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MANAGEMENT OF CRITICALLY ILL PATIENT FOLLOWING MULTIPLE ABDOMINAL TRAUMA WITH MASSIVE HEMORRHAGE: CASE REPORT

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Abstract

Background: *Most patients with severe abdominal trauma with massive bleeding require intensive care. On most occasions patients will be admitted to Intensive Care after surgery and require close monitoring of vital signs. Care in the ICU will focus on monitoring and supportive measures. The management of bleeding in critically ill patients is a dynamic and complex process. In addition, transfusion strategies during bleeding may involve several concurrent strategies to monitor coagulopathy, transfusion of blood products, and administration of drugs to correct coagulation disorders.*

Case report : *A 48-year-old male was admitted to the ICU after a traffic accident. The patient came to the emergency room with bleeding shock and fluid resuscitation was performed to restore MAP > 60 mmHg. Damage control surgery and massive transfusion were performed to save the patient. After the first operation, the patient returned to shock, producing 1500 cc hepatal and subphrenic drain in 3 hours. Re-laparotomy abdominal re-breaking surgery was performed again with additional packed red blood cells (PRBCs), Fresh Frozen Plasma (FFP) and platelet transfusion during surgery. Post-second surgery, the patient's hemodynamics were stable and vasopressor drugs could be weaned. The patient was admitted to the ICU with invasive monitoring and mechanical ventilator. After the 4th day, the patient experienced volume overload and pulmonary edema. Furosemide was given to eliminate fluid accumulation. The patient was extubated on day 6 and moved to the ward on day 7.*

Discussion : *In cases of intra-abdominal trauma, Focused Assessment With Sonography For Trauma (FAST) examination can be performed quickly so that the decision to perform surgical resuscitation can be made immediately. Damage control surgery is performed in conditions where bleeding cannot be controlled through definitive procedures. Abdominal packing can be performed to prevent further bleeding while waiting for hemodynamic stabilization and coagulopathy in the ICU. Giving massive transfusions such as PRBCs, FFP and platelets according to protocol prevents the occurrence of lethal triad in massive bleeding patients. On the other hand, massive transfusion also brings side effects and complications such as volume overload, electrolyte disturbances, acidosis, transfusion reactions and infection in patients. The administration of blood and fluid transfusion in post-traumatic patients in the ICU must be done carefully to prevent these complications.*

Conclusion : *In cases of intra-abdominal trauma patients with massive bleeding, early diagnosis, damage control surgery and proper management of massive transfusion are the management that must be done to save the patient.*

Keywords: *abdominal trauma, massive bleeding, massive transfusion protocol*

Background

Patients who have sustained severe abdominal trauma coupled with massive hemorrhage often require intensive care. Following surgery, most patients are admitted to the Intensive Care Unit (ICU) where they receive meticulous monitoring of vital signs and close medical attention. The primary focus of ICU care is on continuous observation and providing essential supportive interventions.

Central to the treatment of critically ill patients experiencing massive hemorrhage is the administration of blood products. However, it's crucial to recognize that blood transfusions come with inherent risks and potential complications. The management of hemorrhage in critically ill patients is a multifaceted and ever-evolving process. Additionally, the approach to transfusion during hemorrhagic events may encompass various strategies, including ongoing assessment of coagulation disorders, the judicious transfusion of blood products, and the administration of medications to support the coagulation process. It's important to note that there is considerable global variation in the treatment protocols employed for critically ill patients with hemorrhage, as well as the availability of standardized transfusion protocols within the ICU setting.[1]

This case report is dedicated to examining the management of critically ill patients within the ICU following blunt abdominal trauma and the subsequent development of massive hemorrhage. The objective of this report is to delve into the diagnosis, treatment strategies, and potential complications encountered when managing patients with blunt abdominal trauma complicated by massive hemorrhage. By addressing these aspects comprehensively, we aim to contribute to a better understanding of the intricacies involved in the care of such critically ill individuals.

