ACUTE NORMOVOLLEMIC HEMODILUTION IN PATIENTS UNDERGOING ELECTIVE MAJOR SURGERY

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ABSTRACT

Efficacy of acute normovolemic hemodilution in patients undergoing elective major surgery was studied with the aim to evaluate optimum technique, safety and utility in the service. Forty adult patients undergoing elective major surgery, who were in ASA GD I with preoperative haemoglobin more than 10.0g% were included in this study after a detailed explanation of the procedure and obtaining consent. 350-700 ml of patients' blood was collected before induction of anaesthesia and was kept in the operation theatre at room temperature. This was followed by rapid infusion of crystalloid calculated at the rate of 3ml for every ml of blood withdrawn. Intraoperative blood loss, serial haemoglobin assessment, change in pulse rate, blood pressure, SpO₂ and urine output were carefully monitored. The blood was reinfused once haemostasis was secured at the end of surgery. All the vital parameters were maintained within normal limits throughout the procedure. This simple, easy and inexpensive technique was found to be very useful in obviating the necessity of other forms of blood transfusion and preventing all transfusion related hazards. It was found that this method has an important role in patients with uncommon blood groups and has an excellent patient acceptability. This technique has an important role in peripheral service hospitals, where formal blood bank facilities do not exist.

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KEY WORDS : Acute normovolemic hemodilution; Autologous transfusion.

Introduction

A large number of blood transfusions are made for surgical and gynaecological patients undergoing elective major surgery. Homologous transfusions of stored blood entail a host of risks viz. transmission of infectious diseases like AIDS, Hepatitis B and Hepatitis C, Hemolytic and non hemolytic transfusion reactions, immunosuppression, alloimmunization and life threatening clerical errors [1].

It was as a natural result of these complications of homologous blood transfusion that the concept of autologous transfusion took birth. Use of autologous blood obviates most of the complications enumerated above. The techniques of autologous transfusion include (a) predonation (donation of blood by the patient over a period of weeks before elective surgery) (b) intra-operative blood salvage (collection of blood shed at surgery and reinfusion after appropriate processing and (c) acute normovolemic hemodilution (ANH) collection of blood from the patient immediately before surgery with simultaneous infusion of crystalloids or colloids, maintaining euvolemia). The first of these methods requires availability of a blood bank for storage of predonated blood besides sufficient time prior to surgery for predonation. The second technique requires sophisticated gadgetry for processing of blood collected at surgery. Acute normovolemic hemodilution is a simple technique requiring minimal infra-

structure and hence could find an important place in most service hospitals where blood bank facilities are not available.

We used acute normovolemic hemodilution in patients undergoing elective major surgery with the aim to study the optimum technique, safety and efficacy of this procedure in our scenario.

Material and Methods

This study was carried out at MH Bareilly from Jan 98 to Dec 98. Forty patients undergoing major elective surgery such as hysterectomy, cholecystectomy and prostatectomy were included in the study. All patients were in ASA GD I with pre-operative hemoglobin more than 10.0g%. The procedure of ANH was explained to the patient during the pre-operative counseling and informed consent obtained. On the day of surgery, the patients were wheeled into the OT and 350-700 ml of blood was collected in blood collection bags, which were duly labelled. This was followed by rapid infusion of 1000-2000 ml of Ringer's lactate calculated at the rate of 3ml for every ml of blood withdrawn. Standard techniques of GA/spinal/epidural anaesthesia were then administered and operative procedure started. Blood loss during surgery was carefully monitored to detect any sudden heavy loss. The blood was reinfused once the hemostasis was secured or at the end of surgery and the patient was returned to the post operative ward for routine post operative care.

Following parameters were monitored for every patient : (a) Serial hemoglobin estimations- before blood collection, after hemodilution, at the end of surgery, before reinfusion and after 24 h. (b) Pulse and blood pressure every 15 min till 2h after reinfusion. (c) SpO₂ throughout surgery. (d) Urine output.

