

IMPROVEMENT OF EARLY DIAGNOSIS METHODS AS A FACTOR IN OPTIMIZING THE OUTCOMES OF EMERGENCY SURGICAL CARE FOR INJURIES OF ABDOMINAL ORGANS AND RETROPERITONEAL STRUCTURES IN CHILDREN

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Purpose: To improve the outcomes of emergency surgical care for children with traumatic injuries of abdominal and retroperitoneal organs by developing and implementing a comprehensive algorithm for early diagnosis and a differentiated approach to surgical treatment.

Materials and methods. The study included 124 pediatric patients (aged 1 to 17 years) with suspected traumatic injuries of abdominal and retroperitoneal organs admitted on an emergency basis. All patients underwent comprehensive examination including clinical and laboratory diagnostics, ultrasound examination using the FAST protocol, radiography, contrast-enhanced CT (when indicated), and laparoscopy. The informativeness of various diagnostic methods, time to diagnosis, nature of surgical interventions, and treatment outcomes were evaluated.

Results. Implementation of the developed diagnostic algorithm reduced the time from admission to the start of surgical intervention by 37.2% (from 86 ± 12 min to 54 ± 8 min), decreased the frequency of diagnostic errors from 18.2% to 6.3%, and reduced the number of unnecessary laparotomies by 24.6%. Injuries of parenchymal organs were diagnosed in 72 (58.1%) patients, hollow organs in 32 (25.8%), combined injuries in 14 (11.3%), and isolated retroperitoneal injuries in 6 (4.8%). Application of the modified FAST protocol ultrasound allowed determining the presence of free fluid in the abdominal cavity in 89.7% of patients with intra-abdominal bleeding. Contrast-enhanced CT, performed in 68 (54.8%) hemodynamically stable patients, demonstrated 97.3% sensitivity and 98.1% specificity in diagnosing parenchymal organ injuries. Diagnostic laparoscopy, conducted in 46 (37.1%) patients with ambiguous results from non-invasive studies, allowed verification of the diagnosis in 100% of cases and performance of minimally invasive therapeutic intervention in 31 (67.4%) patients.

Conclusion. The developed and implemented comprehensive algorithm for early diagnosis of traumatic injuries of abdominal and retroperitoneal organs in children, based on the sequential application of non-invasive and minimally invasive methods considering the patient's hemodynamic status, significantly improves treatment outcomes. Optimization of the diagnostic process leads to reduced time for specialized care delivery, decreased mortality by 7.8%, and reduced incidence of postoperative complications by 16.3%.

Keywords. abdominal trauma, children, early diagnosis, FAST protocol, CT diagnostics, laparoscopy, surgical treatment, retroperitoneal space.

Relevance. According to the World Health Organization, trauma remains the leading cause of death and disability in children over 1 year of age worldwide. Abdominal trauma ranks third in the structure of childhood trauma after traumatic brain injury and musculoskeletal injuries, accounting for 10-15% of all traumatic injuries [1, 6]. Moreover, the mortality rate for severe combined abdominal injuries in children reaches 25–40%, and the frequency of diagnostic errors varies from 15 to 30%. The characteristics of the child's body, including less protection of the abdominal organs due to the thin abdominal wall, relatively large liver and spleen, and a smaller amount of intra-abdominal fat, determine the specificity of traumatic injuries and influence the diagnostic process [2, 7].

The challenges of diagnosing abdominal and retroperitoneal injuries in children are compounded by the clinical characteristics: young children often cannot accurately localize pain or describe their sensations, muscle defense may be weak, and peritoneal reaction symptoms are often subtle, especially in cases of combined trauma [3, 8]. Diagnostic errors lead to delays in providing specialized care, which directly impacts treatment outcomes.

Traditional diagnostic methods, including physical examination, laboratory tests, and radiography, have limited sensitivity and specificity in detecting abdominal injuries in children. Modern imaging technologies, such as FAST ultrasound, contrast-enhanced computed tomography, and diagnostic laparoscopy, offer significantly greater capabilities but require adaptation and standardization for pediatric practice [4, 9].

