Clinical Paper
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Management of open abdominal trauma through damage control surgery

Abstract

Penetrating abdominal trauma is one of the pathologies with the greatest impact worldwide, since it causes high morbidity and mortality in a population that is in full economic development, such as young adults, causing them large medical expenses, disability and even death from For this reason, the objective is to carry out a clinical case study by collecting medical records, evolutions, operative reports and therapeutic plans to explain the importance of damage control in the patient with trauma, especially in penetrating trauma, and to lay the foundations. for future studies based on the contributions and conclusions offered by the project, such as the use of advanced negative pressure techniques to perform a partial closure of the abdomen, include interventional techniques within the postoperative approach and encompass novel markers of complications in order to predict catastrophic outcomes.

Keywords: trauma, damage control, abdomen, interventional, penetrating

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Introduction

Damage control surgery since its official establishment in 1993 by Professor Rotondo as a neuralgic surgical component within the surgeon's arsenal to manage trauma in its different presentations, the use of this type of techniques such as compression, packaging and even open abdomen techniques at decisive moments in history such as the Vietnam War. Damage control surgery is not limited only to the thorax or abdomen, mention is made of this because its recognition in the current century is that it allows to avoid upcoming complications associated with coagulopathy, acidosis and hypothermia, considerably improves survival time of the patient and provides an invaluable opportunity for adequate stabilization in intensive care.[1]

In our environment, there are many pathologies that can be addressed with damage control, with special mention being made of sepsis of soft tissues, open chest trauma from a gunshot wound, open neck trauma, open fracture of long bones (external tutors).[2] The open abdomen trauma by firearm in particular generates two elements that challenge the surgeon, the first: a surgical one due to the fact that the abdomen is a cavity that contains a rich quantity of elements not only distributed in a particular way but also in constant interrelation for this reason an open injury in this behavior would trigger processes such as rupture of solid viscera with consequent hemo peritoneum, rupture of hollow viscera with release of septic content into the cavity, rupture of pathways for the release of exocrine components and the second, clinical since after the rescue in the surgical center it is necessary to stabilize the patient in the intensive care unit and be aware of it in order to correctly manage the prevention of the appearance of the fatal triad and the subsequent surgical times.[3]

The clinical case study that is exposed in the titling work focuses on the open trauma of the abdomen by firearm, the same pathology that is part of the main causes of morbidity and mortality not only in the country but at the regional level. , currently causing a debacle not only at the health level, since the cost to manage this disease is high in terms of economic and personal resources, the damage is also social since it deprives a being of life and the capacity of productive generation. human.[4] In light of the current situation and tending to the problems caused by trauma in our environment, the following case study was carried out that focused on exposing the importance of damage control surgery, allowing to deepen theoretical knowledge and offering a look comprehensive pathophysiological problem underlying the disease. And thus set an investigative precedent for future projects, corrections and adaptations in the wide world of damage control.

Clinical case

36-year-old male patient, of Ecuadorian nationality, resident of the "Cuba Libre" neighborhood of the Eloy Alfaro parish in Manta canton, worked as a cell phone dealer, right-handed Catholic, single marital status, father of two minors, blood group O+. No personal, family, surgical or allergic pathological history. The mother suffers from chronic arterial hypertension and the father is a carrier of type II diabetes mellitus and chronic arterial hypertension. Regarding habits, he ate three times a day based on a mixed diet without restriction of any food, played basketball on weekends, consumed alcoholic beverages on special occasions (social drinker), smoked cigarettes at a rate of three packs a the week, family members do not report consumption of any other psychotropic or narcotic substance. He sleeps 7 hours a day.

The patient lives in a rented concrete construction house, alone, with two rooms, with all the basic services, only receives visits from relatives, does not have pets, poor interpersonal relationships with his father and with his ex-partner. Patient who, approximately 1 hour before admission, suffered a gunshot wound to the left flank and left iliac fossa with no exit hole, in addition to another gunshot wound to the left wrist with no exit hole. He is brought to the emergency room of the Rafael Rodríguez Zambrano Hospital in Manabí on 09/15/2022, where he is assessed presenting: blood pressure of 80/56, heart rate 130 beats per minute, respiratory rate 24 breaths per minute, axillary temperature 36 degrees Celsius , Glasgow 14/15, Sat O2 99% on room air.

