Discussion on the Key Factors for the Treatment of Extremely High-risk Abdominal Trauma Patients With Partial Full-thickness Abdominal Wall Defects

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Research Article

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Abstract

Background

Patients with extremely high-risk abdominal trauma and full-thickness necrosis and defects of the partial abdominal wall are clinically rare, and the treatments for these patients are very difficult and complex . In this study, we will

explore the key factors for successful treatment of these patients .

Methods

Three patients with extremely high-risk abdominal trauma and partial full-thickness abdominal wall defects were involved in this retrospective study, and one representative case was emphatically reviewed. According to the theory of damage control surgery,the consultation and coordinated treatment of multidisciplinary team(MDT) were involved firstly, then, stepped multiple operations,such as partial perforated small bowel resection, full-thickness abdominal wall defects repair, vacuum sealing drainage (VSD), and wounds skin grafts, were performed, meanwhile, systemic life resuscitation was strengthened.

Results

Two patients were cured and discharged after 3 and 9 operations respectively. One patient suffered 2 operations and eventually died of lung infection and respiratory failure.

Conclusion

The determination and responsibility of surgeons, rational use of damage control theory and multidisciplinary cooperation should be the keys for successful treatment.

Background

Patients with extremely high-risk abdominal trauma and full-thickness necrosis and defects of the partial abdominal wall are clinically rare, such patients caused by car accidents and combined with multiple injuries mostly[1, 2]. Whole-layer defects of the partial abdominal wall are always caused by long-time extrusion injury resulting in ischemia and necrosis of the whole abdominal wall. If treatments for the patients are not timely and inappropriate, which will inevitably aggravate the abdominal infection and increase the death rate. From March 2017 to December 2020, we treated 3 patients with extremely severe abdominal trauma and partial full-thickness necrosis and defect of the abdominal wall. The treatment process was retrospectively studied, and the key factors for successful treatment were analyzed and summarized. According to the NISS scoring system, the 3 patients had extremely severe trauma, with a high risk of death[3, 4].

Methods

The 3 patients were all males, aged 32, 44, and 61 years old respectively. They all suffered from extremely severe abdominal extrusion trauma in the car accidents, combined with full-thickness ischemia and necrosis of part of the abdominal wall, as well as multiple injuries, such as multiple rib fractures, pleural effusion, fractures of the limbs and pelvic, mild head trauma, and so on. One patient was admitted to our hospital 4 hours after the trauma, and the other two were performed the first exploratory laparotomy and partial small bowel resection in the other hospitals, and then were transferred to our hospital on the 4th and 5th day after the trauma, respectively. Immediately after admission, individualized treatment plans were developed according to the multidisciplinary discussion opinions. Based on the theory of damage control surgery, 2, 3, and 9 operations were performed in steps for these patients respectively, such as small enterostomy, abdominal wall defects repair, vacuum sealing drainage (VSD), wound skin grafting, small enterostomy reset, and so on. During the hospitalization period of the patients, multidisciplinary consultations and collaborative treatments, systemic life resuscitation, capacity expansion, anti-infection, anti-shock, ventilators assisted breathing, hemodialysis, and so on, were fully implemented.

Representative case report

On the afternoon of August 8, 2017, a 44-year-old male was accidentally knocked down and squeezed into a corner of the wall by a excavator. Immediately, he felt abdominal pain and limited movement of the lower limbs, and was diagnosed in the other hospital as follows: 1. abdominal organs injury; 2. multiple fractures of the pelvis; 3. hernia of the right abdominal wall; 4. subcutaneous effusion in pelvic cavity and right lower abdomen. On August 12, the emergency laparotomy was performed and the postoperative diagnoses were as follows: 1. partial ileum necrosis, 2. partial necrosis of the right abdominal wall. One-stage anastomosis following partial necrosis small bowel resection and removal of necrotic tissue in the abdominal cavity and abdominal wall were performed.

