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Endoscopic vacuum therapy for rectal injuries

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ABSTRACT *AIM: to evaluate the effectiveness of endiscopic vac therapy in patients with rectal injuries.*
PATIENTS AND METHODS: the retrospective study included 33 patients with rectal injuries treated with endoscopic vacuum therapy (EVT).
RESULTS: in 26/33 (78.8%) patients, treatment using EVT was successful and complete healing of intestinal wall defects developed. There was no sufficient deformation of the intestine or its severe narrowing in any case. In 2 (6.1%) cases it was possible to almost completely close the defect of the intestinal wall, but at the same time an internal fistula with abscess developed. The cavity was drained under ultrasound control. In 5 (15.2%) patients, the treatment failed. Three (9.1%) patients died, despite the good healing of defects in the rectal wall against the background of vacuum aspiration therapy.
CONCLUSION: the proper use of EVT can reduce the risk of wound infection and clean a highly infected area. As well it helps to reduce the rate of severe complications and minimizes the surgical procedure. The use of vacuum therapy in the early stages of surgical care can improve the results.

KEYWORDS: *rectal injuries, methods for diagnosing rectal injuries, vacuum aspiration therapy (VAT)*

CONFLICT OF INTERESTS: *the authors declare no conflict of interests*

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INTRODUCTION

According to modern data, rectal injuries account for about 1–5% in peacetime [1] and 5–12% in military conflicts [2]. Even in peacetime, such injuries are accompanied by complications in 3.6–27.7% of cases, mortality reaches 38.4%, and in case of combined injury — 50% [3], which requires further improvement of diagnostics and therapeutic tactics for this type of injury. According to the BMMCH's data (2023) the most common mechanism of occurrence of these wounds are gunshot and shrapnel wounds (71–85%), blunt trauma (5–10%), while the explosive mechanism of injuries accounts for about 23% of rectal wounds. Isolatedinjury of the rectum due to adjacent pelvic organs and blood vessels is rare. Despite significant progress in surgery, mortality rates remain at 3–10%, and associated complications account for 18–21%.

For the first time, the concept of wound drainage using negative pressure was proposed by Redon H. [4] in 1954. Due to the armed conflict in the Republic of Afghanistan, Soviet doctors widely used negative pressure wound treatment. For example, military surgeon Bagautdinov N. in Kazan began using devices to create negative pressure along with an absorbent bandage in the treatment of infected wounds in 1985. Over time, vacuum therapy has been recommended for the treatment of open fractures and gunshot

wounds. Since the introduction of vacuum aspiration therapy into clinical practice, the equipment and consumables have been improved, and the indications and scope of its application have been constantly expanding. The combination of vacuum therapy with instillation of solutions was first described by Fleischmann W. et al in 1998 [5]. Using this technique, Wolvos T. et al. (2004) obtained good results of vacuum instillation therapy using anesthetic and antiseptic solutions. After instillation, according to the authors, no pathological growth of microorganisms was found, and the pain syndrome decreased significantly [6]. At the same time, a number of authors point to the risk of ischemia in certain areas of the intestine located close to the source of negative pressure, which in 5–20% of cases can lead to the development of perforation of the intestinal wall [7,8].

Initially, endoscopic VAT was used in the treatment of perirectal abscesses with the failure of rectal anastomoses.

The first report on the successful use of a vacuum aspiration system installed transanally was published by Meyer, G. et al in 2002 [9] and studied more deeply by Weidenhagen R. et al in 2008 [10]. There are few publications on the clinical use of VAT, and they analyze a small number of clinical observations. Due to its implementation, the use of transrectal local vacuum therapy techniques has reached a new stage of clinical application.

