CASE REPORT: RESUSCITATION IN INTRAOPERATIVE THIRD SPACE LOSS IN PEDIATRIC PATIENT WITH PARACENTESIS FOR MASSIVE ASCITES

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Abstract

The accuracy of intraoperative fluid resuscitation is one of the important factors influencing the outcome of surgery. In action conditions with the occurrence of fluid loss from massive "third space loss" in a fast period of time can affect fluid regulation causing ascites re-accumulation hyponatremia, hepato-renal function disorders, to shock. This case report evaluated the success of fluid replacement during massive paracentesis and post-procedure monitoring in the recovery unit. Case description: 5-year-old girl, with massive ascites suspicious of malignancy planned to undergo a paracentesis procedure. The patient had clinical abdominal distention, mild-moderate dehydration, vomiting, and decreased skin turgor. Another abnormality found was a hydrocephalus post-VP Shunt in 2023. The patient was assessed as ASA 3 based on his physical status. Maintenance fluids are calculated to meet basal metabolic needs during surgery based on the Holliday-Segar formula using the 4-2-1 rule. Fluid resuscitation during procedure can be performed with crystalloid, typically 40-60 mL/kg, with a bolus of 10-20 mL/kg to assess fluid responsiveness. In conclusion, fluid administration was carried out using goal-directed fluid therapy, where fluid resuscitation is adjusted based on various hemodynamic parameters.

Keywords

Ascites, fluid, intraoperative “third space loss”

Introduction

Intraoperative fluid administration is a primary option for managing fluid loss during surgery. Accurate intraoperative fluid resuscitation is crucial for surgical outcomes and depends on factors such as the type of surgery, basal needs, fluid replacement, and any underlying conditions.[1] Inadequate or excessive fluid administration can lead to complications. The main goal of fluid management during surgery is to maintain normal hemostasis, particularly in pediatric patients with higher metabolic rates, larger body surface areas relative to body weight, and faster respiratory rates, making them more susceptible to hemostatic imbalances due to fluid loss. [2] Fluid loss in children can occur pre-operatively (due to fasting), intra-operatively (due to bleeding, fluid loss, or evaporation), and postoperatively. Conditions with massive "third space loss" can cause rapid fluid shifts, leading to complications like ascites, hyponatremia, hepatorenal dysfunction, and shock.[3,4] This case report evaluated the success of fluid replacement during massive paracentesis and post-procedure monitoring in the recovery unit.

Case Report

A 5-year-old female child, suspected to have massive ascites due to malignancy, was planned for a paracentesis procedure. The patient was presented with abdominal distension and a waist circumference of 69 cm, without venectasia or edema in the extremities. The patient did not have shortness of breath but was more comfortable lying at a 45-degree angle. Clinically, she was mildly to moderately dehydrated with vomiting, decreased skin turgor, a capillary refill time > 2 seconds, a respiratory rate of 30 breaths per minute, and an oxygen saturation of 98% on room air. Other congenital abnormalities included hydrocephalus, for which a VP shunt was placed in 2023. There was no alteration in consciousness, no increased intracranial pressure, no signs of limb lateralization, and no temperature instability.

Radiological examination by abdominal ultrasound showed massive ascites with a volume of 3848.7 mL, septated with sludge in the gallbladder, and intra-abdominal organs were displaced by ascites. Contrast-enhanced abdominal CT scan confirmed massive intra-peritoneal ascites.

The patient was then planned for massive paracentesis under general anesthesia. She was classified as ASA 3 due to her physical condition and underlying comorbidities. Pre-medication with 1 mg Midazolam was administered. Pre-oxygenation and ventilation were performed with a size 2 mask, with adequate ventilation achieved. Anesthesia was induced with inhaled Sevoflurane 4%, intravenous Propofol 20 mg, and Fentanyl 50 mcg.

An LMA size 2 was inserted, and after confirming adequate ventilation and secure placement, the LMA was connected to the ventilator with pressure control settings and a target tidal volume of 6-8 mL/kg.