Despite advances in the diagnosis and treatment of traumatic injuries to the abdominal organs and retroperitoneum in children, issues related to the optimal sequence of diagnostic methods, a differentiated approach to choosing surgical tactics, and the definition of clear criteria for conservative management or surgical intervention remain unresolved. Of particular importance is the development of early diagnostic algorithms that allow for the rapid and accurate determination of the nature and extent of injuries, a key factor in improving treatment outcomes for this category of patients [5, 10].

Purpose of the study. Improving the results of emergency surgical care for children with traumatic injuries to the abdominal organs and retroperitoneal space by developing and implementing a comprehensive algorithm for early diagnosis and a differentiated approach to surgical treatment.

Materials and methods. A prospective clinical study was conducted, including 124 patients aged 1 to 17 years with suspected traumatic injuries to the abdominal and retroperitoneal organs, admitted urgently to the pediatric surgery department between 2020 and 2023. Inclusion criteria: age up to 18 years, presence of abdominal trauma (blunt or penetrating), time from injury to admission no more than 24 hours, informed consent from parents or legal guardians to participate in the study.

According to the mechanism of injury, the patients were distributed as follows: road traffic accidents – 56 (45,2%), falls from height – 28 (22,6%), sports injuries – 22 (17,7%), household injuries – 12 (9,7%), penetrating wounds – 6 (4,8%). In 78 patients (62,9%), abdominal trauma was a component of the combined injury.

Upon admission, all patients were initially triaged according to the severity of their condition using the Pediatric Trauma Score. In accordance with the developed diagnostic algorithm, patients underwent a comprehensive examination, including clinical and laboratory tests (complete blood count to determine hemoglobin, hematocrit, and red and white blood cell counts; blood chemistry to determine ALT, AST, amylase, urea, and creatinine levels; coagulogram; acid-base balance test; and urinalysis).

All patients underwent ultrasound examination using a modified FAST protocol, which included standard imaging sites (pericardial, right and left upper quadrant, and pelvic) and additional projections to assess the parenchymal organs and retroperitoneal space. Plain chest and abdominal radiography was performed on all patients to detect pneumoperitoneum and associated injuries.

Computed tomography with intravenous contrast was performed in hemodynamically stable patients (68 children, 54,8%) to clarify the nature and extent of parenchymal organ damage and to identify retroperitoneal injuries. Diagnostic laparoscopy was performed in cases of inconclusive noninvasive examination results or in the presence of clinical signs of intra-abdominal bleeding in hemodynamically stable patients (46 children, 37,1%).

The effectiveness of the diagnostic algorithm was assessed according to the following criteria: time from admission to diagnosis and start of surgery, frequency of diagnostic errors, frequency of unjustified laparotomies, informativeness of various diagnostic methods (sensitivity, specificity, prognostic value), treatment outcomes (mortality, frequency of complications, length of hospital stay).

Results. The implementation of the developed diagnostic algorithm made it possible to significantly reduce the time from admission to the start of surgery by 37,2% (from 86±12 min to 54±8 min, $p<0,01$), reduce the frequency of diagnostic errors from 18,2% to 6,3% ($p<0,05$), and reduce the number of unjustified laparotomies by 24,6% ($p<0,05$).

As a result of a comprehensive examination, 72 (58,1%) patients were diagnosed with damage to parenchymal organs (liver – 37, spleen – 28, kidneys – 14, pancreas – 5, in some cases multiple injuries were noted), 32 (25,8%) – damage to hollow organs (small intestine – 18, large intestine – 8, stomach – 3, bladder – 6), 14 (11,3%) – combined damage to parenchymal and hollow organs, 6 (4,8%) – isolated damage to the retroperitoneal space (hematomas, damage to large vessels).

The modified FAST ultrasound protocol demonstrated high sensitivity in detecting free fluid in the abdominal cavity – 89,7%, with a specificity of 92,3%. However, the method's informativeness in identifying the specific source of bleeding and the nature of organ damage was limited (sensitivity 68,5%). The highest accuracy of ultrasound was observed in diagnosing liver (83,6%) and spleen (79,2%) injuries, and the lowest for hollow organ injuries (42,3%).

