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high risk for haemorrhage, the surgeons called a meeting of the team that would be involved in the care of the patient basically to inform and to plan blood loss containment strategies. The team included the ward, theatre and intensive care nurses, the anaesthetists, the social workers, and the patient himself. The patient expressed his religious objections to blood transfusion and also because of the risk of contracting viral diseases both known and as yet unknown. He was informed of the possibility of AIH, the safety of the technique, that some JWS accept it and that he should consult his sect members about it and inform us of his decision. He accepted AIH and did not insist on keeping his phlebotomy line. Two units of blood were planned for AIH and he was reassured.

The theatre nurses being aware of the circumstances of this patient, prepared additional supply of instruments and consumables for control of haemorrhage, and scheduled the most experienced neurosurgical scrub nurse for the procedure.

At induction, routine monitors of non-invasive blood pressure, electrocardiogram, and oximetry were applied and the baseline readings were within normal limits. AIH was performed while the patient was still awake with simultaneous phlebotomy of the first unit of blood (500ml) from one arm and replacement with 1500 ml of normal saline administered via the other arm. The second unit of blood was replaced with isoplasma, a non-blood colloid. The exact volume of blood was ensured by weighing on a scale at regular intervals while agitating the blood during the collection. The procedure was well tolerated and the units were duly labelled with the patient's name and hospital number and kept in the operating suite. The patient was thereafter anaesthetised with intravenous fentanyl 150mcg and thiopentone 400g. The trachea was intubated with a size 8 cuffed armoured tube after muscle relaxation with pancuronium. Anaesthesia was maintained with 50% nitrous oxide and 0.5% halothane in oxygen and the ventilation was controlled. A urethral catheter was passed and connected to a drainage bag.

The patient was placed prone for the procedure. The fracture was elevated, the fragments were discarded, the extradural haematoma was evacuated and the wound was thoroughly debrided. Haemostasis was achieved using standard techniques. Blood loss was 300ml and this was replaced with normal saline. As planned, the patient was transfused with his blood at the end of the procedure. The residual effects of muscle relaxants were reversed with neostigmine and atropine. The patient woke promptly and was transferred to the recovery ward. He had Dipyrone 2.5mg 6 hourly for postoperative analgesia. The wound healing was satisfactory and his overall recovery was uneventful at the time of discharge on the 10<sup>th</sup> postoperative day.

#### Case 11

The second patient was a 19-year-old boy with a left fronto-parietal cerebral tumour with an intraventricular extension. His speech was slurred, the right half of the face was weak and there was an asymmetrical quadriparesis, worse on the right. He was scheduled for craniotomy but his social history had revealed that he was JWS.

At preoperative assessment, he was conscious and alert but with severe neurological deficits from the tumour. He had slurred speech with right facioparesis and quadriparesis. The chest was clinically clear and the blood pressure was 110/80mmHg, with pulse of 98 beats per minute and normal heart sounds. His weight was estimated at 40 kg.

The preoperative PCV was 41%, with normal white cell

count and coagulation profile. The serum electrolytes, urea and blood glucose were also normal. He was placed on dexamethasone 4 mg 8 hourly with antacid prophylaxis.

The surgical team held a meeting with the patient and his older brother to explain the risks of haemorrhage and the AIH option since his PCV was 41%. They re-affirmed their objection to any form of blood transfusion. Following another meeting with the patient and representatives of his church, some misconceptions about AIH were clarified and the option of AIH was accepted. The patient however insisted that the donated blood should not be disconnected from phlebotomy line. It was decided that one litre of blood would be removed for AIH. He was classified ASAIII.

At induction, after routine monitoring, an intravenous (i.v) line was inserted on the right arm with 500ml isoplasma for replacement while phlebotomy was performed on the left arm. The phlebotomy needle was left in place and the blood bag was hung up after 500ml had been collected. For the second unit the phlebotomy was from the right arm while fluid replacement of 500ml Isoplasma was through a cannula on the foot. Post-phlebotomy blood pressure was 120/80mm Hg, the pulse rate was 100 per minute, oxygen saturation was 100%, the ECG was normal, and PCV was 33%. Ten milligrams of dexamethasone was administered i.v. He was subsequently anaesthetised with 100mcg of fentanyl and 250mg of thiopentone and paralysed with 6 mg of pancuronium. The trachea was intubated and the lungs moderately hyperventilated with 50% oxygen in 0.5% halothane and nitrous oxide. Muscle relaxation and analgesia were maintained with incremental doses of fentanyl and pancuronium. There was a modest increase in blood pressure and heart rate post-induction and this responded to 50mcg of fentanyl. At craniotomy the brain was slack and mannitol was not required.