Patient is algic, sweaty, pale. On physical examination, normocephalic head, normoreactive pupils, pale facies, neck without palpable adenopathies, thorax with preserved air sounds and tachycardia on auscultation, painful abdomen on palpation, holes in the flank of the left flank and right iliac fossa by firearm and hole in doll by firearm. Immediately proceed to place him in the intermediate care room, channeling two routes immediately since the patient was transferred to the hospital by a private car and not by the city's emergency services, Ringer's lactate 1000 ml is applied

in one way and in another, a package of red blood cells is transfused without performing cross tests since the hemorrhagic shock code was activated in the hospital.

It is decided by the general surgeon who addressed the case in emergency to perform an exploratory xiphopubic laparotomy under general anesthesia with asepsis and antisepsis standards, the process of emergency transfer to the surgical center took more than an hour. During surgery, the following surgical findings were obtained, being found during the surgical intervention:

I. Hemoperitoneum of 2500ml between clots and non-coagulated blood (Figure 1).

II. Perforation of the jejunum 40cm from the angle of Treitz and hematoma in zone 1 with lesion of retroperitoneal duodenum in its third portion through it it was possible to visualize the exit of bile, indirectly demonstrating for the moment the integrity of the bile duct, likewise it was decided to introduce two probes, one caudal and the other cephalic.

III. Pancreatic head with injury that was counteracted with hemostasis by ligation, without apparent exposure of the pancreatic duct.

IV. No apparent injury to the bile duct.

V. Subsegment VII liver injury.

VI. No apparent injury to large vessels. Immediately after the entire procedure performed, four compresses were packed in the upper right quadrant and the abdomen was closed with a Bogotá bag, thus allowing the drainage to be externalized, normalizing blood pressure but maintaining tachycardia.

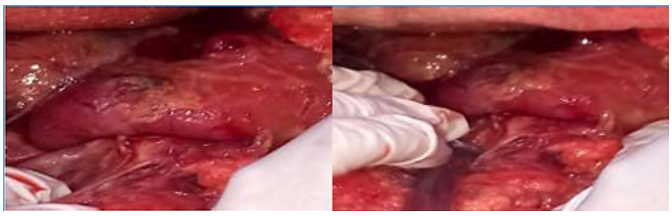

Figure 1 Manual exposure of the bleeding bed in the upper quadrants.

He is admitted to the intensive care unit where general stabilization measures are indicated with continuous monitoring of vital signs, control tests (GOT, GPT, TTP, PT, UREA, CREATININE), blood glucose every 6 hours, electrolyte balance, oral hygiene, anti-decubitus measures, respiratory therapy every 6 hours, analgesia with fentanyl, sedation with midazolam in addition to the use of omeprazole, hydrocortisone and calcium gluconate. The antibiotic therapy was established with piperacillin + tazobactam and metronidazole. Through invasive arterial methods, a tendency towards hypotension is reported.

In a second surgical time on 09/16/2021, a relaparotomy was performed plus surgical cleanliness under general anesthesia and antisepsis standards, an enlargement of the median incision, finding during the intervention: 1) Free bile fluid in the peritoneal cavity 400ml that it was aspirated, the previous compresses were removed, the four quadrants were also washed, the duodenal lesion was raphied and a T-tube was placed through the lesion, (Figure 2) 2) Retroperitoneal hematoma with non-expansive content towards the right retrocardiac region, 3) Postpyloric lesion on the upper face of more/less 4cm than 50%, 4) Lesion in the bile duct is observed without being able to locate the leak site, for this reason a Jackson Pratt drain is left. At the end, the laparostomy bag is placed. He is re-admitted to the intensive care unit for supportive measures and general care. Invasive monitoring continues to report his tendency towards hypotension and now he presents temperature rise as a novelty during hospitalization.

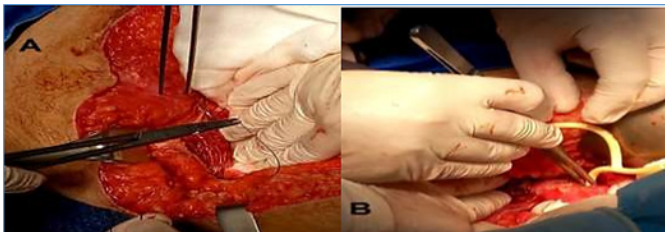

Figure 2 A) Manual and instrumental exposure of duodenal raffia; B) T-tube placement through the lesion.