On August 13, due to septic shock and multiple organ dysfunction syndrome, the patient was transferred to the Department of Critical Care Medicine of our hospital. Immediately after admission, a multidisciplinary team (MDT) for the patient was formed, and the first multidisciplinary consultation was been had. According to the discussion protocol, endotracheal intubation and a ventilator were used to assist the patient with breathing in the early stage, and the other treatment measures, such as anti-infection and nutritional support, were strengthened. However, one week later, the patient's condition continued to deteriorate, with the body temperature of 38-39.5°C, the heart rate of about 140 times/min, further expanding necrosis of part of the abdominal wall tissue, more obviously defects of the abdominal wall, and being exposed for part of the intestinal tube. The outflow of intestinal contents from the abdominal wall defects reached about 200ml/day, and the Patient was getting worse and worse (Figure 1).

MDT consultation had to be held again, with assessments for the patient as follows: 1. septic shock (lung and abdominal cavity infection); 2. multiple organ dysfunction syndrome; 3. multiple full-thickness abdominal wall defects and intestinal leakage. The patient had been in a critical condition, and how to

deal with it? The only way was to performed exploratory laparotomy once again, and only a second operation might be give the patient a glimmer of survival. Considering the difficulty and risk of the operation, the other senior doctors of the department of gastrointestinal surgery tactfully refused to participate in the operation. Basing on the principle of the supremacy of life, we had to suffered the great psychological pressure and performed the second operation on August 24.

As expected in advance, the operation was very difficult. The intestine was highly edema, and the intestine, membrane were covered with pus moss and dense adhesion (Figure 2). According to the principle of damage control, We had to try our best to stop the source of the infection firstly. A part of the perforated small intestine was removed, and small enterostomy was performed, then, large-scale defects of the abdominal wall were temporarily repaired with biofilm (Figure 3). The operation was eventually completed with great difficulty, however, the follow-up treatments for the patient still remained very complex.

According to the opinions of the MDT, the wound was completely closed for drainage with VSD, then, the wound clearing and the VSD dressing renewal were performed 6 times under general anesthesia, and skin grafts for the wound was performed twice. Gradually, the patient's condition improved (Figure 4). With the skin grafts alive, the abdominal wall was definitively sealed. Then, the patient recovered well after 4 months of rehabilitation treatment.

In order to improve quality of life, the patient required a reset operation for the small intestinal stoma. With the careful evaluation, we accepted the patient's request , so, we had to face the great difficulties and pressure once again. On March 13, 2018, we performed the operation of the small enterostomy reset for the patient. As assessed preoperatively, the intraperitoneal adhesions were very dense, and the operation procedure was very difficult and slow. It was extremely difficult to separate the small intestinal due to dense adhesion, eventually, we completed anastomosis of the small intestine and transverse colon fortunately. The patient recovered and was discharged on the 9th day postoperatively (Figure 5).

Results

Two patients were cured and discharged after 3 and 9 operations, and the hospital stays were 2 months and 16 days, 5 months and 9 days, respectively. One patient, 61 years old, died of lung infection and respiratory failure, who was diagnosed with severe abdominal trauma combined with multiple rib and pelvic fractures, and the first exploratory laparotomy and partial small bowel resection were performed in the other hospital. On the 4th day after the trauma, the patient was transferred to our hospital for the further treatment. Later, due to intestinal leakage, peritonitis, and partial full-thickness necrosis of the abdominal wall, the patient had to been suffered a second operation in our hospital, in which, small intestinal stoma and abdominal wall defects repair with biofilm were performed. Unfortunately, on the 19th day after trauma, the patient eventually died of residual abdominal cavity infection, lung infection and respiratory failure.

All the 3 patients had the following common characteristics: (1) The NISS trauma score was extremely severe, mainly abdominal extrusion injury accompanied by subsequent partial ischemia and necrosis of the abdominal wall, combining with multiple trauma of other parts of the body, and the mortality rate was very high; (2) Stepped operations were performed, such as partial small bowel resection, small bowel stoma, abdominal wall defect repair, VSD closed drainage, wound skin grafting and small bowel stoma reset operation; (3) MDT played an important role in the treatment; (4) The operation was very difficult and risky, and the best timing for the operation was difficult to control, so the surgeon had to bear great psychological pressure.

