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INTRAOPERATIVE COMPLICATIONS OF LAPAROSCOPIC FUNDOPLICATION IN THE TREATMENT OF REFLUX ESOPHAGITIS: ANALYSIS OF RISK FACTORS AND PREVENTION METHODS

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Abstract

This article analyzes intraoperative complications during laparoscopic fundoplication for reflux esophagitis treatment. The research examines global prevalence data and evaluates surgical complications, focusing on bleeding (0.3-0.75% incidence), organ perforation (0-4%), and nerve damage (10-41%). The study emphasizes that successful outcomes (80-95%) correlate with surgeon experience and hospital equipment level, while inexperienced surgeons show reduced success rates (40-50%). Key findings highlight the importance of comprehensive preoperative diagnostics, including endoscopic, radiological, and pH monitoring methods for accurate surgical planning. The article outlines specific preventive measures and management strategies for various complications, including vascular injuries, hollow organ perforations, and pleural damage. The research concludes that complication prevention primarily depends on surgeon expertise, surgical team coordination, and thorough preoperative patient assessment. These findings contribute to improving surgical outcomes and reducing complication rates in laparoscopic fundoplication procedures.

Introduction

According to statistical data, the prevalence of reflux esophagitis in 2014 was 18.1-27.8% in North America; 8.8-25.9% in Europe; 2.5-7.8% in East Asia; 8.7-33.1% in the Middle East; 11.6% in Australia; and 23% in South America [6]. While this disease has multiple causes, sliding hiatal hernias are the primary cause in 90% of patients, ranking among the most common gastrointestinal tract disorders, although its exact prevalence cannot be determined due to often asymptomatic progression [11].

Despite the introduction of "powerful," relatively effective eradication and antisecretory drugs into practical use, which provide temporary positive effects in reducing clinical manifestations but do not address the root cause, surgical treatment should be considered preferred. Analyzing literature data, the main indications for

surgical treatment are: reflux esophagitis resistant to conservative treatment, reflux esophagitis with complications, pseudo-coronary syndrome unresponsive to conservative treatment, and combination of clinically manifested forms of sliding hiatal hernia with other surgical pathologies of the abdominal cavity. In recent years, antireflux surgical operations have been considered the "standard" treatment for complicated forms of reflux esophagitis [20].

Due to the active development of minimally invasive technologies, it has become possible to perform antireflux surgery through endovideosurgical access, the practical application of which actively promotes further actualization and popularization of such operations. According to many authors, in almost all cases, surgical intervention to eliminate reflux esophagitis can be performed laparoscopically [13], [14]. However, when antireflux surgery is performed in a specialized hospital by an experienced highly qualified surgeon, a positive result is achieved in 80-95% of cases [17]. When such surgery is performed by a surgeon with limited practical experience, positive results decrease to 40-50% during the first year [18]. It is rightfully noted that there is a positive dynamic in the influence of a technically equipped hospital's level on the patient's quality of life in the context of the absence of negative factors such as untimely examination and treatment, as well as long waiting times for diagnostic and therapeutic procedures [8].

Discussion of the Results

Due to the diverse clinical manifestations of reflux esophagitis, often combined with its extraesophageal manifestations, implementing a differential approach in diagnostics is possible through the comprehensive simultaneous application of several examination methods, particularly endoscopic, which is essentially the "standard" diagnostic method, and radiological. To clarify the presence of functional disorders, their degree and type, manometric and radioisotope methods, and intraesophageal pH monitoring are significant. These examination methods, whose results possess a sufficiently high degree of informativeness, will be necessary for evaluating the verification and true causes and grounds for reflux esophagitis development, contributing to establishing an accurate and correct diagnosis, which determines the treatment tactics, both conservative and operative. Data obtained from laboratory and instrumental research methods, confirming the presence of esophageal shortening and its degree, peptic esophageal stricture, comorbidities in relation to extraesophageal manifestations of RE, should be considered when choosing surgical intervention and its scope. For example, untimely or missed diagnosis of a short esophagus can lead to cuff slippage with possible rotation or partial destruction, as

intraoperatively, when attempting to fix the stomach below the diaphragm level, excessive traction and unnecessary suturing of the cuff to the diaphragmatic crura are employed [5].

Among all the most "life-threatening" intraoperative complications during laparoscopic fundoplication, intra-abdominal bleeding ranks first. According to literature data, the frequency of this complication is diagnosed in 0.3-0.75% of episodes [21]. As a rule, bleeding occurring during laparoscopic fundoplication is fairly easy to diagnose. The most common source of bleeding is the short gastric vessels, which are damaged during stomach mobilization or at the stage of fundoplication formation when passing the organ into the retroesophageal space.

In addition to short gastric vessel injury, bleeding can occur from damage to the stomach wall, liver or spleen parenchyma, lesser omentum vessels, aberrant hepatic artery, diaphragm and its crura, as well as from trocar puncture sites in the anterior abdominal wall. During intraoperative bleeding, conversion of access provides clear identification of anatomical structures of the hepatoduodenal ligament and visualization of the bleeding source with subsequent thorough hemostasis. These complications may result from the surgeon's insufficient experience in endovideosurgical fundoplications [17,20].