On 09/17/2021 he was admitted to the surgical center for a third stage where he began under general anesthesia and antisepsis standards with the removal of the laparostomy bag, visualizing during the intervention: 1) Leakage of bile fluid limited to the subhepatic space due to for this reason, this region is washed, 2) Duodenal injury with intact raffia, immediately afterwards the proximal and distal pole of the jejunal injury is clamped, performing a resection of the segment (6cm). A laterolateral gastrojejunal anastomosis is performed by traction on the stomach and an incision on its anterior face, which will later be fixed to the jejunum on its posterior face. Finally, a double Bogotá bag is placed, but in this case two compresses are left in front of the first bag (Figure 3).

Figure 3 Abdomen partially closed with a double Bogotá bag and compresses.

He was admitted to the intensive care unit again to maintain himself with general and supportive care measures, maintaining the tendency towards hypotension and maintaining the thermal rise. On 09/24/2021 he was admitted again for a fourth surgical procedure in which a relaparotomy, surgical cleaning, removal of the duodenostomy, suture of the duodenal lesion in two planes and placement of a contained laparostomy were performed. Findings: 1) Scant fibrin material, purulent interloops, in the greater omentum and wall edges, 2) Free gastrobiliary fluid in the right upper quadrant which is aspirated, 3) Necrosis of the pancreas towards the head, 4) Leak of gastric fluid and bile. The jejunostomy tube is removed, the duodenal lesion is resected in two planes, the subhepatic space is washed, and the tubular drainage is rearranged next to the duodenum. On his way back, he enters the intensive care unit, for previously explained measures and anti-decubitus care.

He is admitted in a new surgical time on 09/27/2021 due to abdominal sepsis where a relaparotomy, wall suture, surgical cleaning, partial abdominal closure prior to general anesthesia and removal of the laparostomy bag are performed. In the surgical act, the following findings were obtained: 1) Little purulent bile fluid towards the right upper quadrant in the hepatic bed, for which the subhepatic bed was washed and tubular drainage of the subhepatic bed was rearranged, 2) No evidence of leakage in the duodenal suture. A Jackson Pratt drain is placed in the right paracolic gutter with its fixation. It ends with closure of the aponeurosis with continuous suture.

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He was admitted to the intensive care unit and assessed by traumatology where he reported a foreign object on the palmar radial side of the wrist. The X-ray showed a fracture of the distal end of the exposed radius. In the days that he was studying in said room, new upper digestive bleeding was reported with novelty since 09/29/2021, the use of red blood cell concentrates is available. On 09/30/2021 preserved truncal reflexes, reactive pupils and persistence of thermal rise were reported, for this reason it was decided to change the antibiotic scheme to meropenem and metronidazole was discontinued. On 10/01/2021 the patient is reported hemodynamically unstable with low-dose norepinephrine support, under orotracheal intubation connected to mechanical ventilation, presents periods of oxygen desaturation. Drainage of great amount and exit of clot by inferior suture, in spite of all this he is afebrile. Dialysis therapy is performed.

On the same October 1, surgery was performed at 10:00 p.m. due to aponeurotic suture dehiscence. For this, a laparotomy and aponeurosis raffia were planned. The patient had prolonged coagulation times. For this reason, it was decided to transfuse two frozen plasmas. during his passage to the operating room and a concentrate of blood cells. After general anesthesia and standards of asepsis and antisepsis, the following findings are obtained: 1) suture dehiscence in the lower third of the wound, glove or penrose drainage is left, 2) small segments dehiscence in proximal suture, 3) scant inflammatory fluid in the bottom of the sac, placing glove drainage. Aponeurosis raffia and partial skin closure with separate stitches are performed.

He was admitted to the intensive care unit after surgery with tendencies to hypertension and with a decreasing PAFI according to the last two blood gases. Performs thermal rise of 38 degrees Celsius despite support with antibiotics. The patient progresses during the days of hospitalization in the intensive care unit with a reserved prognosis and support measures. On 10/6/2021 at 7:00 a.m., he presented with RASS -5, FOUR 5, hyporeactive pupils to light, hemodynamic instability with norepinephrine dose response, increasing the requirements when performing hemodialysis, after replacement therapy, greater use of norepinephrine so feeding is discontinued.