PATIENTS AND METHODS

The diagnosis of rectal injuries is based on the victim's complaints, clarification of the circumstances of the injury, clinical examination and the use of instrumental methods. Digital rectal examination in 80–95% of cases makes it possible to suspect its injury [11]. The effectiveness of the examination is enhanced if the examination is performed using rectal mirrors under sedation. An X-ray scan of the abdominal cavity allows you to detect the presence of free gas, trace the flight path of the injuring agent, detect foreign bodies and injuries of bone structures. If it is impossible to trace the course of the wound canal, vulnerography or contrast proctography is performed. Computed tomography of the pelvis with water-soluble contrast allows you to detect the perforation of the rectal wall by contrast agent leaks into the surrounding fatty tissue or into the abdominal cavity, as well as injuries of neighboring organs and bones of the pelvis. The most accurate information about intestinal lesion can be obtained by visual control by proctoscopy or colonoscopy. However, the effectiveness of these studies depends on the quality of intestinal cleansing, which is difficult at the early stages of the patient's checkup [11–16].

In case of injury of the intraperitoneal rectum, surgical tactics depend on the nature of the injury. Suturing of wall defects is performed only in the presence of a small lesion (up to 2 cm) for a period of no more than 3 hours from the moment of trauma in the absence of signs of peritonitis. A prerequisite for the completion of the surgery is the formation of a dischargeloop colostomy and drainage of the abdominal cavity. In case of multiple injuries of the rectum or extensive defects in its wall, Hartmann's procedure is the method of choice [11,16].

The treatment strategy for patients with complete defects of the extraperitoneal (pelvic) rectum has several aims: sanitation of the rectal cavity and drainage of the perirectaltissues, diverting colostomy, closure of the rectal wall defect, prevention and treatment of purulent-septic complications. However, even early closure of rectal wall defects does not reliably restore its integrity due to pronounced inflammatory infiltration of the tissue, its contamination and the presence of virulent microflora. In this regard, treatment methods are used aimed at self-healing wounds of the intestinal wall and active sanitation of purulent cavities of the perirectal fiber. One of them is the method of vacuum aspiration therapy (VAT).

This method involves the use of a polypropylene sponge of various porosity, which, under conditions of negative pressure, effectively removes wound exudation, cleanses the wound, eliminates tissue swelling and promotes blood flow. Improving microcirculation in the injury area creates conditions for the formation of granulation tissue and wound healing. Since the introduction of this method into clinical practice, the indications and scope of vacuum therapy have been constantly expanding.

The technique of vacuum aspiration therapy in the treatment of rectal injuries has been successfully used since 2017 [17].

At the first stage of the treatment, issues of surgical approach for combined injuries, the scope and sequence of instrumental diagnostic methods were addressed, indications and contraindications for the use of vacuum aspiration therapy were discussed. When performing a proctoscopy, the following were determined: the number, size and site of intestinal wall defects, the presence of foreign bodies, bleeding vessels, etc. Computed tomography and ultrasound of soft tissues assessed the condition of the perirectal tissue, the size of the cavities of the occlusions and the wound canal.

We used the following VAT technique. The procedure was performed in an operating theatre under anesthesia. A polymer reinforced splinting tube with a diameter of 20 mm was installed on the endoscope (Fig. 1). The device was inserted into the rectum beyond the defect zone (in the presence of two defects, beyond the proximal lesion zone). Then the splinting tube was lowered through the endoscope to the desired level so that its distal end was above the level of the wound in the intestinal wall. After that, the endoscope was removed. The VAT system prepared for each specific case consisted of a formed polypropylene sponge and a probe with a diameter of 16–22 Fr. The system was carried out using a pusher through the inner lumen of the splinting tube and dumped into the intestinal lumen (Fig. 2). After that, the tube was removed. The correct location of the vacuum system was visually monitored by inserting an endoscope and, if necessary, its correction was performed. The probe removed through the anal canal was fixed, and a vacuum aspirator was connected to it in a dilution mode of 70–100 mmHg. Depending on the stage of the treatment, we used a polypropylene sponge with different pore diameters. During the first treatment sessions, a vacuum system was formed from a coarse-pored sponge and a large diameter probe (20–22 Fr) for maximum adsorption of the exudate. In subsequent VAT sessions, we used a finely porous sponge, which had a greater effect on the healing of intestinal wall defects. The negative pressure created in the closed cavity made it possible to remove exudate, reduced tissue edema, and

