed with warm saline. At the end of the procedure, air is aspirated from the upper gastrointestinal tract, then a nasogastroduodenal probe is installed to evacuate air and to prevent iatrogenic damage to the intestine. To perform the second stage, the patient's position is changed by turning onto his back. After the processing of the operating field, working trocars are installed at typical points of the Calca and LCE is performed.

With TS treatment tactics, the techniques of ERCP + EPST and LCE remain identical as with OS tactics, however, there is a time interval of 48-72 hours between ERCP + EPST and LCE.

Statistical analysis

According to generally accepted statistical According to the technique, the data array obtained during the examination of patients was processed on a personal computer using the statistical program GraphPad Prism 8 (GraphPad Software, San Diego, California, USA) using the methods of parametric and nonparametric statistics. All continuous variables were presented as mean $\pm$ standard deviation. All categorical variables were presented as frequencies (percentage). Student's t-test was used to test the statistical significance of differences in measured variables between the two groups. When determining the criteria that exclude the use of parametric methods (absence of equality of variances and normal distribution), the Mann-Whitney test was used. To determine the significance of differences in qualitative data between the two study groups, a two-sided Fisher's exact test was used. To refute the null hypothesis, the level of differences had to exceed $p < 0.05$.

Results

Analysis of the results of surgical treatment revealed a limited number of differences between the OS and TS intervention groups, but they play a significant role in the clinical characteristics of the postoperative course.

Analyzing laboratory parameters, data were obtained presented in table 2.

Table 2 Indicators of laboratory examination in dynamics

Parameters	One-stage surgery group (n = 63)	Two-stage surgery group (n = 72)	p
Total bilirubin ($\mu\text{M} \cdot \text{l}^{-1}$):			
- on admission	86.2 $\pm$ 8.8	98.7 $\pm$ 10.9	>0.05
- after surgery	24.2 $\pm$ 6.5	31.8 $\pm$ 7.7	>0.05
ALT (U/l):			
- on admission	225.5 $\pm$ 63.4	203.0 $\pm$ 61.0	>0.05
- after surgery	85.5 $\pm$ 17.0	87.6 $\pm$ 18.6	>0.05
AST (U/l):			
- on admission	173.0 $\pm$ 48.4	157.8 $\pm$ 41.3	>0.05
- after surgery	50.4 $\pm$ 19.4	53.2 $\pm$ 17.0	>0.05
Amylase (U/l):			
- on admission	164.2 $\pm$ 51.3	144.3 $\pm$ 56.1	>0.05
- after surgery	56.6 $\pm$ 14.3	58.9 $\pm$ 11.7	>0.05
Leukocytes ($10^9 \cdot \text{l}^{-1}$):			
- on admission	13.1 $\pm$ 3.2	12.0 $\pm$ 2.8	>0.05
- after surgery (3 rd day)	10.8 $\pm$ 2.0	12.1 $\pm$ 2.5	>0.05
- after surgery (5 th day)	8.9 $\pm$ 1.1	10.2 $\pm$ 1.7	>0.05

It should be noted that the studied indicators of the functional state of the liver did not differ significantly between the groups. Before surgical treatment, a sharp increase in the level of bilirubin in the blood was recorded in comparison with the normative indicators, which was determined by obstruction of the biliary tract. After surgery, a rapid decrease in this indicator was determined; in the group with a single-stage intervention during the study period, it was slightly lower than in the comparison group, but the differences were not statistically significant.

Similar conclusions should be drawn regarding the activity of the studied enzymes. There were no differences in ALT, AST and amylase activity indicators, reflecting the degree of damage to the liver and pancreas tissues.

The total leukocyte count was insignificantly higher than that of the two-stage intervention group in the one-stage group. During the examination 5 days after the operation, the opposite state was observed - the indicator was lower in the group of one-stage operation. The degree of reduction in the first case was 32.2%, in the second - 14.8% ($p = 0.037$).

Table 3 presents an analysis of the frequency of early complications of surgical interventions.