Discussion

Severe abdominal trauma patients with partial full-thickness necrosis and defects of the abdominal wall are relatively rare in clinical practice, and the patients are often accompanied by multiple injuries. The treatment for the patients is very difficult and complex, which is need for multidisciplinary collaboration[5, 6]. Does abdominal crush injury cause abdominal organ damage and full-thickness necrosis of the abdominal wall? How to accurately master the timing of the operation?If there's multiple organ failure, how to deal with it? For these questions, the clinicians have to observe closely and make decisive decisions, which are the keys to patients' survival.We conducted a retrospective study on the treatment of three severe patients, and through which we are convinced that the determination and responsibility of the surgeon, the rational use of damage control theory, and multidisciplinary cooperation are the keys to the success of the treatment.

1. The determination, courage and responsibility of the surgeon to defy difficulties and face risks are the footstone of success.

Three patients were in critical condition, and the treatment was very intractable.

For the representative case, after the first exploratory laparotomy, who was complicated with intestinal leakage, acute peritonitis, septic shock, multi-organ dysfunction, large area necrosis and defects of the abdominal wall. As the patient's condition continues to deteriorate, even if the second surgical intervention was performed, the patient had very little hope of survival. The second operation was extremely difficult: (1) More than 10 days after the first operation, the patient developed a large area of abdominal wall defects combined with intestinal leakage, high edema and dense adhesion in the abdominal cavity, which would lead to extremely difficult to separate intestinal tube during operation , and with a high risk of to cause intraoperative collateral injury, such as iatrogenic intestine rupture, hemorrhage, etc.; (2) Due to extreme edema of small intestine with poor mobility, and large area of the abdominal wall defects, the small bowel stomy, which should always be a simple operation, would become very difficult; (3) The abdominal wall presented multiple large-area full-thickness abdominal wall necrosis and defects, how to repair it? Furthermore, the operator would face great psychological pressure: (1) The patient have to suffer a second surgery, however, the successful probability of the second operation would be minimal, and the hope of patient's survival should be very slim; (2) The patient was bound to have legal disputes with the accident party. Once the operation fails, we were likely to be

passively involved in legal disputes as a joint liability party; (3) Almost all senior colleagues suggested giving up the second operation. If the patient died of the second operation, the peers would definitely have negative comments on us. In the face of such difficulties and risks, the surgeon must abandon all other thoughts and put the patient's life first, and only in this way could we be ultimately successful.

2. The rational use of damage control theory would improve the success rate and reduce complications.

The core idea of damage control theory regards operation as an important part of the life-resuscitation process in critically ill patients [7, 8]. For patients with septic shock caused by acute peritonitis, the prompt and simple operation should be performed firstly to stop the source of infection, and the complete and reasonable reoperations or stepwise operations should be performed when the patient's condition is stable [9, 10]. After the first operation, 2 patients were complicated with intestinal leakage, abdominal infection, partial abdominal wall necrosis and defects, how to treat which? Infection was the primary fatal factor, and controlling infection should be the primary key to the life-resuscitation. According to the damage control theory, we decisively performed laparotomy once again. In operation, abdominal cavity cleanup, small enterostomy, and temporary repair of abdominal wall defects with biological patch were performed, which were simple and would be effectively stop the source of infection in the abdominal cavity. The biological patch has strong tension and certain anti-infection characteristics, which can effectively repair large defects of the abdominal wall, completely close the abdominal cavity, temporarily isolate infection sources from outside the abdominal cavity, and play a temporary role in protecting the abdominal organs [11]. When the patient's condition was stable, the abdominal wall wound was completely closed by VSD for continuous negative pressure drainage, and the wound debridement and the replacement of VSD dressings were performed for several times under general anesthesia.