Before the procedure began, we communicated with the surgeon to perform the paracentesis gradually to allow time for fluid resuscitation if there was any drop in hemodynamics (Figure 1). Prior to starting, the patient was rehydrated with 5 mL/kg of crystalloids (100 mL). The pre-induction hemodynamics were as follows: BP 84/61 mmHg, HR 110 bpm, RR 25 bpm, and SpO2 100%. The ascites fluid was removed in three stages, with a total of 1,400 mL. After each stage, fluid resuscitation with 100 mL of crystalloids was administered, for a total of 400 mL of crystalloids given intra-operatively. The patient's hemodynamics remained stable during the procedure, with a post-extraction BP of 82/65 mmHg, HR 118 bpm, RR 20 bpm, and SpO2 100% on room air after removal of the LMA (Figure 2).

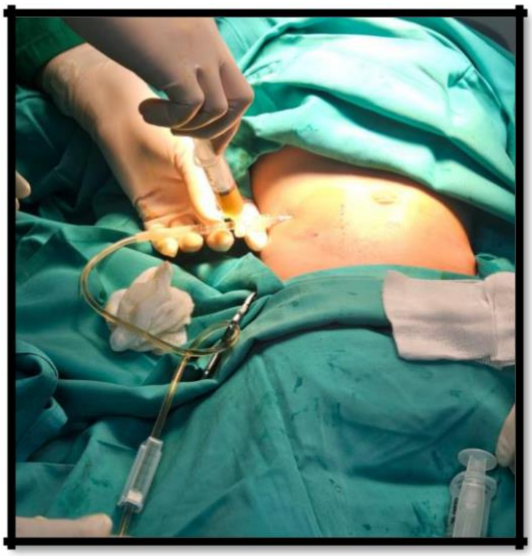

Figure 1. The surgeon performed the paracentesis gradually to allow time for fluid resuscitation

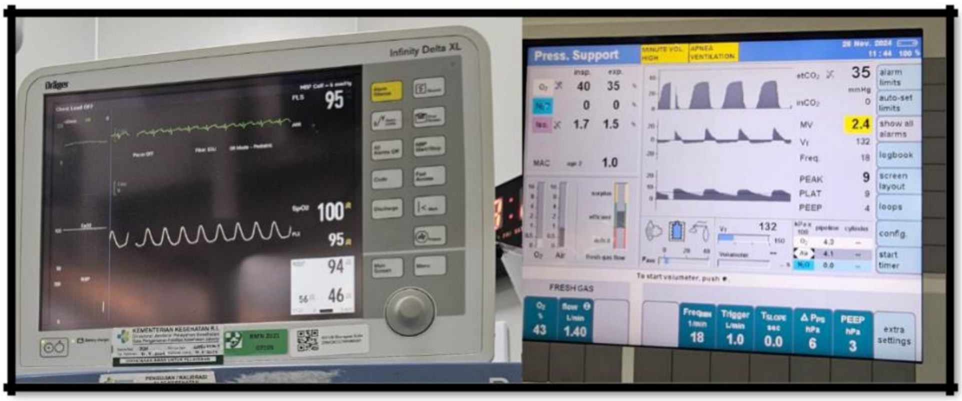

Figure 2. Hemodynamic and ventilation monitoring during paracentesis

Post-operatively, the patient was monitored in the recovery room for 2 hours before being returned to the ward. Strict hemodynamic and shock monitoring was recommended for 24 hours following the paracentesis. If there was any hemodynamic deterioration or loss of consciousness, fluid administration and albumin resuscitation were advised.

After 24 hours of post-operative monitoring, the patient had no complaints of shortness of breath, no chest wall retractions and remained more comfortable lying at a 45-degree angle. The abdominal distention had decreased, and the pigtail catheter was still in place.