Figure 1. *Reinforced splinting tube*

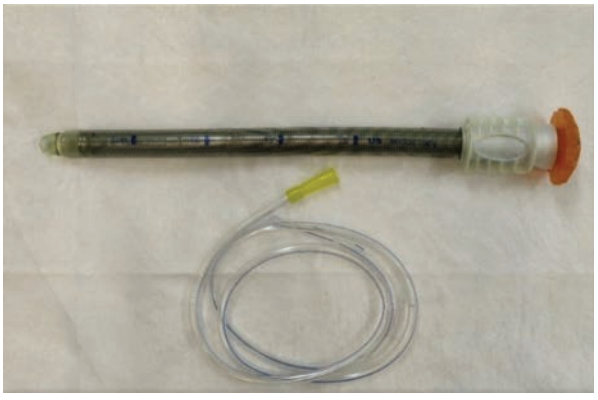

Figure 2. *Formed system for VAT*

improved microcirculation, which in turn led to increased regeneration, increased metabolic activity, blood flow, and the formation of granulation tissue. This contributed to the healing of wounds with fistula.

The replacement time of the vacuum system was determined individually and averaged 3–6 days [17]. During the treatment, the level of dilution in the system, the amount and nature of discharge through the system and drains installed in the perirectal tissue were monitored.

RESULTS

Firty-eight patients with rectal wounds were included in the cohort study (February 2022 — January 2024). In 38 (79.2%) patients, this diagnosis was verified at the stage of qualified care. In 10 (20.8%) cases, lesion of the rectum was detected during a follow-up in the hospital after rectosigmoscopy. All of those patients had combined injuries to the abdominal cavity, pelvis, and musculoskeletal system. Thirty-three (68.8%) patients had indications for endoscopic vacuum aspiration therapy.

All the wounded were of working age.

The time from receiving intestinal injuries to the start of the treatment fluctuated, which was due to the stage-by-stage provision of qualified and specialized care to the wounded and difficulties in diagnosing rectal wounds with severe combined injuries. In 34 (70.8%) cases, the time from the moment of injury to the start of endoscopic treatment did not exceed 3 days, and in 14 (29.2%) cases — from 3 to 7 days.

Of the 48 patients, 15 (31.3%) underwent emergency surgery: Hartmann's procedure was done in 13 patients, and abdomino-perineal resection — in 2 patients. Of this group, the rectal stump leakage developed in 3 cases. Endoscopy revealed 1 defect of the intestinal wall in 9 (27.2%) patients, 2 or more defects in 17 (51.5%) patients, and in 7 (21.2%) cases there was a rectal stump leakage. In 2 cases, incomplete rupture of the rectum from the pelvic muscles was noted with an extensive soft tissue defect in the buttock area.

The location of defects in the rectal wall is distributed as follows: upper rectum — 9 (27.2%) patients, middle — 12 (36.4%) ones, and lower — 12 (36.4%) patients, including one of them had injury of the anal sphincter.

In 27 (81.8%) of the 33 cases, rectal wounds were through-the-wall, while in 16 (59.3%) of these 27 cases, the opposite wall was damaged. In 6 (18.2%) patients, the wounds ended blindly in the rectal wall and looked like ulcerative defects or areas of mucosal necrosis. Bleeding from the injury site occurred in two cases. In one of them, the patient successfully underwent endoscopic hemostasis with hemostatic clips, the other was operated on, since the source of bleeding was located outside the intestinal wall.

Depending on the degree of lesion of the rectal wall, in most cases, 1 to 6 sessions of VAT were required before the wound defect was completely closed. The maximal number of treatment sessions for the three patients was 12, which was due to the large size of the rectal wall defect, their number and extensive lesion of the soft tissues of the perineum. Complete closure of intestinal wall defects in one session of VAT was obtained in 9 (27.3%) patients, 15 (45.5%) patients required from 2 to 6 treatment sessions. In 6 (18.2%) patients, 6 or more procedures of intraluminal negative pressure treatment were performed, among them there were three patients with rectal stump leakage after obstructive resection.

