

Do we need blood transfusion in elective infrarenal abdominal aortic aneurysm repair

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The discovery of the human immune deficiency virus, the risk of transmission of hepatitis C virus and the immunosuppressive effect of blood transfusion made the surgeons use every effort to avoid or minimize the use of blood and its products. It has been a supposition that any aortic surgery has to have a form of blood transfusion method available routinely,¹ and most of the studies now are focusing on the autologous blood transfusion especially the cell saver to decrease or eliminate the need for allogenic blood.² Unfortunately, autologous blood transfusion methods are expensive and in fact their routine use in elective infrarenal abdominal aortic aneurysm (EIAAA) repair, which constitute approximately 80% of aortic surgery was not shown to be cost effective.

In this observational study, our aim was to evaluate our method of using meticulous surgical technique and avoiding hypothermia to decrease the rate of blood transfusion in EIAAA repair and to identify preoperative predictors. The charts of 72 patients were reviewed. All underwent EIAAA repair consecutively at our institution over a 3-year-period from January 1997 to December 1999. One surgical team using the same protocol did all repairs. All patients were cross-matched with 4 units of blood preoperatively. A standard midline laparotomy incision was used. Minimal aortic dissection, distal to the left renal vein and proximal to both common iliac arteries was carried out. All patients were given 5,000u of heparin 5 minutes before clamping, and reversed with protamine sulfate after the release of clamps. The comorbid conditions, preoperative hemoglobin (Hb), intraoperative hemodynamics, blood loss and an intraoperative Hb level less than 9, all were used as basis for transfusion. Patient's age, sex, vascular risk factors and the aneurysm characteristics by computed tomography scan for size, calcifications and iliac involvement, were recorded. Pre and postoperative Hb, discharge Hb, type of repair, blood loss, hospital stay, perioperative morbidities and mortalities were compared between patients who received blood and those who did not.

Seventy-two patients underwent repair of EIAAA over 3 years. Average age was 74 with the range of 54-89 years. Seventeen patients were more than 80 years old. Fifty-five (73%) of patients were males. There were no significant differences between transfused and non-transfused patients in risk factors. Thirty-nine (54%) patients had tube repair, 28 (39%) had aortobi-iliac bypass and 5 (7%) had aortobifemoral bypass. No significant difference

was found in the type of repair ($p=0.22$). Eighteen patients (25%) received allogenic blood in the perioperative period with an average of 2.1u per patient. Thirteen (72%) out the 18 transfused patients had a preoperative $Hb \leq 13\text{gm/dl}$ ($p=0.0001$).

There were no perioperative mortality and no transfusion complications (Table 1). Major cardiac complications occurred in 4 patients, 3 (5.6%) with postoperative of $Hb > 10\text{gm/dl}$ and had blood transfusion and one (5.6%) with postoperative of $Hb < 10\text{gm/dl}$ ($p=0.1$). From the 18 patients with a postoperative of $Hb < 10\text{gm/dl}$, 3 (16.7%) developed minor cardiac complications compared to 8 (14.8%) with postoperative Hb of $> 10\text{gm/dl}$ ($p=0.1$). Two (8%) patients from 25 who had blood transfusion developed minor cardiac complications compared to 9 (19%) in the non-transfusion group ($p=0.31$). With respect to the major cardiac complication, 3 (12%) were recorded in the transfusion group while only one (2.1%) in the non-transfusion group ($p=0.12$). Atelectasis was the most common complication, 10 (13.8%) patients. There were no significant differences in non-cardiac complications between both groups. Seven (64%) patients out of the 11 who had an aneurysm equal or more than 7cm were transfused ($p=0.0013$). Eighteen patients had an estimated blood loss (EBL) more than 1000ml, 10 of them were transfused ($p=0.0005$). Interestingly, all patients who had EBL more than 1000ml and received blood transfusion had a preoperative $Hb < 13\text{g/dl}$. There was no significant difference in Hb between the 2 groups in the length of stay or discharge. Patients who had transfusion stayed more days in the Intensive Care Unit ($p=0.0089$).

An association between anemia, anesthesia and surgery was recognized near the turn of the century when physicians observed that surgical patients with Hb levels $\leq 10\text{g/dl}$ did not do well. The effect of anemia on the oxygen-carrying capacity of the blood resulted in inadequate transport of oxygen to the tissues. They suggested preoperative transfusion of blood when the concentration of Hb is $\leq 8-10\text{g}$ per cubic centimeters.³ From then and for almost 40 years the transfusion trigger was established as a Hb concentration of $\leq 10\text{g/dl}$.⁴ In animal studies, normal

Table 1 - Association between transfusion and hemoglobin level at the end of surgery with cardiac complications.