Table 3 Early postoperative complications in the study groups

Parameters	One-stage surgery group (n = 63)		Two-stage surgery group (n = 72)		p
	n	%	n	%	
Complications of endoscopic retrograde cholangiopancreatography					
Reholedocholithiasis	0	0	7	9.7	0.011

Acute pancreatitis	7	11.1	15	20.8	0.124
Bleeding in the area of the greater duodenal papilla	2	3.2	2	2.8	0.661
Total	9	14.3	24	33.3	0.009
Laparoscopic Cholecystectomy					
Cystic artery stump bleeding	2	3.2	3	4.2	0.573
Bile leakage	1	1.6	2	2.8	0.550
Suppuration of a postoperative wound	0	0	3	4.2	0.149
Bleeding from the gallbladder bed	1	1.6	2	2.8	0.550
Total	4	6.4	10	13.9	0.128
Grand total	13	20.6	34	47.2	0.001

The most significant complications of interventions performed on the common bile duct were recurrent choledocholithiasis, acute pancreatitis and bleeding from the area of the greater duodenal papilla. At the same time, despite the fundamental identity of the performed surgical interventions, there were no cases of recurrent choledocholithiasis in the group of one-stage treatment, while there were 7 (9.7%) in the group of two-stage intervention. The differences turned out to be statistically significant.

The incidence of acute pancreatitis as a result of the intervention was almost twice as high in the two-stage intervention group, although the differences were not significant.

Overall, the number of complications associated with choledochus interventions in the OS surgical treatment group was 14.3%, and TS was 33.3% ($p = 0.009$).

Complications associated with the stage of cholecystectomy did not differ in frequency between the groups, although there were tendencies towards a decrease in the frequency of complications with the single-stage variant of the intervention. As a result, the overall incidence of complications recorded during the follow-up period with OS intervention was 2.3 times lower than with TS.

An analysis of the total duration of anesthesia during interventions was also performed (Figure 1).

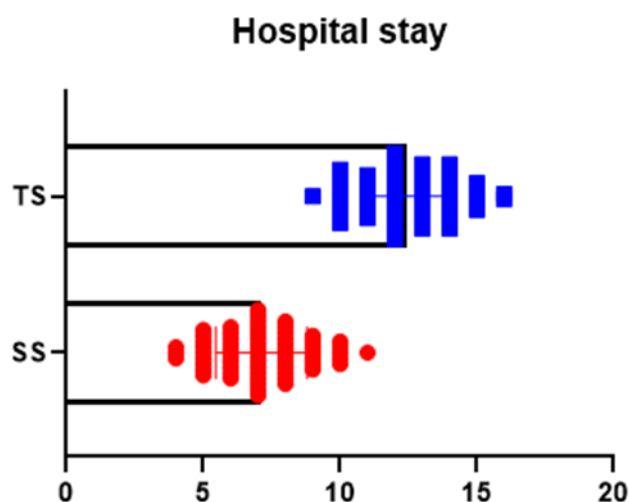


Fig. 1 Distribution of the cumulative anesthesia period by duration

The total duration of the anesthesia period taking into account the second stage of intervention in the TS group was 145.6 ± 17.2 minutes versus 133.0 ± 14.5 minutes in the OS group (the differences are insignificant).

Figure 2 shows the data on the duration of hospitalization depending on the group of the examined.

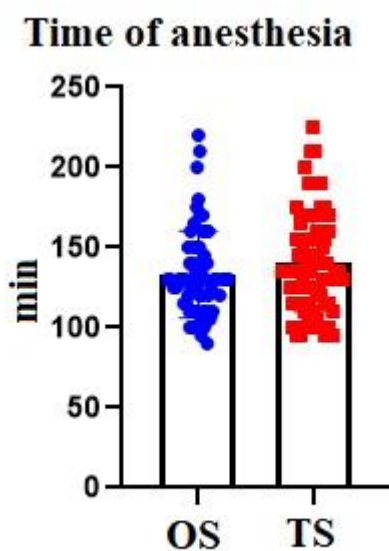


Fig. 2 Duration of inpatient treatment depending on tactics

Duration of inpatient treatment in patients of the OS group ranged from 4 to 11 days, TS group - from 9 to 16 days. The average values were 7.3 ± 1.5 and 11.9 ± 1.3 ($p = 0.030$).