Case Description

A 48-year-old male patient with weight 60 kg and height 160 cm came to the emergency department due to a motor vehicle accident, specifically a collision between a motorcycle and a car, which occurred about 3 hours before his presentation. After the accident, he reported experiencing abdominal pain, coupled with active bleeding in the lower right abdomen. The patient has no history of loss of consciousness, although he did not exhibit vomiting or seizures. There is no indication of bleeding from the ears, nose, or mouth. The patient arrived at the Emergency Department in a state of shock but had clear consciousness. His vital signs include a blood pressure of 78/45 mmHg, a heart rate of 135 beats per minute, and a respiratory rate of 28 breaths per minute. The initial treatment involved resuscitation of the fluid, consisting of 500cc gelofusin and 2000cc crystalloids, resulting in an increase in blood pressure of up to 90/60, a heart rate of 110 beats per minute, and a respiratory rate of 24 breaths per minute. Intravenous analgesics, specifically 50 mcg of fentanyl and 30 mg of ketorolac, are administered. Physical examination of the patient's head, chest, and pelvis revealed normal findings, with no evidence of injury or fractures to the extremities. Through the examination of Focused Assessment With Sonography For Trauma (FAST) identified fluid collection in the hepatorenal space, spleenorenal space and retrovesical space. After the initial assessment, the patient undergoes an emergency laparotomy procedure. During this surgical intervention, the medical team discovered a rupture of both the liver and spleen, as well as lacerations of the bowel. Additionally, there was evisceration of the ileum and omentum in the flank region. To address these injuries, splenectomy and abdominal packing were performed over a 4-hour period. Fluid management during the surgery included 3000 cc of crystalloid, 1500 cc of colloid, 1500 cc of packed red blood cells (PRBCs), and 900 cc of fresh frozen plasma (FFP), in addition to 250 cc of platelets. The intraoperative bleeding amounted to 4000 cc. The patient was also given tranexamic acid at a dose of 1 gram intravenously. After surgery, the patient was admitted to the ICU.

