ACUTE NORMOVOLEMIC HEMODILUTION IN SICKLE CELL PATIENT

- A Case Report -

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Abstract

Sickle cell disease patients with relatively high hemoglobin (≥12 g.dl) and those who have elevated alloimmunizations antibodies with rare phenotype subgroups, are problems challenging anesthesiologists. Acute Normovolemic Hemodilution (ANH) is rarely used in the perioperative management of homozygous sickle cell disease (SCD) in patients undergoing surgery. We hereby present a case in which ANH was used successfully.

A 22 year old male patient with known homozygous sickle cell disease undergoing orthopedic surgery, underwent Acute Normovolemic Hemodilution (ANH) because of the absence of blood and suitable blood donors and high hemoglobin level .Just before establishing spinal anesthesia, a 400 ml blood was extracted from patient and then replaced by 6 % Hydroxyethylstarch HES solution.The surgery was performed uneventfully under spinal analgesia. Patient was discharged 48 hours later. A week later, his follow up visit showed no complications and his lab work returned to basic levels.

We recommend the ANH technique as an on hand tool in the perioperative anesthetic management of sickle cell disease patients who have high Hb S with relatively high Hb levels, and in those special patients who have no blood available because of high alloimmunization antibodies or rare phenotype blood groups.

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Introduction

Sickle cell anemia is one of the main hemoglobin disorders responsible for anemia requiring blood transfusion therapy in the Eastern Province of Saudi Arabia.

We report a case of a homozygous sickle cell-beta thalassemia disease scheduled for an orthopedic surgery who had undergone an Acute Normovolemic Hemodilution (ANH) technique.

Sickle cell disease patients with relatively high hemoglobin (≥12 g.dl) with unavailable blood, and those patients who have elevated alloimmunization antibodies with rare phenotype subgroups, pose challenging problems to the anesthesiologist.

The conundrum presented here is the use of ANH in a sickle cell patient with high Hb S and relatively high Hb levels, when no blood is available.

Case Report

A 22 year old male scheduled for intra medullary femur nail removal and with a history of homozygous sickle cell disease-Beta thalassamia, had a mild course of the disease (few painful attacks, two hospital admissions for non sickle cell complication and had not received any blood transfusion previously) His preop. CBC revealed Hb 12.7 gm %, Hct 34.8%, hemoglobin electrophoresis of Hb S 76.5, HbF 15.4 and Hb A2 4.8 and blood group of B positive. Blood and suitable donors were both unavailable as reported by the Blood Bank.

After consultation with the surgeon and explaining the technique of ANH to the patient and obtaining his informed written consent, the decision was taken to go ahead with the intraoperative ANH, the aim being to reduce the viscosity to a hematocrit level of nearly 30 %, and later to restransfuse the autologous blood previously obtained, by the end of surgery.

To estimate the allowable hemodilution required, the allowable blood phlebotomy (ABP) was calculated in accordance to the Bourke & Smith equation:

$$ABP = \frac{\text{Estimated blood volume x } (H_o - H_r}{Htm}$$

H_o = hematocrit at time of operation

H_r = recommended hematocrit

Htm = mean of hematocrit $(H_o + H_r)/2$

The calculated ABP in our patient turned out to be 450 ml. 400 ml was of autologous blood was therefore collected in a bag, labeled, signed showing patient's name, medical record number and autologous blood label attached, was kept inside the OR at normal room temperature. 500 ml 6 % Hydroxymethylstarch HES solution then replaced the autologous blood. Meanwhile 1000 ml L/R solution was started as a preload before spinal analgesia was commenced, Following optimization of patient's condition with warm IV fluid, face mask oxygenation at 4 L/min and thermal blanket, a successful spinal analgesia was performed at L 3-4 interspinous space, using 12.5 mg of heavy marcaine with 25 ug fentanyl.

The procedure passed uneventfully with stable CV parameters and oxygen saturation. Ephedrine 10 mg IV was administered to treat mild hypotension which had occurred subsequent to the spinal analgesia. The estimated blood loss was around 300 ml. By the end of surgery, the previously collected autologous blood was administered slowly. Postperatively, there was good oxygenation and monitoring parameters. Patient was discharged in good condition 48 hours later. A cell-phone contact was maintained around the hour. A week later, the follow up visit showed no complications and his lab work returned to basic levels.

Discussion

Sickle cell anemia and thalassemia major are the main hemoglobin disorders responsible for anemia that requires regular blood transfusion therapy in the Eastern Province of Saudi Arabia. The perioperative management of sickle cell patients is a conundrum between aggressive intervention and therapeutic nihilism, with little scientific data to support any approach.[3].

Partial exchange transfusion is highly indicated for patients with high Hb S and relatively high hemoglobin and hematocrit levels for the purpose of improving their oxygen carrying capacity and decreasing the incidence and frequency of sickle crisis.

