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Case Report

Anesthesia management for acute severe bleeding from rupture of inferior vena cava during laparoscopic right nephroureterectomy in elderly patient: case report and literature review

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Abstract: Acute rupture of the inferior vena cava during nephroureterectomy is a rare but serious complication. We reported an elderly patient who had an iatrogenic injury to the inferior vena cava while undergoing laparoscopic right nephroureterectomy. He suffered from acute severe bleeding and hypovolaemic shock. The patient received blood transfusion and rapid volume therapy, and the inferior vena cava injuries were repaired successfully after an urgent laparotomy. Postoperatively, he recovered well. This case suggests that immediate intervention strategy and effective anesthesia management result in a successful outcome.

Keywords: Nephroureterectomy, iatrogenic massive bleeding, vascular injury, anesthesia management

Introduction

Acute severe bleeding (ASB) has remained one of the most serious complications that occur during surgical procedures [1, 2]. The occurrence of ASB is associated with significant perioperative morbidity, such as increased risk of acute renal failure, brain injury, acute respiratory distress syndrome, disseminated intravascular coagulation (DIC), and obvious increases in postoperative mortality and hospital length of stay and costs [3-7]. We reported a successful case of acute severe bleeding and hypovolaemic shock from rupture of the inferior vena cava in an elderly patient while undergoing laparoscopic right nephroureterectomy. Immediate intervention strategy and effective anesthesia management in this subgroup of patients with acute massive bleeding are also discussed.

Case presentation

A 72-year-old male patient was admitted to our hospital with intermittent hematuria and acratia for a month. Except for an appendectomy in 2006, he had no significant past medical or family history such as hypertension, cardiac or pulmonary disease.

Initial laboratory analysis, including complete blood count, electrolytes, coagulation tests, liver and kidney function tests were all within normal range. There were no positive findings in EKG or chest radiograph. Abdominal MRI revealed a giant mass (7.2×6.3×5.6 cm^3) of mixed intensity, with poorly-demarcated margins that protruded towards the right renal vein and inferior vena cava. The right renal pelvis and superior segment of right ureter were also invaded (**Figure 1**). The patient was diagnosed with right kidney tumor and was scheduled for laparoscopic right nephroureterectomy.

Preoperative physical examination findings were within normal limits. The airway assessment included a normal neck movement, a 4-finger-breadth mouth opening, a Mallampati grade 2 and a 6-cm thyromental distance, suggesting that this isn't a difficult airway. Standard monitoring of the patient showed SpO_2 of 97%, blood pressure of 122/68 mmHg and heart rate of 65 BPM. Anesthesia was induced and

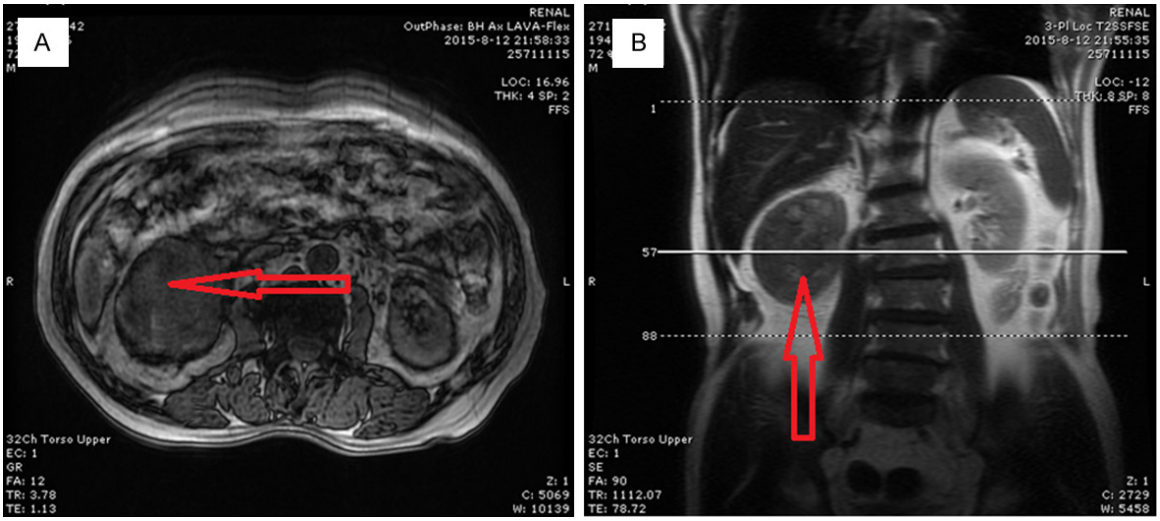

Figure 1. Abdominal MRI revealed a giant mass (7.2×6.3×5.6 cm^3) of mixed intensity (red arrows), with poorly-demarcated margins that protruded towards the right renal vein and inferior vena cavain axial view (A) and sagittal view (B). The right renal pelvis and superior segment of right ureter were also invaded.