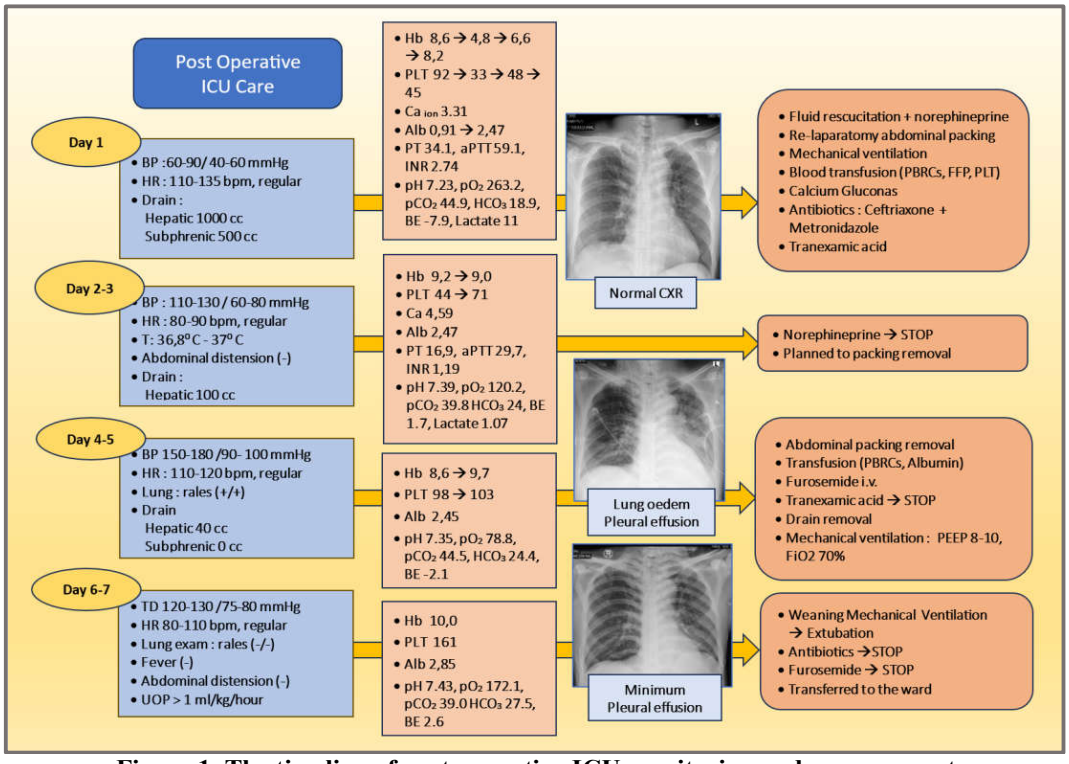

Figure 1. The timeline of post-operative ICU monitoring and management

(Alb = Albumin (g/dL), aPTT = Activated Partial Thromboplastin Time (second), BE = Base Excess, BP = Blood pressure, Ca ion = Ionized Calcium (mg/dL), FFP = Fresh Frozen Plasma, Hb = Hemoglobin (g/dL), HCO_3 = Bicarbonate, CXR = Chest radiography, HR = Heart rate, INR = International Normalized Ratio, PBRCs = Packed Red Blood Cells, pCO_2 = Partial pressure of carbon dioxide (mmHg), PEEP = Positive End Expiratory Pressure (cmH_2O), PLT = Platelets (10^9/L), pO_2 = Partial pressure of oxygen (mmHg), PT = Prothrombine Time (seconds), UOP = urine output)

Over the course of a 3-hour observation in the Intensive Care Unit (ICU), the patient experienced another episode of shock, with a blood pressure as low as 78/45 mmHg and a rapid heart rate of 135 beats per minute. During this time, 1000 cc of fluid was drained from below the liver, and an additional 500 cc was drained from the area beneath the diaphragm. Laboratory test results indicated critical values, such as a hemoglobin level of 4.8 g/dL, a platelet count of 33 x 10 /L, a prolonged prothrombin time (PT) of 34.1 seconds, an extended activated partial prothrombin time (aPTT) of 59.1 seconds, an INR of 2.74, and a calcium ion level of 3.31 mg/dL. Blood gas analysis showed an acidic pH of 7.23, a high pO2 of 262.2 mmHg, elevated pCO2 at 44.9 mmHg, an HCO3 level of 18.9 mmol/L, and a negative base excess of -7.9 mmol/L. To address these critical issues, the patient received 2000 cc of resuscitation fluids and norepinephrine to maintain a mean arterial pressure (MAP) above 65 mmHg. Additionally, 2 grams of Ca Gluconate were administered intravenously. Subsequently, the patient was taken back to the operating room for a re-laparotomy and abdominal re-packing. During this surgical procedure, the patient received transfusions of 1000 cc of packed red blood cells (PBRCs), 750 cc of fresh frozen plasma (FFP), and 250 cc of platelets.

Following the second surgery, the patient was readmitted to the ICU, and received additional transfusions of 500 cc of PBRCs, 750 cc of FFP, and 250 cc of platelets. Furthermore, the patient was given an additional 4 grams of Ca Gluconate via intravenous infusion over an 8-hour period. Antibiotics were continued for 5 days, consisting of intravenous Ceftriaxone (1 gram every 12 hours) and Metronidazole (500 mg every 8 hours). The administration of Tranexamic acid was maintained until the fourth day of treatment.