Make fevers of 37.8 degrees Celsius, physical means are placed. Throughout the day the patient is in critical condition, with 4mm pupils, unreactive, corneal reflex present, hemodynamically unstable, unable to compensate despite norepinephrine (blood pressure: 60/30 mmHg, heart rate: 120 beats per minute, hypoperfused, lactate 3.5 mmol/L, febrile: 39.5 Celsius, anuric). He presented significant acrocyanosis and abundant purulent debit through the laparotomy wound. At 11:00 a.m., he presented sinus bradycardia that evolved into pulseless electrical activity, ventricular fibrillation, and asystole; CPR maneuvers are performed for 30 min without obtaining return to spontaneous circulation. Relatives and prosecutors are informed of the death that occurred at 11:30 a.m.

Theoretical framework

Background:

Ordonez et al.,[5]has shown that more than 90% of all combined injuries of the small intestine and colon due to penetrating trauma can be managed with primary or delayed anastomosis, even in the most severe cases, thanks to the implementation of damage control principles. With the application of the proposed management algorithm, the general requirement for ostomies (primary or deferred) can be less than 10%. Álvarez-Ibarra et al.,[6] clinical findings compatible with hemoperitoneum or peritonitis and the absence of femoral pulses constitute an indication for laparotomy. Similarly, anatomical knowledge of the retroperitoneum, of the vessel approach routes, as well as an adequate clinical examination will help reduce the morbidity and mortality of these injuries. The vicious cycle of hypothermia, acidosis, coagulopathy, and cardiac arrhythmias commonly occurs in abdominal vascular injuries. Alonzo & Lopez[7]a survival trend can be observed according to the increase in the number of interventions. This hint can be explained as the properly applied damage control technique needs at least two surgeries.

Theoretical bases

Penetrating abdominal trauma is predominant in men in the third decade of life (90%), the most common etiology is aggression by third parties. Upon arrival, patients with penetrating abdominal trauma should be approached differently depending on the mechanism of trauma. In a patient with a stab wound, a positive local analysis of the wound is mandatory for laparotomy, while, on the other hand, in patients with gunshot wounds, extra diagnostic studies are performed, including radiology and FAST. Abdominal trauma accompanied by marked hemodynamic instability is an absolute indication for surgical involvement. Hemodynamic instability and signs of peritoneal irritation make up absolute instructions for performing emergency laparotomy, in which evisceration of intra-abdominal contents is estimated to be the third indication for laparotomy in most trauma centers because up to 90% of patients with intestinal evisceration show some visceral injury, although it has been reported that up to 40% of patients with simple omental evisceration do not have any other significant injury; Another indicator of emergency intervention is bleeding from the digestive tract evidenced by hematemesis, significant outflow of blood from the nasogastric tube and proctorrhagia, for this reason the use of two units of red blood cells is ordered. Most damage control procedures are performed in the abdomen, and the injuries that most commonly require it are liver and vascular injuries. However, patients with penetrating abdominal trauma frequently present with multiple injuries that, in addition to injuries to solid organs and vascular structures, include hollow viscera, the biliopancreatic tree, and urological structures.

Up to 90% of preventable deaths in trauma patients are related to shock caused by inadequate recognition of intra-abdominal hemorrhage caused by injury to solid viscera; With the correct use of damage control, up to 40% of critically injured patients can be saved.[8] The components of danger for infection in penetrating abdominal traumas described include peritoneal contamination with intestinal material, severity of the trauma (hemodynamic status at admission, number of injured organs and number of transfusions required throughout the surgical method), increases in age of 20 years and left colon injury. Early coagulopathy is a recognized clinical entity, present at admission in greater than 25% of injured patients, with a base deficit of less than 6 mmol/L. Other components that remain present in tissue trauma are; hemodilution, hypothermia, acidemia and inflammation, which actively participate in triggering acute coagulopathy of trauma in patients in shock. Recent early transfusion protocols, They mention an early intervention of 1:1:1, which means; a packed cell unit, a fresh frozen plasma unit and a platelet unit; This initiative demonstrated a decrease in mortality in seriously injured patients.

Hypothermia temperature less than 35oC, is a component of complication that is present in the patient with these properties. The predisposing components that favor it are; low temperature exposure of the emergency room and operating room, restoration of fluids with crystalloid resolutions at room temperature, transfusion of blood products at a temperature of 4oC, surgical exposure and exuberant blood loss. In the operating room, measures must be taken to counteract hypothermia, such as; lower limb bandaging, placement of an electric blanket, and covering the entire patient area with a hot air blanket.