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Results

A total of forty patients undergoing elective major surgery were included in this study. The mean age of the patients was 38.5 years (range 29-61 years). Table 1 shows different types of surgeries performed on these patients. The most common surgical procedure for which ANH was carried out was abdominal hysterectomy. The duration of surgery ranged between 70-180 min. Table 2 depicts the preoperative hemoglobin values. Mean initial hemoglobin before hemodilution was 11.6g%. Mean volume of blood collected during the procedure was 510 ml (range 350-700ml). Post-hemodilution mean hemoglobin had fallen to 9.2g% as a result of surgical blood loss and after reinfusion the mean haemoglobin increased to 10.7g%. None of our patients required homologous blood. Pulse, blood pressure and SpO₂ were maintained throughout the procedure in all cases.

TABLE 1
Distribution of surgeries

Type	No (n = 40)
Abdominal hysterectomy	18
Vaginal hysterectomy	07
Cholecystectomy	12
Prostatectomy	03

TABLE 2
Perioperative hemoglobin values

Time	Hb (g%)	Range (g%)
Pre haemodilution	11.6	10-13.5
Post haemodilution	10.1	8.9-12.1
Pre transfusion	09.2	6.0-11.5
Post transfusion	10.7	8.8-12.6
24 hours after surgery	10.9	8.7-12.8

Discussion

Transfusion of homologous blood carries the risk of both infectious and immunologic complications. In addition, shortage of blood, especially of the rarer blood groups, necessitates the consideration of autologous blood transfusion. Pre-donation during weeks preceding surgery is a popular method of autologous transfusion where three to four units of blood may be deposited over a period of 3-4 weeks. This procedure has its limitations: the patient may not be available for such a period of 3-4 weeks for pre-donation, may be reluctant to deposit blood or may be a carrier of transmissible diseases. Also, the technique does not obviate the risk of the storage related problems and clerical errors.

ANH offers a safer option with the following advantages [2]: (a)Reduces the need for homologous transfusion with its attendant risks. (b)No special equipment is required for this procedure. (c)Minimal biochemical alterations associated with storage of

blood. (d)Blood is readily available in the OT when required urgently. (e)Risk of clerical errors is the least. (f)Can be combined with other forms of autologous transfusions. (g)Can be used in elective as well as emergency clinical settings. (h)Most cost effective as compared to homologous blood or predonated autologous blood.

Despite the advantages, this technique is still highly under-utilized. In a survey of 207 hospitals in Germany, where the technique was initially developed, 30% of hospital were not using ANH at all [3]. ANH was initially described by Kolvekorn and Laks in 1973 [4,5]. Ever since, it has been successfully used in cardio-thoracic, vascular, orthopaedic and general surgery and urology [2]. In one study, ANH was found as effective as autologous pre-donation in avoiding homologous transfusions in patients undergoing radical prostatectomy [7]. Of late, the technique has been safely used for Caesarean section as well [6].

ANH can be performed shortly before or after induction of anaesthesia. Timing of ANH has not been found to affect the outcome [8]. At most centres haemodilution is done after the administration of anaesthesia [9,10]. In our study we collected blood before induction of anaesthesia in order to prevent prolongation of anaesthesia time. In six cases, blood was collected in the pre-operative room.

The volume of blood that can be withdrawn during this procedure depends on the patients' initial hematocrit. As much as 3000 ml of blood has been safely collected in some studies [11]. In this study we initially collected 350 ml of blood from each patient. Subsequently, as we gained experience, we were able to harvest upto 700 ml from each patient.

The blood harvested during hemodilution should be stored in the OT at room temperature to ensure maximal preservation of platelets and clotting factors [12].

However, if a delay of more than six hours is anticipated, blood should be refrigerated. In our study, all the patients were reinfused the blood within six hours. Hence the storage was done at room temperature. Repeated haemoglobin/hematocrit estimations are recommended to monitor oxygen carrying capacity of the blood [2]. In our series, we performed five haemoglobin estimations as mentioned earlier.

We successfully performed ANH in seven Rh Negative patients where homologous blood donors were not available. Since these patients required surgery, the only alternative would have been serial pre-donations which would have delayed the surgical procedure.

To conclude, ANH is a simple, safe, effective and inexpensive alternative to homologous transfusions and autologous serial pre-donations. This technique has tremendous scope in the service scenario. Formal blood bank facilities do not exist in several peripheral hospitals leading to under utilization of the surgical team and available operative infrastructure. It has a definite role in bigger hospitals as well where it will help reduce the morbidity associated with other forms of blood transfusion. ANH also serves to reassure the patient and allay his anxieties about hazards of homologous blood transfusion.

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