On the second day of treatment, the patient's condition stabilized, and the use of norepinephrine as a vasopressor was discontinued. The drainage from the hepatic and subphrenic areas did not exceed 100 cc over a 24-hour period. By the fourth day of treatment, the patient's systolic blood pressure tended to be high, ranging from 160-170 mmHg, with a positive cumulative fluid balance of 5000 cc over 4 days of treatment. An operation was performed to remove the abdominal packing, which lasted for 2 hours. During the operation, the patient received 1500 cc of crystalloid fluid, 250 cc of PRBCs, and 500 cc of colloid. The surgery resulted in a blood loss of 300 cc.

Following the removal of the abdominal packing, the patient experienced shortness of breath and a decrease in oxygen saturation. Physical examination revealed abnormal breath sounds in both lung fields (rales). Chest X-ray images confirmed the presence of pulmonary edema and bilateral pleural effusion. The patient was diagnosed with acute pulmonary edema due to fluid overload and was given furosemide to eliminate the excess fluid. Ventilator settings were adjusted by increasing the positive end-expiratory pressure (PEEP) to 8-10 cmH2O and using a fraction of inspired oxygen (FiO2) of 70% to improve oxygen levels.

On the sixth day of treatment, the patient's condition improved. Rales were no longer detected on lung examination, and chest X-ray images no longer showed signs of pulmonary edema. The patient was successfully weaned off the ventilator and extubated. They were transferred to a regular hospital ward one day after extubation, and their hemodynamic condition remained stable.

Discussion

Blunt abdominal trauma encompasses various injuries to the abdominal organs, each requiring unique management approaches. Liver and spleen traumas are common occurrences, with most cases manageable without surgery, especially in stable patients. Surgical intervention becomes necessary in severe cases characterized by hemodynamic instability or uncontrollable bleeding. For liver trauma, grades 1 and 2 are frequently encountered, while spleen injuries may also fall into less severe categories.[2–5]

In cases where surgical intervention is required, hollow organ abdominal trauma typically necessitates repair or resection. Damage control surgery, a vital strategy, aims to control bleeding, address contamination, and provide temporary abdominal closure, followed by definitive surgery once the patient is stable. [3,5]

Intraperitoneal bladder ruptures due to blunt trauma require surgical repair to prevent complications. Post-surgery, Foley catheter placement and follow-up cystography are routine procedures to ensure proper healing. Abdominal Compartment Syndrome (ACS) is a critical concern when intra-abdominal pressure exceeds 25 mmHg, leading to organ dysfunction. This condition necessitates careful monitoring and management.[3,6]

In this specific case, the diagnosis of intra-abdominal bleeding was confirmed through clinical assessment (shock) and FAST examination, revealing free fluid in various abdominal spaces. Surgical exploration uncovered liver and spleen ruptures, with the severity of the spleen injury indicating splenectomy. However, the liver bleeding was uncontrollable, leading to abdominal packing and drain placement to monitor post-operative bleeding. Additionally, the patient exhibited evisceration of the ileum and omentum in the right flank region, but the damage was not severe enough to warrant resection.[3]

To address the challenging situation, a damage control laparotomy with abdominal packing was performed because the bleeding could not be controlled with definitive surgery. The initial packing proved suboptimal as indicated by ongoing drain productivity and the patient's shock status, necessitating a re-packing during the second surgery. Following the second surgery, the addition of FFP and platelets led to improved hemodynamics, allowing vasopressor therapy to be discontinued within 24 hours post-operation. While intra-abdominal pressure was not directly measured due to the patient's bladder laceration, abdominal distension was used as an indicator during ICU care.