Discussion

Body fluids make up approximately 50-80% of total body weight and the body's fluids are generally divided into two compartments: intracellular fluid, which accounts for 60% of total body weight, and extracellular fluid, which makes up 30-40%.[5,6] A physiological condition with a significant fluid accumulation in a compartment where the fluid has no physiological function is called a third-space fluid shift. An imbalance between oncotic and hydrostatic pressure causes a gradient shift, resulting in fluid movement within that compartment. Conditions such as burns, trauma, pancreatitis, ileus, tumors, and cirrhosis can lead to this fluid accumulation, which can cause pathological conditions known as ascites or effusion when the fluid accumulates in the abdomen or pleura.[5-7]

Pediatric patients have a wide range of body fluid volumes, depending on their weight and age, and they have compensatory mechanisms that make them more susceptible to fluid and electrolyte regulation disturbances. This requires more stringent fluid resuscitation strategies compared to adults.[2] Intraoperative fluid resuscitation is used to meet basal metabolic needs and ensure adequate oxygen perfusion to tissues. Fluid management in pediatric patients can be divided into maintenance fluids, replacement of deficits, ongoing losses, and replacement of lost fluids or mass.

Maintenance fluids are calculated to meet basal metabolic needs during surgery based on the Holliday-Segar formula using the 4-2-1 rule.[8] The first 10 kg of body weight is multiplied by 4 mL/kg/hour, the next 10 kg by 2 mL/kg/hour, and any remaining weight by 1 mL/kg/hour for hourly fluid administration. Fluid deficits, which replace fluids lost during preoperative fasting, are calculated by multiplying maintenance fluid requirements by the duration of fasting. Replacement for blood loss, evaporation, and third-space losses is also required. Evaporative fluid loss during surgery in children varies by type: for minor surgery, it is 2-4 mL/kg/hour; for moderate surgery (e.g., abdominal surgery), 4-6 mL/kg/hour; and for major surgery (e.g., thoracic or abdominal surgeries), 6-10 mL/kg/hour.

In cases of large fluid losses within a short time, tissue hypoperfusion may occur due to inadequate oxygen delivery to meet metabolic demands, increased oxygen consumption, inadequate oxygen use, or a combination of these factors. In pediatric patients, resuscitation can be performed with crystalloid fluids, typically 40-60 mL/kg, with a bolus of 10-20 mL/kg to assess fluid responsiveness.[9] If hypotension persists despite fluid resuscitation, vasoactive agents are recommended, with epinephrine and norepinephrine being preferred over dobutamine. In pediatric patients, excessive fluid administration can lead to more complications than the intended effects, so the maximum fluid volume should not exceed 60 mL/kg of body weight, or signs of fluid overload (such as periorbital edema or rales) should be monitored.[10]

In cases of fluid loss from ascites or effusion with hypoalbuminemia, which caused fluid shift due to unstable hydrostatic and oncotic pressures and massive albumin leakage (greater than 5 liters in adults or >50 mL/kg body weight in pediatric patients), resuscitation using colloids, particularly albumin, is recommended. Although there are no established standards for albumin administration in pediatric patients, it is generally recommended at a dose of 6-8 grams per liter of drainage output or 1 gram/kg of dry body weight. Albumin administration aims to prevent post-paracentesis circulatory dysfunction, which can arise 24 to 48 hours post-operatively.[4]

Thus, in this case, fluid administration was carried out using goal-directed fluid therapy, where fluid resuscitation is adjusted based on various hemodynamic parameters.

Fluid administration was assessed by changes in heart rate, blood pressure, and the Pleth Variability Index (PVI).[11] Since a urinary catheter was not inserted and the procedure was brief, urinary output was not used as a parameter in this case. However, in pediatric patients, urine output can be used as an indicator of adequate fluid status. The target urine output for neonates to children up to 3 years old is >2 mL/kg/hour, and for children over 3 years old, it is 0.5-1 mL/kg/hour. Other parameters that can be used to assess fluid adequacy include lactate levels and electrolytes.

This case report highlights the importance of anesthesiologist to be aware in intraoperative fluid management during paracentesis in children with massive ascites. Goal-directed fluid therapy is a method used to optimize fluid resuscitation in patients, often guided by specific physiological parameters to ensure effective treatment while minimizing complications.

Competing Interests

The authors declared that there is no conflict of interest with respect to the research, authorship, and/or publication of this article.

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