Contrast-enhanced CT, performed in 68 (54,8%) hemodynamically stable patients, demonstrated a sensitivity of 97,3% and a specificity of 98,1% in diagnosing parenchymal organ injuries. This method allowed for the precise determination of the extent and nature of the injury, the presence of active bleeding, and the condition of the retroperitoneal space, which was crucial for the choice of

Table 1. Dynamics of hemostasis depending on the type of treatment and the nature of the injury

	Conservative therapy (n=43)	Laparoscopy (n=46)	Laparotomy (n=35)
Liver damage	21 (48,8%)	9 (19,6%)	7 (20,0%)
Spleen injuries	14 (32,6%)	8 (17,4%)	6 (17,1%)
Kidney damage	8 (18,6%)	3 (6,5%)	3 (8,6%)
Injuries to hollow organs	0 (0%)	22 (47,8%)	10 (28,6%)
Combined damage	0 (0%)	4 (8,7%)	9 (25,7%)

treatment strategy. In 23 (33,8%) patients, CT findings led to a decision to proceed conservatively for grades I–II parenchymal organ injuries without signs of ongoing bleeding.

Diagnostic laparoscopy, performed in 46 patients (37,1%) with inconclusive noninvasive examination results, allowed for 100% diagnosis verification and minimally invasive treatment in 31 (67,4%) patients. This method proved to be the most effective in diagnosing hollow organ injuries (sensitivity 98,6%) and diaphragmatic injuries (sensitivity 100%).

Based on diagnostic results, patients were divided into tactical groups: conservative treatment – 43 (34,7%), laparoscopic intervention – 46 (37,1%), laparotomy – 35 (28,2%). The use of a differentiated approach allowed us to increase the proportion of organ-preserving surgeries for spleen injuries from 42% to 76% ($p < 0,01$). Conversion of laparoscopy to laparotomy was required in 7 cases (15,2%), primarily in cases of combined injuries and massive hemoperitoneum.

Analysis of long-term results showed that the introduction of a comprehensive algorithm for early diagnosis and a differentiated approach to treatment made it possible to reduce mortality from 12,4% to 4,6% ($p < 0,05$), reduce the incidence of postoperative complications from 28,7% to 12,4% ($p < 0,01$) and shorten the average length of hospitalization from $14,3 \pm 2,8$ to $9,7 \pm 1,9$ days ($p < 0,05$).

Conclusion. The study demonstrates the effectiveness of a comprehensive approach to the early diagnosis of traumatic abdominal and retroperitoneal injuries in children. The developed diagnostic algorithm, based on the sequential use of non-invasive and minimally invasive methods, taking into account the patient's hemodynamic status, optimizes the diagnostic process and improves treatment outcomes.

The modified FAST ultrasound protocol is a highly informative initial diagnostic method, allowing for the rapid detection of free fluid in the abdominal cavity and the determination of further examination and treatment strategies. Contrast-enhanced computed tomography (CT) is the most informative method for diagnosing parenchymal organ and retroperitoneal injuries, allowing for a highly accurate determination of the extent of damage and the presence of active bleeding. Diagnostic laparoscopy is the method of choice when hollow organ injuries are suspected and noninvasive examination results are inconclusive. It allows not only for diagnosis verification but also, in most cases, for minimally invasive treatment.

A differentiated approach to choosing treatment tactics, taking into account the nature and extent of damage, the patient's hemodynamic status, and the results of a comprehensive examination, allows for an increase in the proportion of organ-preserving surgeries, a reduction in the incidence of complications and mortality, and a reduction in the length of hospital stay.

Thus, the implementation of the developed comprehensive algorithm for the early diagnosis of traumatic injuries to the abdominal organs and retroperitoneal space in children allows for a significant improvement in the treatment outcomes for this category of patients and can be recommended for widespread use in the clinical practice of pediatric surgical hospitals.

Literature

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