CASE REPORT

Acute normovolemic haemodilution for management of 4200 ml blood loss during radical prostatectomy

Gal R, Cundrle I

Department of Anesthesiology, University Hospital Brno, Czech Republic. **rgal@iol.cz**

Abstract

Background: **We refer a case report of patient with 4200 ml large blood during urological surgery, in which was used acute normovolemic haemodilution as a solely method for avoiding of allogeneic blood transfusions.**
Methods: **A 65 years old patient was scheduled for radical prostatectomy. After starting general anaesthesia was removed 2360 g (target haematocrit 0.30 in patients with calculated total body blood volume 5460 ml) of whole blood from patient and circulation volume was replaced by 1500 ml of colloids and 2000 ml of crystalloid solution. Retransfusion was started after 1800 ml blood loss (transfusion trigger – Hct 0.20).**
Results: **The total blood loss was 4200 ml during 4 hour and 40 minutes of surgery. The patient was the whole operation time haemodynamic stable, with minimal systolic blood pressure 100 mmHg and haematocrit value was 0.32 after the procedure.**
Conclusions: **To reduce the risk of anaemia and also the risk of allogeneic blood transfusion is the one of the basic part of the anaesthesia management of large urological procedures. This case demonstrated the effectiveness and safety of acute normovolemic haemodilution as a method for avoiding allogeneic blood transfusion in a patient with 77 % loss of total body blood volume.**
Key words: anaesthesia management, large blood loss, acute normovolemic haemodilution.

To reduce rhe risk od anaemia and also the risk of allogeneic blood transfusion in one of the basic part of the anaesthesia management of large urological procedures. The therapeutic use of allogeneic blood carries with it uncommon but potentially fatal complications. In addition to well known infectious and haemolytic transfusion complications, clinical evidence suggest that blood transfusions can cause significant immune effects as well (Savarese, 1999). Multiple retrospective human studies have suggested a correlation between allogeneic blood transfusion and both recurrence and decreased survival too (Jackson, 1989; Busch, 1994). We refer a case report of patient with 4200 ml blood loss during urological surgery, which demonstrates the possibilites of acute normovolemic haemodilution (ANH) as a solely method for management of extremely large blood loss too.

Material and methods

A 65 years old, 78 kg weighty male patient with adenocarcinoma prostate was scheduled for a radical prostatectomy. He also suffered from hypertension and he had haematocrit value 0.53 preoperatively. After application of antihypertensive drugs and low molecular weight heparin was premedicated intramuscularly with atropin 1 mg and promethazin 100 mg. General anaesthesia was induced with fentanyl 100 µg, flunitrazepam 2 mg, etomidate 20 mg and muscle relaxation was provided with 8 mg of pancuronium. The trachea was intubated and ventilation was adjusted to maintain a normal $P_{ET}CO_2$. Anaesthesia was subsequently maintained with sevoflurane (end tidal concentrations of 1 to 1.5 %) and next doses of fentanyl and pancuronium. Except cannulation of two veins on upper extremities was performed puncture the right jugular vein by three-way catheter. The left

Department of Anesthesiology, University Hospital Brno, Czech Republic

Address for correspondence: R. Gal, MD, PhD, Dept of Anesthesiology, University Hospital Brno, Jihlavska 20, CZ-639 00 Brno, Czech Republic
Phone: +420.5.43193850, Fax: +420.5.43193801

Tab. 1. Blood count values during and after operation.

Hour	0	1	3	5	12	24
Leu	7.6	8	9.6	11.2	15.8	12.6
Ery	5.83	3.26	2.54	3.47	4.15	4.08
Hb	183	105	78	106	128	127
Hct	0.53	0.30	0.22	0.32	0.38	0.37
Plt	160	142	95	98	123	133

radial artery line was placed for invasive blood pressure monitoring and withdrawaing blood for haemodilution. ECG, SaO_2, $P_{ET}CO_2$, central venous pressure, and urine output were monitored continually too.

After induction of anaesthesia was removed in advance calculated 2360 g of blood (target haematocrit 0.30) from patient into four transfusions bags, with 70 ml of CPDA solution in each of them, with restoration of circulation volume by 1500 ml of colloids and 2000 ml of crystalloid.
Formula:

Haemodilution volume (in ml) = (Hs - Hr) x TBB/Hs

Hs = started haematocrit (Hct), Hr = recquired Hct, TBBV = total body blood volume (5460 ml).

In course the ANH (the general time 60 minutes) was maintained the systomic blood pressure above 100 mmHg. The starting blood loss was compensated by next infusion of warmed crystalloid and colloids solutions. Retransfusion was started after 1800 ml blood loss (calculated transfusion trigger – Hct 0.20). Blood units were returned in the reverse order of collection and the blood was infused in ratio 1:1 to next blood loss. Controlling the value of haemoglobin and haematocrit was performed every hour.