Discussion

According to some authors, ERCP + EPST + CLE + LCE under one anesthesia is the best approach in this category of patients, since from diagnostic ERCP it is possible to switch to therapeutic measures when calculi are detected and to eliminate the block in the common bile duct with minimal aggression on the patient's body [13]. Friis et al. (2007) in their recent systematic review showed that early LCE after endoscopic choledocholite extraction significantly reduces mortality, the risk of recurrence of acute cholecystitis and the length of hospital stay compared with delayed LCE [14]. The authors concluded that, ideally, patients should be operated on within 24 hours after ERCP + EPST, or at least within the first few days. It should be noted that this study did not include patients with acute cholecystitis. In our study, we used the criterion of the effectiveness of one-step tactics (laboratory data, risk of recholedocholithiasis, length of hospital stay) in patients with acute cholecystitis in combination with choledocholithiasis. Terauchi et al. in 2006 analyzed the results of treatment of 119 patients with acute cholecystitis in combination with choledocholithiasis [15]. For 106 patients, OS was used, and 13 patients were treated with TS. Comparison of the two groups did not reveal significant differences in the time of surgery, the incidence of postoperative complications and bed-days.

Rabago et al. in 2006 reported success in the ERCP + EPST + LCE group in 96.6% of patients and in 90.2% in the LCE group + laparoscopic debridement of the common bile duct [16]. However, LCE with simultaneous laparoscopic elimination of choledocholithiasis is still not widely used, since this method requires a high level of technical training of the surgeon in terms of laparoscopic skills and special video endoscopic equipment [17]. If a medical institution does not meet the above requirements, then Vecchio and MacFadyen at 2002 recommend resorting to ERCP + EPST + CLE + LCE under one anesthesia, as a method that is not inferior in efficiency of laparoscopic sanitation of the common bile duct [18]. In our study, surgical treatment was performed by a highly specialized experienced surgeon and endoscopist. All operations were performed by the same specialists.

Optimal management of patients with acute cholecystitis in combination with choledocholithiasis largely depends on the professional level of medical personnel, multidisciplinary (radiologist, endoscopist, surgeon, anesthesiologist) and technical equipment of the medical institution [19]. In our practice, we did not experience difficulties in organizing the stages of OS tactics.

In the randomized trials of Muhammedoğlu and Kale, patients with acute cholecystitis in combination with choledocholithiasis were divided into 2 groups with the participation of 119 patients who received OS treatment tactics and TS tactics with delayed LCE [20]. The results of the study show that TS tactics have the greatest success in the treatment of acute cholecystitis in combination with choledocholithiasis, advantages in terms of the duration and cost of

hospitalization, and a short duration of anesthesia. The biggest advantage of OS tactics is that the procedure is carried out in one stage in the same medical institution, there is no risk of repeated episodes of acute cholecystitis and recholedocholithiasis. Williams and Vellacot argue that the number of bed-days can be significantly reduced precisely by using ERCP + EPST + CHLE + LCE under one anesthesia [21]. In our study, the number of bed-days spent in the hospital in group A was significantly less than in group B. Jones et al. in their studies compared the effectiveness between OS and TS tactics based on the treatment of 20 patients [22]. As a result, there was a statistically significant difference between the methods in terms of costs ($p = 0.033$), although there were no statistically significant differences in terms of length of stay and complication. In our study, statistical differences were found in terms of anesthesia time, in the dynamics of a decrease in total bilirubin and blood leukocyte after surgery and the average hospital stay in favor of OS treatment tactics.