Table 1. Arterial blood gas at different times

	pH	PCO_2	Hb	Hct	Na^+	K^+	Ca^{2+}	HCO_3	BE
12:44	7.274	50.7	10.8	33.5	141	4.1	1.19	20.6	-3.1
14:02	7.095	51.3	4.2	13.5	145	3.5	0.96	14	-13
14:09	7.098	57.7	3.6	11.8	145	4.9	0.71	17.8	-8.3
14:34	7.245	58.9	4.7	14.9	146	2.5	0.94	23	-1.7
15:30	7.267	48.8	6.3	19.9	137	3.1	0.96	20.7	-4.3
2^{nd} day	7.461	41	12.9	38	141	3.9	1.18	29.2	5

Abbreviation: Hct, Hematocrit; HCO_3, Bicarbonate; PCO_2, Partial Pressure of Carbon Dioxide; BE, Base excess (the loss of buffer base to neutralize acid).

endotracheal intubation was performed successfully [8-14]. Mechanical ventilation parameters were set at Vt=450 ml, f=13 bpm, I:E=1:2 and FiO_2=60%. Maintenance of anesthesia was done using 1.5% sevoflurane and remifentanil and muscle relaxant was administered as required. After radial artery puncture, invasive arterial blood pressure monitoring was done continuously for more accurate BP regulation. The patient was placed in left lateral position.

During the operation, surgical resection was uneventful initially. BP was observed to be in the range of 130-110/70-80 mmHg. 5 h after the start of operation, during the final removal of specimen, acute massive bleeding of more than 3000 ml occurred within 15 min. Because the massive bleeding did not be managed under laparoscopy, an urgent laparotomy was performed immediately. The massive blood loss resulted in hypotension (patient's BP decreased from 110/55 mmHg to about 55/30 mmHg within 5 min). Arterial blood gas analysis (ABG) showed: pH 7.095, PCO_2 51.3 mmHg, Hb 4.2 g/L, Hct 13.5%, Ca^{2+} 0.96 mmol/L, HCO_3 14 mmol/L, BE-13 (**Table 1**). Volume resuscitation was initiated immediately with compound sodium chloride and voluven. Compressive infusion set was used to increase the rate of fluid transfusion. A second peripheral venous channel was opened immediately. A bolus dose of 4 mg of dopamine was administered followed by continuous infusion at the rate of 10 ug/kg/min. Dopamine was soon proved to be ineffective because BP didn't improve and HR also decreased from 90 to 55 Bpm. Meanwhile, both the pupils were dilated to 6 mm. Ice cap was applied to the patient for cerebral protection. Adrenalin was administered at a dose of 0.2 to 0.5 mg, which prevented further circulatory collapse. Dopamine was replaced by noradrenaline, which was continuously infused at the rate of 0.5 μg/kg/min. More skillful and experienced surgeons were called to deal with this critical situation. Director of the Department of Anesthesiology was also involved in the resuscitation of the patient. The placement of central venous line was performed under ultrasound guidance, since the conventional method was impossible in lateral position. A two lumen catheter was inserted for fluid transfusion and central venous pressure (CVP) measurement. After 15