The tumour was totally excised via a left fronto-parietal craniotomy. He was haemodynamically stable during the surgery. Intraoperative blood loss was steady and was replaced with crystalloids until about 1000 ml had been lost and a spot PCV check was 25%, when the first unit of blood was transfused. The second unit was transfused during scalp closure about 6 hours after the blood was collected. The estimated blood loss was 2000ml. This was replaced with a total of 2500ml of fluids consisting of 1500ml of crystalloid and 1000ml of his own blood. The immediate postoperative PCV was 31%. At the conclusion of the surgical procedure, anaesthesia was discontinued and the residual effects of muscle relaxants were reversed with neostigmine and atropine. On regaining consciousness, the trachea was extubated and he was transferred to the intensive care unit where he spent 24 hours having made an uneventful recovery. The 24-hour postoperative PCV was 25%. He was placed on oral iron and folic acid. The PCV increased to 30% at the end of the second postoperative week.

Post-operatively, the speech and motor deficits receded gradually. He developed meningitis and a subgaleal effusion both of which resolved with antibiotic treatment. He was ambulant and independent when he was discharged 3 months post-operatively.

#### Discussion

Anaesthesia for surgical procedures with a high risk for major haemorrhage is being increasingly undertaken in JWS who desire that their wishes for avoiding transfusion be respected. Previously, JWS have been refused surgery on moral and ethical grounds with the physicians unable to come to terms with the strictures required by the religious convictions of these patients[8]. With the acceptance of extracorporeal circulation



## Acute isovolaemic haemodilution in two Jehovah's Witnesses presenting for major intracranial surgery

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### Summary

The Jehovah's Witnesses (JWS) is a religious sect with strong convictions against acceptance of blood and its products for medical care, including surgery. We present two cases of JWS, aged 24 and 19 years old, who had craniectomy for trauma and craniotomy for tumour excision, respectively. A team approach was employed in the care of both patients. During exhaustive preoperative discussions they re-affirmed their religious convictions but agreed to some modifications. Both patients accepted Acute Isovolaemic Haemodilution (AIH). However one of them insisted on non-discontinuation of the line used in collecting the blood from the vein, as that would constitute blood storage. The preoperative Packed Cell Volume (PCV) was 45% and 41% for the trauma and the tumour patients respectively. Two units of blood (1000ml) were collected from each patient resulting in post donation PCV of 40% and 33%. The intraoperative blood loss was 300ml and 2000ml, respectively, and the units and crystalloid fluids were transfused for replacement. Postoperative PCV were 42% and 25%. The latter improved to 30% over the following two weeks with oral haematinics. The two cases are discussed in the light of the experience gained.

**Keywords:** *Jehovah's witness, acute isovolaemic haemodilution, craniotomy*

### Résumé

Les temoins de Jehova forment une secte religieuse ayant une forte conviction contre la chirurgie. Nous présentons deux des ces cas, l'un âgé de 24 ans et l'autre de 19, qui avaient respectivement la craniectomie d'un trauma et la craniotomie provenant d'une excision tumorale. Une équipe était mise sur pied pour s'occuper des deux maladies. Au cours des discussions pré-opératoires, ils ont ré-affirmé leurs convictions religieuses mais ont accepté quelques modifications. Les deux patients ont accepté l'isovolaémie Haémodilution Aiguë (IHA). Cependant, l'un d'eux a insisté sur la non-discontinuation de la ligne utilisée pour collecter le sang de la veine, car cela constituerait l'émagasinage du sang. Le volume du paquet de cellules (VPC) périopératoire était de 45% et 41% pour les deux maladies, respectivement. Deux unités de sang (1000ml) ont été collectées sur chaque patient résultant du don de VPC de 40% et 33%. Le sang perdu au cours de l'opération était de 300ml et 200 ml, respectivement et les unités et les fluides cristalloïdes étaient transfusés pour le remplacement. L'opération post VPC était de 42% et 25%. Le dernier s'améliora de 30% au cours de deux semaines avec l'hématinique orale. Les deux cas sont discutés à cause de l'expérience acquise.

### Introduction

"But flesh with the life thereof, which is the blood thereof, shall ye not eat" (Genesis 9:4) and "That ye abstain from meats offered to idols, and from blood, and from things strangled and from fornication: from which if ye keep yourselves, ye shall do well" (Acts 15: 29) [1]. These verses from the Holy Bible are the basis upon which the Jehovah's Witnesses (JWS) refuse transfusion of homologous or autologous blood and its products' thereby presenting a special challenge to the medical profession in general. In surgical practice, this challenge becomes critical when major surgery anticipating major blood loss is required, such as vascular, cardiac, and intracranial operations. The challenge has been met over the years with various innovative techniques accruing from research [2,3,4]. The JWS have also modified their belief in accepting the bypass machine used in open heart surgery as an extension of the circulation and therefore does not constitute transfusion of shed blood [5,6]. Furthermore, some JWS accept AIH provided the patient is not separated from the blood bag after the phlebotomy is performed, i.e., retain the phlebotomy line, while some do not insist on line retention at AIH [7].