Bleeding occurring directly from the stomach wall, after preliminary grasping with a dissector where the compressed tissue becomes less vascularized and tissue resistance increases, is stopped using point monopolar coagulation. In case of large vessel integrity violation, the most optimal solution would be ligating it with a Z-shaped suture. However, when using monopolar mode, electrothermal damage (intestinal wall burns) is possible in the laparoscopic view zone, developing with underestimated anatomical-topographical organ relationships and when working quite "close" to the intestinal wall under visual control.[20]

It should be noted that when damaging vessels of the lesser omentum, with the adjacent vagus nerve, clipping of the former is performed with preliminary soft clamp grasping and irrigation of the operation zone, since otherwise, nerve trunk capture between clips with subsequent coagulation damage and postoperative complications development is possible [4,19].

According to data published in foreign literature, after laparoscopic fundoplication, the frequency of vagus nerve trauma ranges from 10 to 41% [19,20]. Posterior vagus nerve damage, compared to anterior damage, is less dangerous since it controls 40% of the stomach's motor and secretory function. With anterior nerve damage or damage to both vagus nerves, the patient develops persistent gastroparesis postoperatively, leading to possible gastric atony combined with pylorospasm. During control

endoscopic examination and contrast radiography, stomach overdistention is noted due to food masses and mucus with pronounced disturbance of its motor-evacuation function and pylorospasm [12].

Left liver lobe tissues are typically damaged during rough retraction to the right side or when the retractor slips. Bleeding control in this case is accomplished without particular difficulty through bipolar coagulation of the traumatized liver parenchyma. Accessory hepatic arteries are often damaged, which need to be clipped before electrosurgical transection to prevent bleeding. The most effective results are achieved with intraoperative diagnosis of injuries with simultaneous correction by a qualified specialist [10].

In the era of open antireflux surgery, splenic capsule bleeding requiring forced splenectomy also occurred. When performing laparoscopic surgery together with safe electrosurgical instruments, the frequency of splenic capsule bleeding followed by splenectomy does not reach even 1%[14,20].

To avoid bleeding from lesser omentum vessels occurring during "careless" tissue dissection or clip slippage, stomach traction should be performed by the fundal region, thus "stretching" these vessels, and two clips should be placed on each side of the largest ones.

Prevention of bleeding from trocar puncture sites in the anterior abdominal wall is based on the specialist's knowledge of anatomical location of superior and inferior epigastric arteries. Bleeding from puncture sites is most often eliminated by suturing the wound through all layers, excluding skin. Severe bleeding requiring laparotomy is extremely rare. However, to avoid this complication, the operating surgeon's knowledge of vascular anatomy is important, as vessel damage carries the risk of profuse bleeding development [14].

With laparoscopic access, the risk of hollow organ injury is higher than in open surgery; perforation rates vary from 0 to 4% [22]. This is especially pronounced with adhesions resulting from repeated surgical interventions, where the probability of iatrogenic injury significantly increases. This complication can occur during trocar placement in the abdominal cavity, both during abdominal organ mobilization stages and gastric tube placement [1,3]. The doctrine notes information about abdominal organ injury during laparoscopic instrument introduction through the anterior abdominal wall. Mechanical bowel perforation at the site of instrument, Veress needle, or trocar introduction into the abdominal cavity can occur in cases, but not always, when it is adhered to the anterior abdominal wall. If small-diameter internal organ perforation occurs during pneumoperitoneum creation with a needle, operative treatment can be avoided, and conservative treatment is quite sufficient. For large-

diameter injuries caused by a trocar, laparotomy is usually required for suturing. Cases of vessel injury during pneumoperitoneum creation with needles, trocars, and scalpels have been described; their initial bleeding can be noticed by the surgeon if blood flows into the retroperitoneal space [9,20]. To reduce the risk of major vessel injury, it is necessary to know precisely the aortic bifurcation location and technique of trocar introduction into the abdominal cavity.

It should be noted that hollow organ perforation can occur not only due to technical reasons but also considering the main pathogenetic, pathophysiological factors and mechanisms of various pathologies' development. For example, the cause of perforation during retroesophageal window formation may be the presence of esophageal ulcer, most often localized on its posterior wall, retroperitoneal location of the gastric fundus, presence of adhesions in the esophagogastric junction area as a result of long-existing erosive-ulcerative esophagitis. The presence of reflux esophagitis complications, such as peptic esophageal stricture, esophageal shortening, can also lead to the above-described intraoperative complication. When detecting a hollow organ defect, the perforation is sutured, and to avoid secondary infection, broad-spectrum antibacterial therapy is prescribed intraoperatively and postoperatively. Unrecognized perforation during surgery presents the greatest danger, with mortality rates ranging from 8.3 to 26% [16,17,20].

During laparoscopic fundoplication, while mobilizing the distal esophagus, parietal pleura damage may occur. Predominantly, the left pleural sinus is injured, however, bilateral injuries with pneumothorax development are not excluded. The incidence of this complication is 1% but can reach 10% of cases [15]. Pneumothorax occurrence during surgery can complicate lung ventilation, and tension pneumothorax phenomena can lead to lung "collapse" with subsequent cardiovascular system dysfunction, necessitating intraoperative pleural cavity drainage [2].

Conclusion

The analysis of intraoperative complications during laparoscopic fundoplication reveals several critical factors affecting surgical outcomes. The success rate significantly depends on surgeon expertise, with experienced surgeons achieving 80-95% positive results compared to 40-50% for less experienced ones. Major complications include bleeding (0.3-0.75%), organ perforation (0-4%), and vagus nerve trauma (10-41%). Prevention strategies center on comprehensive preoperative diagnostics, thorough understanding of anatomy, and proper surgical technique. A technically equipped hospital environment and coordinated surgical team are essential for minimizing complications and improving patient outcomes. These

findings emphasize the importance of specialized training and systematic approach to reduce intraoperative risks in laparoscopic fundoplication procedures.

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