Given the elevated risk of infection associated with penetrating abdominal organ trauma, especially in cases requiring multiple surgeries, broad-spectrum antibiotics were administered, including ceftriaxone and metronidazole. These antibiotics were continued until the fifth day of ICU treatment, with discontinuation contingent upon confirming the absence of intra-abdominal infection in the patient. A tailored approach to each patient's specific abdominal trauma is pivotal in ensuring optimal care and recovery.[7]

Massive bleeding refers to the loss of a significant amount of blood within a short period. This can occur due to various reasons, including trauma or surgery. Managing massive bleeding is critical in preventing life-threatening complications. The criteria for defining massive bleeding include the loss of more than one total blood volume within 24 hours, 50% of the total blood volume within less than 3 hours, or bleeding exceeding 150 ml per minute.[8–10]

The primary goal in managing massive bleeding is to stabilize the patient's hemodynamics and replace the lost blood components effectively. It involves several key principles, starting with the management of intravascular volume. Physiologically, the body can compensate for blood loss by maintaining vital organ perfusion until approximately 30% of the total blood volume (TBV) is lost. Beyond this point, there is a risk of critical hypoperfusion, leading to shock. Adequate resuscitation during this stage is crucial to prevent shock.[8–10]

Resuscitation should begin with the rapid infusion of warm isotonic crystalloids, such as Hartmann's solution or Ringer lactate. The initial fluid dose is typically 1 to 2 liters for adults, and subsequent volume replacement should be guided by the patient's hemodynamic response. The resuscitation goal is to restore organ perfusion. In some cases, accepting lower-than-normal blood pressure levels, known as "permissive hypotension," may be necessary to balance organ perfusion with the risk of re-bleeding, allowing more time for surgical control of bleeding.[9,10]

Managing blood component replacement is another vital aspect of massive bleeding. As blood loss continues, it's essential to replace the components efficiently. This includes PRBCs, FFP and platelets. PRBCs are administered when hemoglobin levels fall significantly, while platelets and FFP are given based on laboratory tests indicating deficiencies in these components.[8–10]

One of the challenges in managing massive bleeding is the dilution of coagulation factors. As blood is replaced with fluids, coagulation factors may become diluted, leading to coagulopathy. This situation is particularly critical during massive blood loss. In such cases, empirically replacing coagulation factors based on established protocols is recommended to prevent rapid-onset coagulopathy.[8–10]

The management of massive bleeding requires careful monitoring of various parameters, including mean arterial pressure (MAP), hemoglobin levels, coagulation factors, pH, temperature, and base deficit. These parameters guide the resuscitation efforts and help ensure that the patient's condition is stabilized effectively.[8–10]

In the case described, the patient experienced massive bleeding due to the rupture and laceration of solid abdominal organs (liver and spleen). The patient's condition deteriorated to grade IV shock after the initial surgery, with bleeding exceeding 50% of the TBV within 3 hours and over 100% within 24 hours. To address this, aggressive resuscitation measures were taken, including the transfusion of packed red blood cells, platelets, and fresh frozen plasma. The use of vasopressors helped achieve the target blood pressure and maintain vital organ perfusion while buying time for further surgical preparations and blood product availability.

Massive Transfusion Protocol (MTP) is a critical component of managing massive bleeding. It is defined by specific criteria, such as the transfusion of a large number of blood units in a short time or when there is a significant loss of blood volume. The primary goal of MTP is to prevent or address the complications associated with massive bleeding, including coagulopathy, acidosis, and hypothermia. MTP outlines the ratio of different blood components, including red blood cells, fresh frozen plasma, and platelets, to be transfused to the patient. This protocol is designed to ensure that the right balance of blood components is delivered promptly, reducing the risk of complications and improving patient outcomes.[11,12]

PRBCs transfusions are typically indicated when a patient's hemoglobin levels fall significantly. However, the decision to transfuse PRBCs should also consider clinical factors, such as the rate of blood loss and the patient's overall cardiovascular status. Platelet transfusions are essential to maintain platelet counts above a certain threshold, typically 50-75 × 10^9 /L. This is especially crucial in patients experiencing acute bleeding. FFP contains clotting factors and is administered to correct deficiencies in coagulation factors. It is particularly useful when significant blood loss has occurred.[10–12]