In 26 (78.8%) patients, the treatment with VAT was successful and resulted in complete healing of intestinal wall defects. During control endoscopy, whitish scars were detected in their place after 3 months, in some cases with a dimple in the form of a pseudodiverticle. There was no gross deformation of the intestine or severe narrowing in any case. In 2 (6.1%) cases, the intestinal wall defect was almost completely closed during the VAT process, but an internal

fistula was formed associated with a purulent cavity in the perirectal tissue. The cavity was drained under ultrasound control. In 5 (15.2%) patients, intraluminal VAT did not achieve a positive result, which, in our opinion, was due to severe homeostasis disorders associated with the presence of combined traumatic injuries and a decrease in the body's reparative abilities. All these patients underwent surgery.

In 3 (9.1%) cases, despite the positive changes of rectal wall defects healing during vacuum aspiration therapy, there was a fatal outcome. The clinical efficacy of using VAT in rectal wounds is illustrated by 2 clinical cases.

Case 1

Patient K., 35 years old, was transferred to the hospital on the 3rd day from the moment of injury was diagnosed with multiple internal wounds. Combined shrapnel injury of the chest, abdomen, with extraperitoneal injury to the rectum, injury to the soft tissues of the buttocks, fracture of the pelvic bones. Upon admission, a CT was performed, which revealed an extensive soft tissue defect in the left gluteal region involving perirectal tissue in the wound process. The patient underwent diagnostic laparoscopy followed by conversion. At the same time, no damage of the abdominal organs was detected.

In order to stop the passage of fecal matter through the rectum, a loop descendostomy was formed, drainage of the abdominal cavity, secondary surgery of the wound of the left gluteal region, its drainage and tamponing were done. A video proctoscopy 10 cm from the anus revealed a complete defect in the rectal wall 25 × 18 mm, irregular in shape, with no signs of bleeding. A gauze swab was placed at the bottom of the defect, which was installed during primary surgery of the wound (Fig. 3). On the opposite wall, a second complete defect of the intestinal wall was visualized up to 8 mm in size, from which cloudy hemorrhagic contents enter during active aspiration. The intestinal mucosa was gray-pink in color, dull in places, with multiple intramucosal hemorrhages. Indications for endoscopic VAT were provided. According to an original technique developed at the hospital, a 10 × 4 cm large-pored polypropylene sponge was inserted into the rectal lumen into the wound area on a polymer probe with a diameter of 20 Fr (Fig. 4). This system was fixed to the thigh skin and connected to a vacuum aspirator with a discharge of 90 mm Hg.

At the same time, an external vacuum aspiration system was installed in the area of soft tissue defect of the gluteal region. On the 4th day after the installation of the vacuum system, a control endoscopy was performed, which showed a slight decrease in the size of a larger defect in the intestinal wall. In addition, it was

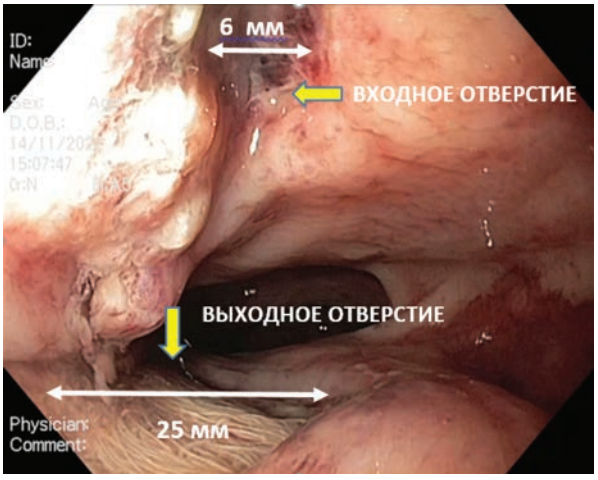

Figure 3. *Videorectoscopy before the start of intraluminal VAT. 2 defects of the rectal wall are identified*