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Predominantly metabolic acidosis; it is an indicator of existing compromise in tissue hypoxia perfusion, whose element could be ischemia, necrosis or could be due to high concentrations of sodium or chloride. The correction of acidosis should be adequate, its delay increases mortality up to 50%. Early correction of base deficit has been reported to reduce mortality by up to 9%. The implementation of parenteral resolutions and the transfusion of blood products, in order to promote cardiac output, oxygen transport and systemic oxygenation, are the benchmark for the correction of metabolic acidosis.[9]

Methodology

The present investigation is a descriptive case report, with the authorization of the coordinator of the surgery service of the Rodríguez Zambrano Hospital for its documentation, the native patient of the city of Manta, Ecuador, transferred to the emergency room of the reference hospital mentioned in the city of Manta for its comprehensive approach and critical care. The case report was submitted to the "CARE CASE REPORT GUIDELINES" Checklist in order to have quality control of the manuscript.

Investigative diagnosis

The patient presented in the case study is admitted due to an evident open trauma to the abdomen by a firearm, where the entry and orientation of the projectile will determine the pathological picture to be expressed. With the entrance orifice on the left flank, a diagonal orientation directed towards the liver is determined, injuring Couinaud's zone I and VII, segments that house important irrigation, especially VII with a considerable number of branches of the left hepatic artery, right here is where most of the vascular damage occurs and where it was tried with greater intensity to pack with compresses to stop the hemoperitoneum causing the patient's hemodynamic instability.[10] The use of a Bogotá bag allows intra-abdominal pressure to be reduced, improving both visceral irrigation and stabilization of hemostatic plugs.[11] Immediately after each surgical time, stabilization in intensive care was necessary, making use of antibiotics, sedatives, vasoactive agents and other care, allowing the patient's survival to be increased.

The following surgical times were used in order to repair the damaged hollow viscera with primary closure techniques, use of drains and diversions such as the gastrojejunal one, which kept the patient's digestive integrity as intact as possible.[12] Already 16 days after admission to the hospital and after 5 surgeries, surgery was performed due to dehiscence of the aponeurotic sutures. By this time the patient was in very poor condition as he presented fever peaks despite the use of meropenem and desaturation on several occasions. After 5 days of his last surgical time, the patient is in critical condition, hemodynamically unstable despite the use of norepinephrine with vital signs of blood pressure: 60/30 mmHg, heart rate: 120 beats per minute, febrile: 39.5 Celsius, with 3.5 mmol/L lactate and anuric; all this being a sign of peritoneal sepsis.[13] The septic condition ended causing sinus bradycardia that evolved into pulseless electrical activity, ventricular fibrillation and asystole, despite resuscitation maneuvers the patient died.

Discussion

A clinical case is presented about a pathological and social circumstance that greatly affects Latin American society, the penetrating trauma of the abdomen, which must be carefully addressed at the scene of the disaster by trained personnel, a fact that did not occur in the case presented. since the patient initially arrives at the hospital in a private car without any rescue or resuscitation measures, such as the use of tranexanic acid as a clot stabilizer in the best of cases, which has been shown to reduce subsequent transfusions, permissive hypotension with the use of crystalloids with less capacity for apoptosis, assurance of the airway and cervical protection, if these basic measures are not respected, the patient's survival decreases drastically, principles rescued by articles such as that of Tomas Marsilla & Ignacio[14]and expose a chaotic situation in our region with the initial approach of these patients in Latin America.

The passage from the emergency room to the surgical center is a very essential point, it is established that on average for a successful emergency surgical intervention, no more than 50 minutes should pass, as mentioned.[15] But in the case of the context of the patient presented, the time elapsed is excessive until the first laparotomy is performed, a very unfortunate concept due to the fact that the patient is in frank hypovolemic shock and it is essential to explore for bleeding from solid organs such as the liver or spleen, which are the main organs that cause hemoperitoneum in these pathological contexts, therefore, articles such as,[16] Transfusion medicine in the context of polytrauma and especially in penetrating trauma to the abdomen is crucial, since the complications derived from the well-known deadly triad documented in articles such as the one by Rotondo et al.,[17] mention that the main trigger is exangination, which initially causes tissue to be hypoperfused, causing anaerobic metabolism, releasing lactate, contributing to acidosis. With the low metabolic rate, cellular thermogenesis is altered, causing hypothermia, and coagulopathy occurs due to the scarcity of coagulation factors. due to blood loss and denaturation of prothrombotic enzymes due to temperature alteration, for this reason hemostasis control and blood product transfusions must be timely since series of indexed cases mention that for proper management, 11 to 22 packets of blood are required.