The simple allogenic blood transfusion increases the risk of disease transmission, transfusion reaction,

Table 1
Perioperative Laboratory Data

Parameter	Preoperative	Post ANH	24 hours Postoperative
Rectic count NR (0.7-2.5%)	5.6	6.0	5.0
Hb level (gm.dl)	12.3	11.0	10.9
Hct	37.8	34.3	33.8
PT (11-14 sec) Control 12.1 sec	11.1	13.6	12.5
aPTT (25-38 sec) Control 32.0 sec	29.9	37.6	28.9

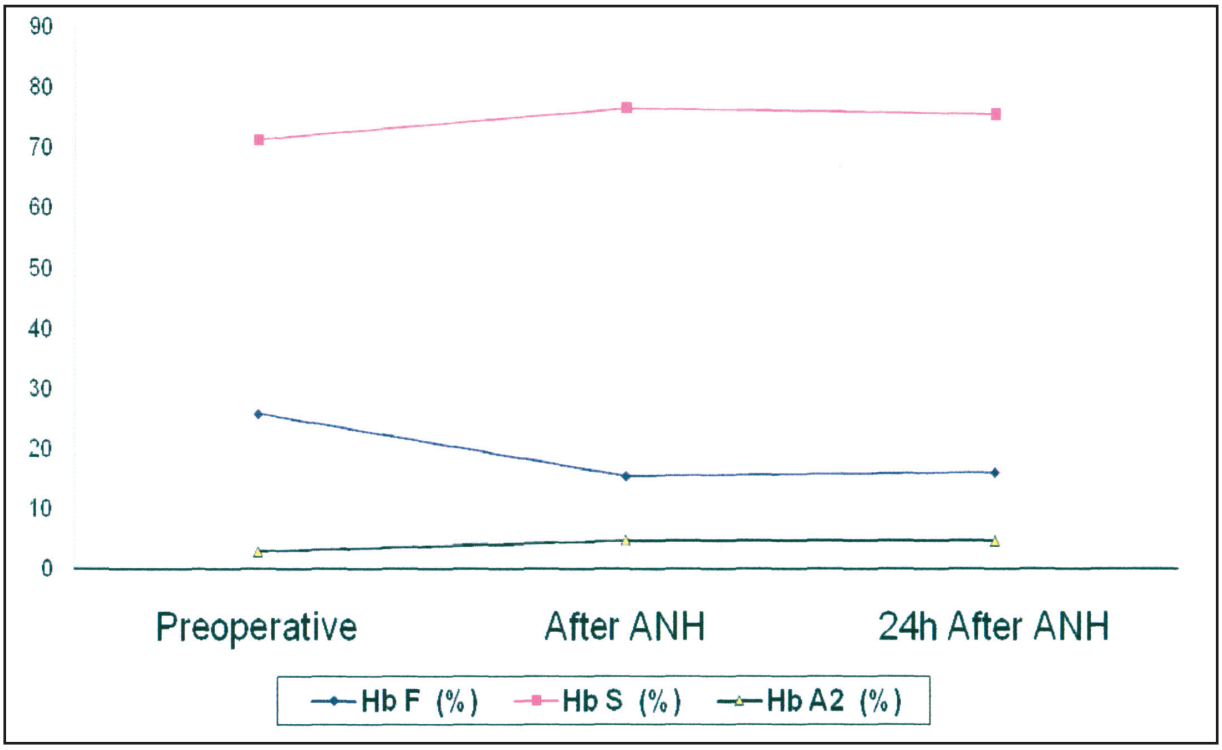
aPTT = activated partial thromboplastin time
Hb = hemoglobin
Hct = hematocrit
PT = Prothrombin Time
N R = Normal range

reduces immunity and increase viscosity[4,5]. However, the autologous blood transfusion decreases transfusion in patients undergoing elective procedures[6].

The entertained management must be carefuly discussed with the patient, explaining the benefits of ANH and the adverse events of allogenic blood transfusion that may possibly occur.

Few publications[7-11] have reported good conditions on transfusing autologous sickle blood, allowing good lab results (Fig. 3, Table 1) with minimum blood loss during surgery. The work supported by Weiskop[12] encouraged us to use autologous blood transfusion in this case.. Contrary to our management, however, Shulman et al[13], exchanged one-volume whole blood

Fig. 3
Hemoglobin Electrophoresis shows perioperative stability



after initial partial exchange transfusion before initiation of CPB.

Most sickle cell anemia patients undergo transfusion therapy in order to prevent complications. Despite its efficacy, transfusion therapy is limited by its alloimmunization[14].

On the medical side, sickle cell disease patients scheduled for surgical procedure, can have their hemoglobin level increased by the use of iron rich food, and oral iron supplements etc.. The improved Hct level will facilitate ANH to be done by the anesthesiologist.

To our knowledge after literature search, our case was the first homozygous sickle cell patient who underwent ANH uneventfully. We emphasize ANH as a convenient tool in the perioperative anesthetic management of homozygous sickle patients who have high Hb S and relatively high Hb levels.

The technique of ANH opens a new door optimization of patient's condition, reduction of transfusion of allogenic blood not only in sickle cell patients, but also in those patients who have no blood available because of high alloimmunization antibodies or have rare phenotype blood groups. It is essential that assessment of the benefit-ratio of the management be made very clear to the patient.

The present single case though successful, brings out the need to a prospective double-blinded randomized study on sickle cell disease patients, to prove the benefits of ANH technique.

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