Transfusion	Hb level	Cardiac complications		Number of patients
		Minor	Major	
Yes	$\leq 10\text{gm/dl}$	1	1	10
	$> 10\text{gm/dl}$	1	2	15
No	$\leq 10\text{gm/dl}$	2	0	8
	$> 10\text{gm/dl}$	7	1	39
Total	-	11	4	72

animals tolerated a Hb equal to 5g/dl, but animals with coronary artery disease developed signs of myocardial ischemia with Hb 7-10g/dl. In Humans, when blood was removed from conscious resting healthy individuals and replaced with physiological red blood cell free solution, oxygen delivery was not affected with acute Hb reduction up to 5g/dl, and was maintained by increasing heart rate and stroke volume. Although it is recommended that elderly patients with multiple risk factors especially cardiac disease, should have a preoperative Hb of ≥ 10 g/dl to avoid complications, it has been shown that they can tolerate lower levels of Hb (8g/dl), and Jehovah's witness patients were used as example (their religion prevents them from accepting allogenic blood transfusion. In few cases they survived a very low Hb level). In 1988, at The National Institute of Health Consensus Conference on Preoperative Red Cell Transfusion, the transfusion trigger concept (Hb level of < 10) was questioned. The conference concluded that the available data does not support a single criteria for transfusion.⁵ Presently the only indication for transfusion is to increase the oxygen carrying capacity with the goal of improving tissue oxygenation. As oxygen delivery (OD) is directly related to cardiac output, patients without cardiac disease have a significant capacity to compensate for a decreased Hb. As such a Hb concentration in excess of 7g/dl is adequate to meet tissue oxygen demand when cardiac function is normal. Although it is clear that patients with impaired myocardial function will require a higher Hb level to maintain DO, there are currently no practical guidelines for determining an appropriate transfusion trigger in patients with significant coronary artery disease.⁵ Transfusion decision requires careful consideration of individual patient and should be based on more than subjective clinical evaluation. Clinical basis such as mental status, renal function and lack of myocardial ischemia should be considered. Our decision to transfuse patients was individually based according to comorbidities, aneurysm size, preoperative Hb, blood loss, and intraoperative Hb level ≤ 9 g/dl. All patients had 4 units of packed red blood cells available. There was no perioperative mortality. Having a Hb level ≤ 10 g/dl or receiving blood had no significant effect on preventing or development of cardiac complications. This correlates with the observation that there is no transfusion trigger and transfusion decision should be individualized. All the perioperative methods we used that is stopping anacin acetylsalicylic acid, non-steroidal anti-inflammatory drug, warfarin and other anticoagulation agents; strict phlebotomy for tests, careful surgical homeostasis, use of local homeostatic agents, avoiding hyperthermia and prolongation of surgery, were shown to decrease the amount of blood loss by previous studies. In our study, 18 patients (25%) needed blood transfusion with the majority having a Hb level ≤ 13 g/dl. None of them developed transfusion complications. For

the 5 patients who were transfused intraoperatively and had a preoperative Hb more than 13g/dl, charts review could not explain the indication for transfusion. This may be explained by the inconsistency of the anesthetic team and their individual preference in transfusing patients intraoperatively. Ten out of the 18 patients who had EBL equal or more than 1000ml, needed blood transfusion. Interestingly, all 10 patients had a preoperative Hb ≤ 13 g/dl. Aneurysm size had a role as a predictor for transfusion. Sixty-four percent of patients with aneurysm size > 7 cm, received blood. Autogenic transfusion no doubt has eliminated the risks of allogenic blood transfusion and minimized its use, but it's routine use in EIAAA has been shown to be non-cost effective.^{1,6}

We believe that in EIAAA repair, by having a high threshold for blood transfusion, using meticulous surgical technique, and avoiding hypothermia, majority of the patients with a preoperative Hb > 13 and aneurysm < 7 cm, will not need blood transfusion. If the preoperative Hb is > 13 g/dl, the cell saver could be used as a reservoir, which is not expensive, and converted to autotransfusion when needed. With no cell saver, blood should be available. Autogenic transfusion should be available for patients with pararenal, suprarenal, redo surgery, and patients with aneurysm size > 7 cm. Given the limitation of our study, one hospital, one surgical team, and the relatively small sample size, further and immense studies are required to confirm our observation.

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