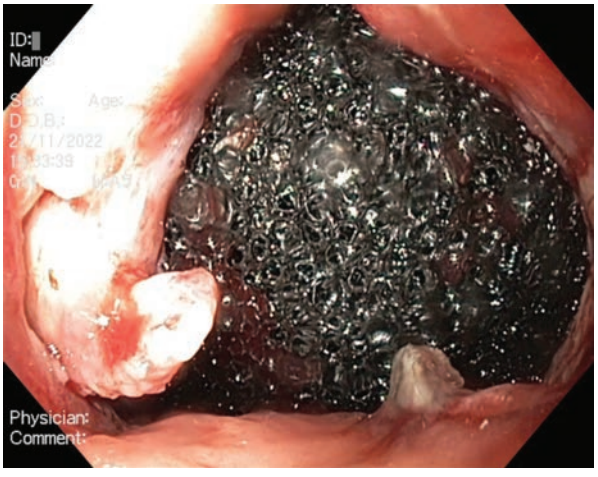

Figure 4. *Videorectoscopy. A large-pored polypropylene sponge was installed into the intestinal lumen in the wound area*

found communication with a collection up to 5 cm in diameter, the walls of which were made of necrotic masses with a dense coating of fibrin. A polypropylene sponge from an external VAT system was visualized at the bottom of this cavity (Fig. 4). The defect located on the opposite wall was cleared of fibrin, and granulations appeared on its edges. After removal of the external VAT system, vulneroscopy was performed, which enabled to visualize an extensive defect in the soft tissues of the gluteal region measuring 10 × 12 cm, up to 4 cm deep, the walls of the wound surface with spot hemorrhages, partially covered with fibrin, granulation tissue was detected in places (Fig. 5). In total, the patient underwent 6 sessions of endoscopic vacuum aspiration therapy in combination with an external installation of a system for local vacuum therapy in the area of an extensive soft tissue defect in the gluteal region. The interval between sessions ranged from 4 to 6 days. During a control endoscopy on the 25th day after the start of endoscopic vacuum therapy, pits of 9 mm and 4 mm were detected in the area of rectal wall defects, the bottom of which was fulfilled with granulation tissue, and the intestinal mucosa was pale pink (Fig. 6).

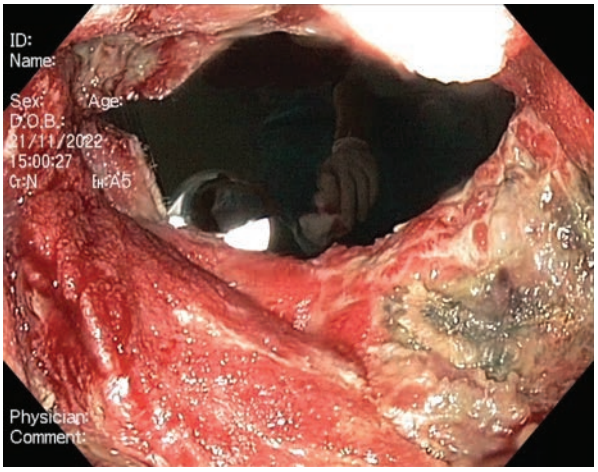

Figure 5. *Vulneroscopy. 6th day after injury and 3rdday after installation of the intraluminal VAT system. In the lumen of the defect there is an open wound cavity measuring 10 × 12 × 4 cm*

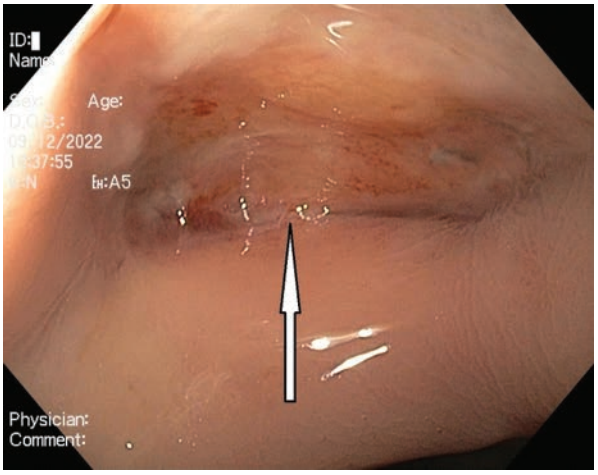

Figure 6. *Video rectoscopy after 6 VAT sessions. Complete closure of rectal wall defects*