Red blood cells and between 3 to 6 fresh frozen plasma, a very distant situation with respect to the case presented since only 6 packages of red blood cells and two fresh frozen plasma were transfused, this deficiency of blood products in the pathological context of penetrating abdominal trauma contributes to the aggravation of the state of shock since the pressure it cannot be maintained due to the low blood volume, it causes a state of infection since the poor irrigation of the intestinal mucosa causes bacterial translocation and prolongs the coagulopathy, all this scenario is the most likely cause of the sustained state of shock and the ineffectiveness of the therapy antimicrobial despite the fact that the therapeutic was broken several times, for this reason the preponderance thatthis deficiency of blood products in the pathological context of penetrating abdominal trauma contributes to the worsening of the state of shock since the pressure cannot be maintained due to the low blood volume, it causes a state of infection since the poor irrigation of the intestinal mucosa causes bacterial translocation and prolongs the coagulopathy, this whole scenario is the most likely cause of the sustained state of shock and the ineffectiveness of the antimicrobial therapy despite the fact that the therapy has been broken several times, for this reason the preponderance given by this deficiency of blood products in the pathological context of penetrating abdominal trauma contributes to the worsening of the state of shock since the pressure cannot be maintained due to the low blood volumen.

It causes a state of infection since the poor irrigation of the intestinal mucosa causes bacterial translocation and prolongs the coagulopathy, this whole scenario is the most likely cause of the sustained state of shock and the ineffectiveness of the antimicrobial therapy despite the fact that the therapy has been broken several times, for this reason the preponderance given byThis entire scenario is the most likely cause of the sustained state of shock and the ineffectiveness of antimicrobial

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therapy despite the fact that therapy was broken several times, therefore the preponderance given byThis entire scenario is the most likely cause of the sustained state of shock and the ineffectiveness of antimicrobial therapy despite the fact that therapy was broken several times, therefore the preponderance given by Fernández-Bolaños et al.,[18] correct management in intensive care, which includes transfusion medicine, antibiotic therapy, parenteral nutrition and mechanical ventilation;

All of this should have improved the patient in a maximum of 72 hours, but the patient's condition remained critical and his survival was very low because the laboratory tests showed high serum lactate values, even twice its upper limit. It largely prevents the aggravation of an acidosis already established by hypovolemic shock, since the abdominal compartment syndrome counteracted by the Bogotá bag causes ischemia at the abdominal level and, in the same way, multi-organ failure caused by the increase in the renin-angiotensin system that triggers systemic vasoconstriction. During the multiple moments that the patient underwent in the resuscitation phase, intensive care management was comprehensive and I tried at all times to reverse the patient's condition. In the attempts to carry out the multiple definitive surgeries, it should be emphasized that the exclusion of injured organs such as the duodenum or the pancreas was a technique that tried to preserve the greatest amount of tissue without resorting to their resection. The biliary exploration was deficient since for a long time the patient continued to leak biliary material, this greatly contributes to the contamination of a cavity that is in an inflammatory state. The outcome of peritoneal sepsis is theoretically one of the consequences of prolonged use of the Bogotá bag since, although it is very advantageous initially in circumstances of deteriorating immune status, it is a gateway for microorganisms and allows the dissemination of pathogenic inocula through the walls of the abdomen due to the accumulation of exudative fluid.

Research proposal

The approach in the patient of the case studied could be improved by including VACUUM PACK systems that would have allowed a better reduction of intra-abdominal pressure and timely drainage of collections in the cavity, considerably reducing the infection rate and promoting good tissue restoration. of the abdominal wall.[19,20] Another important point to take into account was the patient's gastrointestinal bleeding, which could have been addressed with endovascular therapy to rule out hemostasis failure or vascular damage, excluding the bleeding vessel. And thus have avoided areas of poor blood perfusion, bacterial translocation and sepsis.[21] It is recommended to take into account markers such as the CD4 count, postoperative albumin and the amount of transfused red blood cell concentrates (greater than 6 units increase the risk) that can predict fatal complications such as the failure of anastomoses or digestive diversions, decisive in the Survival of patients undergoing abdominal damage control after the first surgical stage.[22]

Acknowledgments

None.

Conflicts of interest

The authors declare that there is no conflict of interest.

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