Continuous negative pressure drainage could keep the wound dry and clean, which was conducive to the growth of wound granulation tissue, and might create a good condition for wound skin grafting in the later stage [12]. The representative case was in the most critical condition. According to the damage control theory, we developed an individualized treatment plan. Finally, the abdominal wall defects were completely closed with certainty, and the patient was healed.

The dead patient was 61 years old, whose the abdominal infection was controlled after the second operation, however, the pulmonary infection was uncontrollable, which might be related to the advanced age and poor resistance. Eventually, the patient died of respiratory failure.

3. Multidisciplinary collaboration is an essential factor for successful treatment

It has been a consensus that multidisciplinary collaboration plays an important role in the treatment of critically ill patients [13, 14]. In the treatment for severe trauma, especially multiple trauma patients, MDT intervention is necessary. In MDT, the experts from different disciplines related to trauma form a treatment team, which collaborate to make diagnoses and develop a best treatment plans for trauma patients quickly. Several studies have shown that MDT model would be effectively reduce complications, mortality and trauma disability rate through accurate diagnosis and effective treatment [15, 16]. The 3

patients mainly suffered from severe abdominal trauma, combined with multiple injuries in other parts, followed by some postoperative complications, such as abdominal and pulmonary infection, septic shock, partial full-thickness necrosis and defects of abdominal wall, and multiple organ dysfunction. Because of the complexity of patients' conditions, effective intervention of MDT was inevitable. The representative case was in the most critical condition among the three patients, however, who was eventually successfully treated. Why was it so? The essential reason should be the timely intervention of MDT. As soon as the patient was admitted to the hospital, multiple disciplines, such as intensive medicine, gastrointestinal surgery, imaging, respiratory, clinical medicine, cardiology, nephrology, and so on, immediately formed a MDT team and quickly developed a individualized treatment program. According to the theory of damage control surgery, life resuscitation was regarded as a systematic project, and early and timely operation was performed to prevent infection, then later stepwise operations were performed to definitively repair the abdominal wall and restore function. Eventually, the department of rehabilitation medicine actively intervened in rehabilitation treatment for the patient. If there has no close coordination of multiple disciplines, the successful treatment for such critically ill patient was almost impossible.

Conclusion

Treatments for the patients with extremely high-risk abdominal trauma and partial full-thickness abdominal wall defects were very difficult and complex, which should be a systematic life resuscitation project. In this retrospective study, we are sure that the determination and responsibility of surgeons, rational use of damage control theory and multidisciplinary cooperation should be the keys for successful treatment.

Abbreviations

MDT: multidisciplinary team; VSD: vacuum sealing drainage
a

Declarations

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None.

Authors' contributions

Data collection and analysis were performed by JiaQing Gong, MingHui Pang, Wei Li and GuoDe Luo. JiaQing Gong and MingHui Pang wrote the original draft and contributed equally. ZhiBing Yuan and Bin Zhang performed the final review and editing of the draft. All authors read and approved the final manuscript.

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Availability of data and materials

The data and materials are available from the corresponding author upon reasonable request.

Ethical approval and consent to participate

This clinical study was approved by Dujiangyan Shoujia Hospital, Sichuan Provincial People's Hospital and West War Zone General Hospital of Chinese People's Liberation Army.

Consent for publication

All authors have read and approved the submitted manuscript.

Competing interests

The authors declare that they have no competing interests for this article.

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Figures

Figure 1

On the day 9 of first operation, the incision being swollen and poorly healed. A:complete necrosis of the local abdominal wall of the incision; B, C, D—multiple full-thickness and large-area defects in the right abdominal wall, with intestinal exposure.

Figure 2

The small intestine and mesentery being extensive and extremely adhesion, oedema, covered with pus moss

Figure 3

Multiple full-thickness and large-area defects in the right abdominal wall, temporarily repaired with biological patch. A:5*6cm; B:10*15cm ; C:10*15cm; D: the small intestinal stoma.

Figure 4

VSD fully enclosed negative pressure drainage and wound skin grafting , the wound being completely cured.

Figure 5

On the day 9 of the small enterostomy reset, the incision healed well and the original wounds healed completely.