Case 2

Patient M., 37 years old. He was urgently taken to a specialized medical unit with a diagnosis of multiple internal wounds. Multiple combined shrapnel wound of the abdominal cavity, shrapnel wound of the pelvis with crushing of the soft tissues of the gluteal regions with partial separation of the middle and lower rectum with preservation of the anal sphincter. Hemorrhagic shock of the 3rd degree. At this stage, the patient underwent laparotomy to

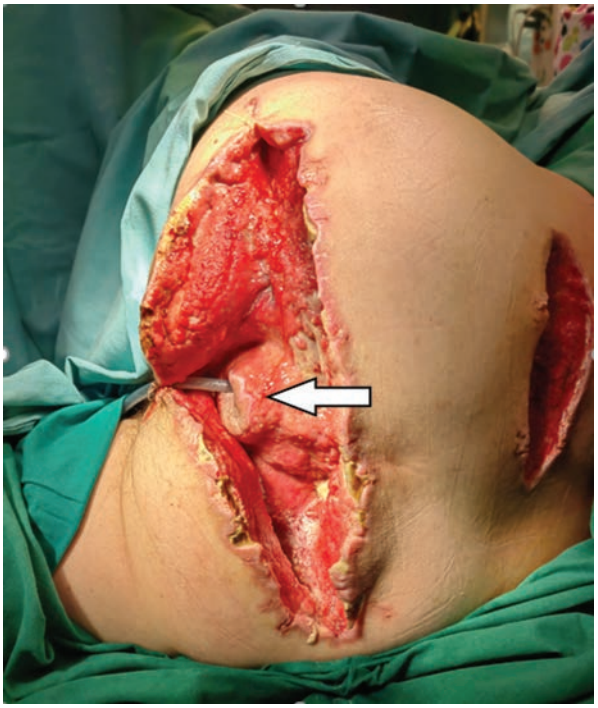

Figure 7. *Injury to the gluteal, perineal and lumbar regions. Incomplete avulsion of the rectum with preservation of the anal sphincter*

stop intra-abdominal bleeding, splenectomy, suturing of small intestine wounds, Hartmann's procedure, as well as primary surgery of perineal wounds, gluteal and lumbar areas wounds (Fig. 7). On the third day after the injury, the patient was evacuated to the hospital. After preoperative preparation in the ICU, the patient was taken to an operating theatre. A video proctoscopy at 10 and 12 cm from the anus revealed two full-thickness wall defects measuring 6 and 15 mm (Fig. 8). According to the method developed in the hospital, the patient had an intraluminal system for VAT installed. During 14 days, the patient underwent 3 sessions of intraluminal vacuum aspiration therapy. During the control endoscopy, the size of the defects decreased to point-like with a fibrin coating. However, on the 18th day after the start of the treatment, the patient's temperature rose to 38^{0}C. The laboratory tests revealed leukocytosis up to 18 × 10^9/l and C-reactive protein up to 48 mg/l. During endoscopy, a pus was detected in the area of one of the residual defects of the intestinal wall (Fig. 9). The ultrasound revealed a collection of 4.5 × 3 cm fluid in the perirectal tissue (Fig. 10). Drainage of the abscess cavity was performed under ultrasound control. The intraluminal vacuum aspiration system was re-installed. On day 23, a control video proctoscopy revealed complete epithelialization of

