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Combined Closed-circuit Acute Normovolemic Hemodilution and Deliberate Hypotension in a Jehovah's Witness: A Case Report

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Authors' contributions

This work was carried out in collaboration between both authors. Author OEE designed the study and wrote the initial draft of the manuscript, while author EE managed the literature search. Both authors read and approved the final manuscript.

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Case Report

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ABSTRACT

Aims: To enlighten both clinicians and Jehovah's Witness patients on closed-circuit acute normovolemic hemodilution (ANH) and deliberate hypotension (DH) as safe and acceptable blood conservation strategies.
Case Presentation: A 32 yr old male Jehovah's Witness patient was scheduled for nephro-lithotomy on account a right nephrolithiasis (Staghorn calculus). He was fit and young weighing 76 kg with packed cell volume of 34%. The anticipated blood loss during the surgery was 1500 ml or more, hence we decided to use combined closed-circuit ANH and DH. These combined strategies were accepted by the patient; they minimized blood loss to only 400 mls and provided a good operating field visibility.
Discussion: Several blood conservation strategies have been developed and accepted by Jehovah's Witness patients provided the blood circulation circuit is not broken. Our resident doctor and patient were not initially aware of the acceptability of ANH by the Jehovah's witness. Blood conservation strategies could be used either singly or in combination, our patient was suitable for both.
Conclusion: Combined closed-circuit ANH and DH are safe and acceptable to Jehovah's witness patients.

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Keywords: Acute normovolemic hemodilution; deliberate hypotension; Jehovah's Witness.

1. INTRODUCTION

The surgical Jehovah's Witness patients will continue to challenge the clinicians due to their 'no blood transfusion doctrine' even in the presence of life threatening anemia and/or coagulopathy [1]. The Witness's determination that blood transfusion violated God's law was made in 1945 and is based on three biblical passages including Gen 9:3-4: 'Every moving thing that liveth shall be meat for you,… but flesh with life thereof, which is the blood thereof, shall ye not eat' [2]. In a retrospective analysis of Jehovah's Witness patients undergoing non-cardiac surgery, a pre-operative hemoglobin (Hb) concentration <10 g/dl significantly correlated with increased post operative mortality [3]. Several blood conservation strategies have been developed, and are acceptable to many Jehovah's Witness patients [4,5], these include acute normovolemic hemodilution (ANH), intra- and post operative cell salvage (CS), deliberate hypotension (DH), perfluorocarbon emulsion etc, provided the blood circulation circuit in not broken. These are used either in isolation or in combination, however, these techniques are infrequently reported in our environment due to lack of awareness by the clinicians and/or patients, or other factors [4,6]. We describe the successful use of combined closed-circuit ANH and DH in a Jehovah's Witness patient.

2. CASE REPORT

A 32 yrs old male Jehovah's Witness was scheduled for nephrolithotomy on account of right nephrolithiasis (staghorn calculus). He had no previous history of surgery or anaesthesia and no co-morbidities. Medical examination revealed a fit young adult weighing 76 kg, his packed cell volume (PCV) was 34%, other laboratory investigations were within normal limits.

An informed consent for surgery was obtained the previous day during routine preoperative assessment, however, the patient refused consent for any form of blood or blood product transfusion in accordance with his Jehovah's Witness believe. On the morning of surgery, the surgeon alerted that the anticipated blood loss may be up to 1500 ml or more, hence we decided to use a combined closed-circuit ANH and DH to minimize the blood loss.

In the theatre, the patient was counseled on closed-circuit acute normovolemic hemodilution as an acceptable form of blood transfusion by the Jehovah's Witness and consent was eventually obtained for the procedure.

He was attached to a multiparameter monitor and baseline vital signs were as follows: Pulse rate- 90/ m, Blood pressure- 130/70 mmHg, SpO_2 – 100% on room air. A tourniquet was applied to the left arm and two intravenous lines were set up with size 18 G canulae, two citrate, potassium, dextrose, adenine (CPDA)–containing blood bags were obtained and blood giving sets were attached to each blood bag. Phlebotomy was performed and blood was collected into the blood bags placed below the arm. At the same time, a size 16 G canula was inserted into the right arm for normal saline infusion. Approximately, a total of 900mls of blood was collected into the two blood bags to roughly reduce the PCV to the estimated 28% before surgery. The blood bags were hung on the drip stand above the patient and the blood giving set connected to the 18 G cannula to establish a closed-circuit after which, the phlebotomy lines were removed (Fig. 1). A total of 3 L of normal saline was infused within 30 minutes to maintain the blood volume.