mins of blood requisition, the first batch of blood products were obtained and 5.5 units of packed red blood cells (PRBC) and 450 ml of fresh frozen plasma (FFP) were administered promptly. Patient's circulation started to be improved, and BP increased to 90/50 mmHg and HR increased to 70 BPM. Second ABG report showed: pH 7.08, PCO_2 57.7 mmHg, Hb 3.6 g/L, Hct 11.8%, Ca^{2+} 0.71 mmol/L, HCO_3 17.8 mmol/L, BE-8.3. Second batch of blood products (7.5 U of PRBC, 800 ml of FFP, 6.25 U of cryoprecipitate and 10 U of pooled platelets) were obtained and transfused thereafter. Arterial blood gas samples were sent for analysis intermittently (record in **Table 1**). Acidosis was corrected by sodium bicarbonate (250 ml) and hypocalcemia was treated with calcium gluconate, which improved the internal environment significantly (pH 7.267, PCO_2 48.8 mmHg, Hb 6.3 g/L, Hct 19.9%, Ca^{2+} 0.96 mmol/L, HCO_3 20.7 mmol/L, BE-4.3). Preservation of renal function was done by administration of furosemide after CVP returned to normal range. At this stage, surgical hemostasis was achieved and hemodynamic parameters returned to baseline level. The total blood loss for the operation was about 4500 ml. The patient's coagulation function was shown to be nearly normal by TEG.

After operation was completed, patient was transferred to the ICU with continuous infusion pump of adrenalin and full hemodynamic monitoring in place. 9.5 U of CRCs and 150 ml of FFP was administered in ICU. The patient became hemodynamically stable and was extubated the next day. On postoperative day 2, the patient was readmitted to the Urosurgery ward. On postoperative day 4, the patient suffered from deep vein thrombosis (DVT) of lower extremities and was treated with thrombolytic therapy. On postoperative day 10, the DVT was successfully cured and the patient was discharged from our hospital.

Discussion

Acute severe bleeding is known to be the major cause of intraoperative critical events all over the world. Intraoperative massive hemorrhage may result in rapid develop of severe hypotension and hypoxemia, and is responsible for a majority of cardiac arrest or permanent disability of the central nervous system in the operating room [15-18]. There are various definitions of the term acute severe bleeding. It has been defined as blood loss of a patient's total blood volume or 50% of circulating blood volume within a 30-min period, or blood loss exceeding 150 ml/min [2]. Another definition is blood loss that necessitates the replacement transfusion of plasma and platelet [19, 20]. The anesthetists should rapidly provide immediate intervention strategy to restore an adequate intravascular volume to the patient, followed by effective blood management to maintain blood composition within safe limits of oxygen-carrying capacity and biochemistry. This case had been demonstrated our rapid response to improve patient outcomes.

Some factors including iatrogenic injury of surgical procedures, carcinoma invasion to inferior vena cava are involved in the process that leads to massive and uncontrolled hemorrhage developing into a critical situation. Mao et al reported the iatrogenic injury of anomalous left inferior vena cava (IVC) due to misdiagnosis during nephroureterectomy [21]. Because the injured left IVC was recognized correctly during cystectomy, the patient recovered well from the surgery. Nam et al indicated surgical treatment of inferior vena cava invasion-related renal carcinoma by use of human cadaveric aorta [22]. The study from Park et al reported the management of blunt, intrapericardial inferior vena caval injury without intra-abdominal bleeding, and found that median sternotomy revealed a vena caval laceration, which was repaired [23]. Nepple et al reported the management of intraoperative hemorrhage during robotic partial nephrectomy, found that safely performing robotic partial nephrectomy was dependent on attention to prevention of hemorrhage and rapid response to the challenge of intraoperative bleeding, suggesting that adequate preparation facilitates to ensure a rapid and efficient response to iatrogenic surgical injury during robotic partial nephrectomy [24].

Providing multiple large-bore blood access and adequate intravascular volume to the patient is a primary goal during massive blood loss in surgical patients. It is well known that intravascular volume is coincidentally low because of rapid or massive hemorrhage. Maintaining adequate intravascular volume is a prerequisite for saving a patient's life. An increasing number of

studies support that there exist the acquired coagulation disorders after intraoperative massive hemorrhage [25-28]. Acute severe bleeding is often associated with massive loss and consumption of coagulation factors. Recent data have suggested that fresh frozen plasma (FFP) play important roles in normalizing coagulation disorder to a steady state and reducing early mortality [15, 29]. The study of massive transfusion practices have been indicated in most patients that a 1:1 ratio of RBC:FFP obviously improves survival rate if more than 20 U of RBC (corresponding to 4,000 ml blood) is transfused during intraoperative massive hemorrhage [2]. Otherwise, Duchesne et al reported low-volume resuscitation (LVR) for severe intraoperative hemorrhage, suggesting that LVR is an effective alternative to conventional resuscitation efforts when used in combination with homeostatic close ratio resuscitation in patients with intraoperative hemorrhage [15].

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Disclosure of conflict of interest

None.

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