Enochsson et al. (2004) reported that in supine patients, cannulation of the common bile duct during ERCP may be more difficult [23]. For selective cannulation of the common bile duct, Pesce et al. in 2017 assessed the effectiveness of the so-called "rendez-vous" technology, in which a conductor was inserted antegradely into the duodenum, which, under the control of a duodenoscope, was removed through the mouth, papillotome was inserted into the BDS and papillosphincterotomy was performed [24]. Thanks to this technique, blind catheterization of the OBD is excluded and, as a result, a decrease in the number of complications is observed. This technique, in turn, is a routine procedure that requires good technical equipment and high professionalism and experience. In our practice, the success of cannulation and sanitation of the common bile duct was complete, and there were no cases of recholedocholithiasis in group A, since the gallbladder with calculi were removed immediately after ERCP + EPST under one anesthesia. Several foreign articles reported some technical difficulties during LCE after ERCP due to pneumatosis of the duodenum and proximal jejunum [23]. In our practice, at the end of the ERCP + EPST procedure, air is aspirated from the upper gastrointestinal tract, then a nasogastroduodenal probe is installed to evacuate air and to prevent iatrogenic damage during intestinal LCE [10].

Zang et al. in their studies evaluated the efficacy and safety of OS tactics in 91 patients and TS tactics in 65 patients [25]. The average duration of endoscopic interventions in the OS group was 34.9 minutes, in the TS group - 35.3 minutes. At the same time, there were no statistically significant differences between the groups in the success of ERCP + EPST (97.8% for the OS group versus 98.5% for the TS group). The authors concluded that the simultaneous resolution of cholecystocholedocholithiasis can be performed under one anesthesia and is safe for patients. In our practice, the average time of ERCP + EPST + CLE was 51.3 ± 23.2 minutes in group A and 51.8 ± 21.9 minutes in group B, and 73.5 ± 20.5 minutes and 80.0 ± 25.9 min, respectively. As our observations have shown, the operating time largely depends on the state of the OBD, the size of the calculus. The larger the diameter of the calculus is the diameter of the common bile duct, the longer ERCP + EPST + CLE takes. Despite different factors, no significant statistical differences in the duration of ERCP + EPST + CLE and LCE were revealed in our work. It is impossible not to note the role of preventive

maintenance of the so-called post-cannulation pancreatitis. The incidence of acute pancreatitis after ERCP + EPST ranges from 1 to 12% and develops within 24 hours after the endoscopic procedure [26]. For prophylactic purposes, we carry out complex conservative therapy, including drugs that inhibit the secretion of the pancreas, inhibitors of proetasis and non-steroidal anti-inflammatory drugs. A number of foreign sources provide tactics for preventing acute pancreatitis, such as selective conjuration of the common bile duct, dosed administration of contrast agents and only in diluted form, followed by complete aspiration [27].

An equally important point during ERCP + EPST is the position of the patient on the operating table. In our practice, for optimal and safe cannulation of the common bile duct, we use the prone position [12]. This position facilitates selective cannulation of the common bile duct, provides a convenient image of the biliary tree and prevents aspiration of gastric contents into the airways.

In most medical institutions, the tactics of managing patients with acute cholecystitis combined with choledocholithiasis is more selective, which in turn is not allows to carry out comparative analysis among different methods on a large number of patients. It is necessary to further accumulate experience and improve these techniques, assess the immediate and distant results, which will allow more effective treatment of patients with acute cholecystitis in combination with choledocholithiasis using minimally invasive and endovideosurgical methods.

There are some limitations in our work. in the form of an individual character in relation to patients and a short period of observation of patients after surgery. According to generally accepted standards, reliable reasoning of long-term results will take at least 5-10 years or more.

Conclusions

Our study shows that both approaches to the treatment of acute cholecystitis combined with choledocholithiasis meet all the requirements of modern surgery. Each method has its own indications and contraindications. However, the most preferable for this category of patients seems to be the OM tactics, the use of which allows to obtain quite satisfactory results. Simultaneous resolution of acute cholecystitis in combination with choledocholithiasis is accompanied by a decrease in moral and psychological trauma to the patient, material and economic costs by reducing postoperative complications (recholedocholiasis) and the patient's stay in a medical institution, the introduction of lower doses of drugs (one anesthesia instead of two), makes it possible early rehabilitation of patients, reduction of the period of incapacity for work of the population.

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