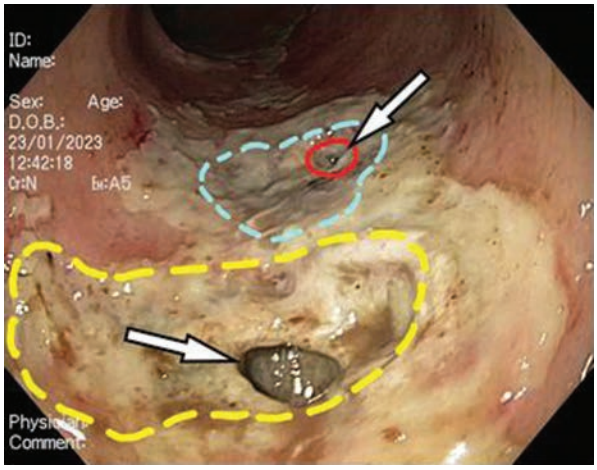

Figure 8. *Videorectoscopy. 2 complete defects of the rectal wall, measuring 6 and 15 mm*

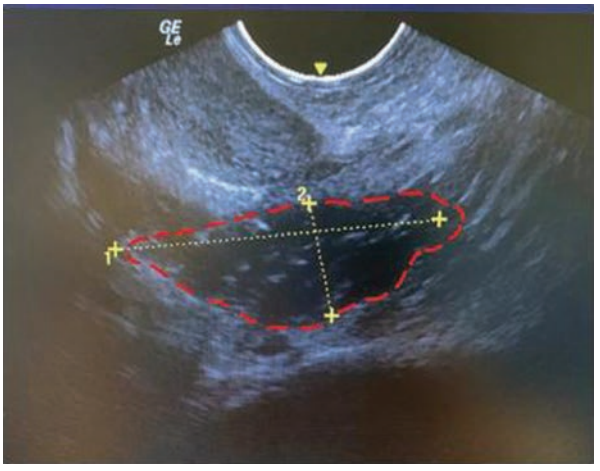

Figure 10. *Ultrasound of soft tissues of the gluteal region. A limited accumulation of fluid measuring 4.4 × 3 cm was detected in the perirectal tissue*

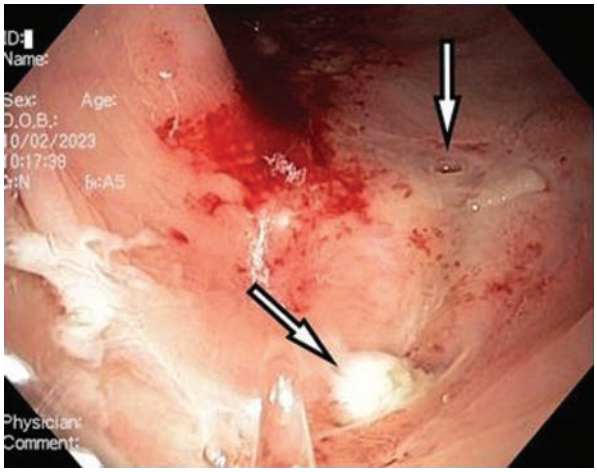

Figure 9. *Video rectoscopy on the 18thday after the start of VAT. In the area of one of the residual defects, the influx of purulent contents was noted*

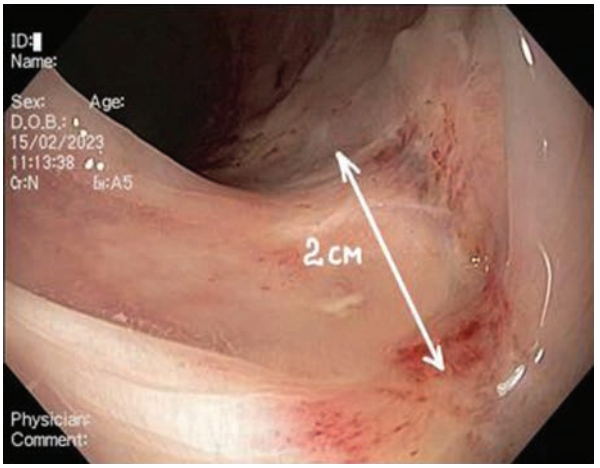

Figure 11. *Video rectoscopy on the 23rd day after the start of VAT. Complete epithelization of rectal wall defects without narrowing or deformation of the lumen*

the rectal wall defects without narrowing and deformation of the lumen (Fig. 11). The ultrasound of the soft tissues of the perirectal fiber revealed no fluid collections. The endoscopic VAT treatment had 5 sessions. The patient underwent elective reconstructive plastic surgery closing the skin defects of the gluteal areas.