Craniotomy, whether for tumor excision or for trauma is often accompanied by significant blood loss and therefore blood for replacement is customarily procured preoperatively against such eventuality. In view of the fact that JWS do not accept any form of banked blood, the surgical team must strategize for blood requirement well in advance for the elective procedure. The strategies must include detailed investigation into the patient options, the anticipated blood loss and the techniques to reduce blood loss. These two cases are presented to highlight the perioperative haematologic and anaesthetic management of craniotomy in JWS.

### Case reports

#### Case 1

The patient was a 24 years old undergraduate student referred to the UCH for further management of a depressed right occipitoparietal compound skull fracture sustained in a road accident a week before presentation. There was no history of loss of consciousness and he had no symptoms of raised intracranial pressure. There were no concurrent illnesses and no allergies. He had no history of previous transfusion or hospitalisation. He was a Jehovah's Witness and would not accept homologous blood transfusion, even in extremis.

The main findings on examination were right-sided occipitoparietal boggy, right abducens nerve palsy and a left hemiparesis. He weighed 60kg. A computer tomographic scan confirmed a depressed right occipitoparietal fracture and revealed a thin film of extradural haematoma, a right parietal haemorrhagic cerebral contusion with effacement of the ipsilateral lateral ventricle. The packed cell volume (PCV) was 45%. He was classified as ASA I. Since he was not in acute neurological compromise and the site of the fracture makes surgery



by the JWS and the numerous reports of successful "bloodless" surgery, many surgeons and anaesthetists now view the care of these patients as a challenge to the scientific basis of surgical management. This has helped to improve the standard of care such that conservative attitudes regarding homologous blood transfusion are now common place[9].

The two cases presented posed major risk for operative haemorrhage. In the first patient, the risk was derived from the location of the fracture across the posterior part of the superior sagittal sinus, while in the second patient the risk was due to the size and anticipated vascularity of the tumour. For both cases the detailed preoperative plan enhanced our management. The lessons gleaned from our cases are that the JWS stance on blood transfusion is personal and some patients may accept autologous blood options. In planning the management with the patient therefore the surgical team should be fully educated on the JWS stance on blood transfusion and the various options they may consent to. Our management plan included discussion of the risks and the patients' specific demands regarding transfusion and they were asked if they would accept blood transfusion under any circumstance. The treatment options were presented to them without threat but rather in friendly cooperation. The patients must freely make the personal choice as their spiritual life if embarrassed by infraction of their religious belief could lead to an intense feeling of low self-esteem thereafter.

Blood conservation techniques are the mainstay of the management of the JWS patient who refuses any form of blood transfusion. The measures, which should be directed by experienced surgeons and anaesthetists, must be planned well in advance as was accomplished in our cases. The methods include ensuring an adequate haemoglobin level by correction of anaemia if present before an elective surgical operation. Optimisation of the PCV is crucial to successful care if major haemorrhage is anticipated and may be quickened by addition of erythropoietin to the haematinics[10]. A good preoperative PCV gives ample room for compensation in the face of major blood loss and total refusal of blood. An estimate states that a 70kg fit man with 5000ml blood volume, and preoperative PCV of 45% could undergo surgical blood loss of 3000 ml (replaced intraoperative with crystalloids or colloids) and still have PCV greater than 25% postoperatively[11]. If that patient had AIH from a PCV of 45% he could lose up to 3500ml and postoperative PCV would be greater than 28%. If it is anticipated that blood loss will exceed what the best PCV will compensate for, then the surgery may be staged if feasible[12].

Other measures, which may be employed, are hypotensive anaesthesia but this requires invasive monitoring which was not available in our centre. Hypervolaemic haemodilution was not considered suitable in our patients for fear of increasing intracranial pressure. Intraoperative volume replacement could be with the oxygen carrying perfluorocarbon emulsion[13]. Other intraoperative measures are patient positioning for surgery, vasopressors to reduce scalp bleeding, meticulous anaesthesia to prevent increased venous pressure and effective haemostasis. Desmopressin and antifibrinolytic agents such as aprotinin and

tranexamic acid are being employed for haemostasis with good results[14]. Intraoperative autotransfusion using a cell saver in a closed circuit system is acceptable to JWS organisation[15]. Postoperatively, oxygen therapy may be required if PCV is critically low. With adequate blood volume more oxygen will be transported dissolved in solution while haemoglobin is improved with intravenous iron dextran and erythropoietin.

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