Anaesthesia was induced with 120 mg of propofol, and halothane at 2%, suxamethonium, 75 mg was given to facilitate endotracheal intubation with size 7.5 mm endotracheal tube, after which pentazocine 30 mg, and atracurium 30 mg were given. Five minutes after intubation, his BP and MAP were 90/68 mmHg and 68 mmHg respectively. He was maintained within a target systolic BP range of 80-90 mmHg, and MAP of 50-70 mmHg using halothane at 1-2%, and controlled manual ventilation (Fig. 3).

The patient was put in the left kidney position and surgery commenced. The kidney stones were removed, the surgery lasted approximately 3 hrs and 50 mins. The estimated blood loss from suction bottle and gauze was 400 ml, and the surgeon was satisfied with the good operating field visibility (Fig. 2).

A total of 2.5 L of normal saline was infused intraoperatively, the two units of blood were reinfused to the patient at the end of surgery. Intravenous paracetamol 1000 mg and intramuscular diclofenac 75 mg were given for

immediate post operative analgesia, neuromuscular blockade was reversed with neostigmine/atropine combination. The patient was extubated and transfered to the recovery room. His PCV 48 hrs after surgery was 28%.

Fig. 1. Patient's blood reinfused

Fig. 2. Good operating field visibility

Fig. 3. Hypotension maintained

3. DISCUSSION

The perioperative management of the Jehovah's Witness patient focuses on the prevention of lethal anemia and coagulopathy [7]. Some Jehovah's Witness patients likewise anaesthetists are not familiar with some acceptable blood conservation strategies for Jehovah's Witness [4,6]. Our patient had previously rejected any form of blood transfusion during preoperative assessment the previous day by our resident doctor who was not conversant with closed-circuit ANH, hence, we counselled the patient in the theatre on closed-circuit ANH and DH as acceptable blood conservation strategies by Jehovah's Witness. To further convince him of the closed-circuit nature of ANH, we performed the phlebotomy before the induction of anaesthesia, against the conventional phlebotomy after induction [5,7].

Blood conservation strategies used either singly or in combnation have been reported by previous researchers [4,5], we opted for combined closed-circuit ANH and DH because the patient was fit for both procedures, also we presumed that outcome of combination technique may be superior to a single measure.

Acute normovolemic hemodilution is based on the concept of removing and storing the patient's Hemoglobin-rich blood before the surgery, replacing the blood with cystalloid or colloid to maintain the blood volume and reinfusing the blood at the end of the surgery. This strategy has been reported to be effective in reducing the total number of units of blood transfused, post operative complications and the overall need for allogenic blood in different types of surgical conditions [4,5,7].

The inclusion criteria for ANH include patients undergoing surgery where greater than 1000 ml of blood loss is anticipated, preoperative hemoglobin concentration is adequate (>9g/dl) and no ischemic heart disease or active bleeding due to coagulopathy are present (8). The American Association of blood banks recommend using the following formula to determine the amount of blood to withdraw for reinfusion [8]: $V= EBV (H_i-H_f)/H_{av}$, where V indicates volume of blood to be withdrawn; EBV, estimated blood volume, typically 70 ml/kg; H_i, initial hematocrit before the procedure; H_f, final desired hematocrit after hemodilution; and H_{av}, average hematocrit during the hemodilution process. Our patient was expected to loose greater than 1500 ml of blood. Although the actual estimated blood loss was only 400mls, this may be attributed to the synergistic effect of combined ANH and DH [9].

Deliberate hypotension or hypotensive anaesthesia entails a controlled lowering of the systolic blood pressure to between 80-90 mmHg or decrease in mean arterial pressure to 50-70 mmHg in a normotensive patient [10]. DH has the risk of hypoperfusion-induced tissue injuries, hence, it is contraindicated in patients with

disseminated vascular diseases, ischemic heart disease, carotid artery stenosis and hypertension [11].

DH can be induced by a variety of pharmacological agents and non-pharmacological measures. These include vasodilators such as sodium nitroprusside (SNP), nitroglycerin (NTG); anaesthetic agents such as propofol, halothane and isoflurane; epidural and spinal anaesthesia as well as non-pharmacological techniques such as change in body position and controlled mechanical ventilation [11].

In our patient, only halothane and controlled manual ventilation were used. We maintained the MAP between 50-70 mmHg throughout the procedure, probably the ANH may have augmented the hypotensive strategies.

4. CONCLUSION

Combined closed-circuit ANH and DH are safe and effective in reducing blood loss during surgeries, and are acceptable by Jehovah's Witness patients.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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