DISCUSSION

Surgery is a traditional method for rectal wounds. The features of the anatomical and topographic location and blood supply, the complexity of access and formation of anastomoses cause high traumatism and a high-volume surgery for such injuries. However, in recent years, it has become possible to apply new treatment methods, among which various methods of wound drainage are basic. The key issues in the treatment of rectal wounds are the preservation of the integrity of the digestive tract, the closure of penetrating lesion in the wall with the cessation of intestinal contents beyond its wall, reducing the rate of infectious complications and mortality. The method that will meet these requirements may be the endoscopic installation of a vacuum aspiration system into the rectal lumen.

According to the results of the study, endoscopic vacuum therapy has proven itself well. A polypropylene sponge installed in the rectum covered the wound defect, and negative pressure ensured effective drainage of the wound area, which created good conditions for wound healing.

In order to separate the passage of fecal matter, colostomies were performed for all patients to divert feces. This is of particular importance for combat wounds, in order to isolate the zone of primary and secondary necrosis significantly and prevent infectious complications. Also, for the prevention of purulent-septic complications, irrigation of the rectum was performed in order to eliminate the remnants of feces from the rectum. The effectiveness of vacuum aspiration therapy depended on many factors. First of all, this indicator was influenced by the number and size of intestinal wall defects, the presence of purulent cavities of the perirectal tissues, the combined injury and the time from the moment of injury to the start of treatment.

It is of interest that 6 patients had wounds that ended blindly in the rectal wall and looked like ulcerative defects or areas of mucosal necrosis. The mechanism of such lesion is not fully clear, it can only be assumed that it is due to several causes: ischemic disorders due to extensive lesion of the soft tissues of the pelvis, general contusion of the rectum and surrounding tissues caused by the air shock wave of the explosion. Depending on the power of the warhead, shock wave lesion can occur at a greater or lesser distance from the wound. Such injuries cause violations of the ultrastructural organization of cells and intercellular connections and lead to regional microcirculation disorders (microvascular dystonia, plasmorrhagia, diapedous hemorrhages).

In patients with extensive purulent-necrotic lesions of the soft tissues of the perineum involving perirectal tissues, bladder, and pelvic bones, purulent edemas were drained in parallel with the use of intraluminal vacuum therapy, and local VAT of the soft tissues of the perineum and gluteal region was performed in 7 (21.2%) patients.

Analyzing the results of the treatment of 3 mortality cases, we came to the conclusion that the causes of death of those patients were due to severe concomitant lesion of vital organs and systems, as well as severe sepsis due to purulent-inflammatory process.

CONCLUSION

There are many problems to be solved in the surgery of rectal injuries. The invention of vacuum aspiration therapy and related technologies gives hope for the treatment of some complications of abdominal and colorectal surgery.

Proper use of VAT can reduce the risk of infection in the wound area, allow adequate sanitation of a highly infected surgical area, reduce the number of severe complications and reduce the surgery volume.

The use of the vacuum therapy in the early stages of surgical care can improve the results of the treatment of rectal wounds. Due to the fact that this study is not randomized, and the results were obtained in a small sample, it is necessary to further study the method of vacuum endoscopic therapy for rectal wounds.

AUTHORS CONTRIBUTION

Concept and design of the study: *Sergey N. Perekhodov, Igor E. Onnitsev, Aleksey A. Sokolov*
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Statistical processing: *Ludmila S. Kharitonova, Eduard N. Artemkin, Nikolay S. Kozlov, Aleksey D. Kuzminov*
Writing of the text: *Igor E. Onnitsev, Aleksey A. Sokolov, Dmitry V. Sokolov, Eduard N. Artemkin*
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