In cases of uncontrolled bleeding unresponsive to standard therapies, the use of activated Factor VII (rFVIIa) may be considered as a rescue therapy. This can help manage life-threatening bleeding episodes effectively. Antifibrinolytic agents, such as tranexamic acid, may be beneficial in cases where fibrinolysis is contributing to bleeding. Early administration of tranexamic acid has been shown to reduce mortality in traumatic hemorrhage. Cell salvage, a process of collecting and reinfusing a patient's own blood lost during surgery, can be a valuable strategy, especially in unexpected blood loss situations and when dealing with rare blood types. However, certain contraindications, such as the potential for contamination or malignancy, should be considered.[13–15]

One limitation of Massive Transfusion Protocol (MTP) is the lack of standardization in trigger criteria. Different institutions may have varying criteria for activating MTP, which can lead to differences in practice. Additionally, there is a risk of blood product wastage if MTP is initiated in situations where massive blood loss criteria are not met, highlighting the importance of careful consideration when activating the protocol. In summary, managing massive bleeding and implementing a Massive Transfusion Protocol are complex but crucial aspects of critical care medicine. These protocols and strategies aim to stabilize patients, replace lost blood components, and prevent complications associated with massive blood loss. Careful monitoring and individualized care are essential for achieving the best outcomes in these challenging situations. [10–12]

The administration of intravenous fluids (IVF) is the most common treatment given in the intensive care unit (ICU). Although widely used, IVF can carry significant risks related to under- or over-administration. The principles of fluid administration should be based on guided safety: the right patient, the right fluid, the right route, and the right dose. IVF administration should be tailored to the volume and composition of fluid loss. If there is no excessive and sustained fluid loss, routine IVF is not indicated.[16]

Fluid management in critically ill patients consists of four phases: resuscitation, optimization, stabilization, and de-resuscitation. Aggressive fluid management is crucial to increase fluid volume during hemodynamic instability in the early phase of critical illness. De-resuscitation involves reducing fluid after shock stabilization. Limiting maintenance fluids and targeting fluid balance can reduce the duration of mechanical ventilation and ICU stay. Diuretics and renal replacement therapy with a negative fluid balance target are the primary strategies for de-resuscitation. The trigger to initiate this strategy after shock stabilization is a fluid excess of >10% and a lack of fluid responsiveness based on various dynamic monitoring methods.[17]

In this case, the fluid balance in the first 72 hours of treatment was 4500 cc due to resuscitation fluids and surgery. Hemodynamic stability was achieved after 24 hours of abdominal packing re-laparotomy without vasopressor therapy, but the patient had critical thrombocytopenia and coagulopathy, requiring additional platelet and FFP transfusions. On the fourth day of treatment, the patient's hemodynamic and coagulation condition was stable, and an abdominal packing removal operation was performed, involving the administration of 1500 cc of crystalloid fluids and 250 cc of packed red blood cells (PRBCs) transfusion over 3 hours. However, after the operation, the patient experienced desaturation and wet basal reonchi on lung physical examination. Chest X-ray confirmed acute pulmonary edema due to volume overload. Therefore, furosemide diuretics were added for 2 days, and ventilator settings were adjusted to address pulmonary edema. ASPEN / SCCM recommends assessing the risk of malnutrition using scores such as Nutritional Risk Screening (NRS 2002) or the NUTRIC score for all ICU patients who are suspected to have inadequate nutritional intake. Patients with a high risk of malnutrition may benefit from early enteral nutrition therapy. If accurate calorie measurement is not available, simple weight-based estimates (25-30 kcal/kg/day) can be used to determine energy requirements. Adequate protein intake (high dose) is around 1.2-2.0 g/kg of actual body weight per day. Early enteral nutrition is recommended in critically ill patients who cannot maintain adequate oral nutrition. Enteral nutrition within the first 72 hours after hemodynamic stabilization is more beneficial than delaying it, as it can reduce sepsis risk.[18]