Results

After ANH was observed decreaseing of central venous pressure from + 12 to + 6 cmH_2O, haematocrit value from 0.53 to 0.30 and haemoglobin from 183 to 105 g/l. The general blood loss was 4200 ml during 4 hour and 40 minutes of operation time. In the course of operation were infused altogether 2000 ml of colloids and 5500 ml of crystalloid and 2360 g of blood gained from ANH. The trachea was extubated in the operating room and he was transferred to the intesive care unit for postoperative monitoring. The drop of AT III value to 46 % instantly after operation was spontaneously increased to 76 % 24 hours postoperatively. The blood loss from drain suction was minimal after the procedure. We had not to use allogeneic blood because the patient was haemodynamic stable with minimal systolic blood pressure 100 mmHg and measured values including coagulogram were stable during the whole operation time and postoperatively too. The main results corresponde to a mathematics calculations are shown in the Table 1.

Discussion

Bloodless medicine and surgery programs have been developed mainly to meet the needs of Jehovah's Witness, but they also apply to non-Witness patients who desire to avoid or minimize they exposure to allogeneic blood products. Preoperative autologous blood donation, application of erythropoietin, intraoperative blood salvage and ANH are the routinely used methods for avoiding of allogeneic blood transfusions. ANH is a technique that comprises the removal of whole blood from a patient with the restoration of circulating blood volume by acellular fluid shortly before an anticipated significant blood loss.

According to some authors ANH can replace preoperative autologous blood donation as an autologous blood procurement strategy in patients undergoing radical prostatectomy because it is less costly and equally effective (Monk, 1997; Goodnough, 1998). Although safer than allogeneic blood, the transfusion of preoperatively deposited autologous blood is still associated with potential risk of error in administration and of bacterial contamination due to improper handling of the blood. In contrast, the blood units obtained by haemodilution remain in the operating room during the operation, so that the cost of blood testing and any risk due to administrative error are eliminated. The elimination of blood wastage and provision of fresh, whole blood for safe use during surgery are also important advantages of the procuring of autologous blood by haemodilution rather than preoperative donation (Monk, 1995).

The haemoglobin value, which can be tolerated, depend on many factors. Oxygen delivery to the tissues is influenced by the respiratory system, blood (the oxygen-carrying system) and the cardiovascular system. Anaemia results in a decrease in blood viscosity, with reduction of peripheral vascular resistance (Hocker, 1996). Compensatory mechanism is both an increasing of cardiac index and an increase in oxygen extraction (Spahn, 1997, 1998).

In our institution is estimated surgical blood loss during radical prostatectomy 1632±751 ml (average value obtained from last 20 procedures). The higher total blood loss 4200 ml in our patient was caused by very large adenocarcinoma prostate with total preparation weight 158 g. The haematocrit value before induction of anaesthesia enabled us to compensate this large blood loss only by ANH with lower haematocrit value 0.22 (haemoglobin value 78 g/l) which is usually well tolerated during general anaesthesia and critical care too (Hébert, 1999). For this patient with preoperatively haematocrit value very near the diagnosis of polycythaemia was ANH also the prevention of thrombosis. This case demonstrated the effectiveness and safety of acute normovolemic haemodilution as a method for avoiding allogeneic blood transfusion in a patient with 77 % loss of total body blood volume during radical retropubic prostatectomy.

References

Busch ORC, Marquet RL, Hop WJC et al. Colorectal cancer recurrence and perioperative blood transfusions: a critical appraisal. Semin Surg Oncol 1994; 10: 195—199.

Goodnough LT, Monk TG, Brecher ME. Acute normovolemic hemodilution should replace the preoperative donation of autologous blood as a method of autologous-blood procurement. Transfusion 1998; 38: 473—476.

Hébert PC, Wells G, Blajchman AM, Marschall J, Martin M, Pagll-liarello G et al. A multicenter, randomized, controlled clinical trial of transfusion requirements in critical care. New Engl J Med 1999; 340: 409—417.

Hocker P. Principles of transfusion medicine perioperatively and in intensive care. Acta Anaesth Scand 1996; 40 (Suppl): 137—138.

Jackson RM, Rice DH. Blood transfusion and recurrence in head and neck cancer. Ann Otol Rhinol Laryngol 1989; 98: 171—173.

Monk TG, Goodnough LT, Birkmeyer JD, Brecher ME, Catalona WJ. Acute normovolemic hemodilution is a cost-effective alternative to preoperative autologous blood donation by patients undergoing radical retropubic prostatectomy. Transfusion 1995; 35: 559—565.

Monk TG, Goodnough LT, Brecher ME, Pulley DD, Colberg JW, Andriole GL et al. Acute normovolemic hemodilution can replace preoperative autologous blood donation as a standard of care for autologous blood procurement in radical prostatectomy. Anesth Analg 1997; 85 (5): 953—958.

Savarese D, Waitkus H, Stewart FM, Callery M. Bloodless medicine and surgery. J Intens Care Med 1999; 14: 20—33.

Spahn DR, Sefert B, Pasch T, Schmid ER. Haemodilution tolerance in patients with mitral regurgitation. Anaesthesia 1998; 53 (1): 20—24.

Spahn AR, Zollinger A, Schlumpf RB, Stohr S, Seifert B, Schmid ER et al. Effect of chronic beta-blockade on compensatory mechanism during acute isovolaemic haemodilution in patients with coronary artery disease. Brit J Anaesth 1997; 78: 381—385.

Received March 12, 2002.
Accepted April 15, 2002.