Critically ill patients in the ICU often experience moderate to severe pain, both at rest and during standard care procedures. Pain assessment in non-communicative patients can use assessment scales such as the Behavioral Pain Scale (BPS) or the Critical Care Pain Observation Tool (CPOT). Opioids are the mainstay for pain management, but their side effects, such as sedation, delirium, respiratory depression, and ileus, can impact ICU prognosis. Non-opioid analgesics like acetaminophen, ketamine, lidocaine, and nonsteroidal anti-inflammatory drugs (NSAIDs) have been evaluated in critically ill adults to reduce opioid use.[18–22]

Sedative drugs are often given to critically ill patients to alleviate anxiety, reduce stress from mechanical ventilation, and prevent agitation-related risks. The choice of sedative drugs should be based on patient needs, comorbidities, and potential side effects. The use of sedative drugs should be regularly assessed using valid and reliable scales such as the Richmond Agitation Sedation Scale (RASS). The unpredictable pharmacokinetics and pharmacodynamics in critically ill patients, drug interactions, organ dysfunction, inconsistent absorption, and drug accumulation can lead to side effects.[22]

Critically ill patients are at a high risk of developing deep vein thrombosis (DVT) and pulmonary embolism (PE). Thromboprophylaxis is a crucial step in reducing this risk. ACCP guidelines recommend evaluating the risk of VTE in ICU patients and providing pharmacological thromboprophylaxis such as low-molecular-weight heparin or low-dose heparin for moderate-risk patients. Mechanical thromboprophylaxis can be considered when there is a high risk of bleeding.[23]

ICU patients are at a high risk of developing stress ulcers in the upper gastrointestinal tract. Stress ulcer prophylaxis typically involves the use of gastric acid-suppressing agents such as proton pump inhibitors (PPIs) or histamine-2 receptor antagonists. The choice of prophylactic agents should be tailored to patient needs, comorbidities, and the risk of infections. Early enteral nutrition can also help reduce the risk of stress ulcers in ICU patients.[24]

Conclusion

This case report illustrates that patients with multiple abdominal traumas can experience shock and massive blood loss. Swift assessment, damage control surgery, and the activation of massive transfusion protocols can save patients in such conditions. Early diagnosis of intra-abdominal massive bleeding can be rapidly achieved using FAST examination, enabling quick decisions for surgical resuscitation. Damage control surgery is performed when bleeding cannot be controlled through definitive procedures. Abdominal packing can be used to prevent further bleeding while awaiting hemodynamic stabilization and coagulopathy correction in the ICU.

In patients with prolonged massive bleeding, coagulation disturbances often occur, especially in those who lose more than their total blood volume. Massive transfusion of blood components such as PRBCs, FFP, and platelets following protocols prevents the lethal triad in patients with massive bleeding.

However, massive transfusion also carries side effects and complications, including volume overload, electrolyte imbalances, acidosis, transfusion reactions, and infections. Blood and fluid transfusion in post-trauma ICU patients should be carried out with caution to prevent these complications. Fluid and nutrition management, adequate pain relief and sedation, decisions regarding thrombosis prophylaxis, blood sugar control, the potential for stress ulcers, appropriate antibiotic administration, and the prevention of mechanical ventilation-related complications, such as VAP, are crucial factors influencing the successful management of post-trauma patients in the ICU.

Learning Point

Key points from the case study include the importance of swift and accurate clinical assessment for diagnosing traumatic abdominal injuries, effective management of hemorrhagic shock with fluid resuscitation and blood transfusions, the role of damage control surgery in severe trauma cases, careful fluid management to avoid complications, early initiation of enteral nutrition, multi-modal pain and sedation management, thromboprophylaxis for at-risk ICU patients, stress ulcer prophylaxis considerations, continuous monitoring of patients, preventative measures to reduce complications, the significance of radiological assessments, surgical interventions when necessary, and the importance of teamwork and collaboration among healthcare professionals in providing comprehensive care to trauma patients.

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