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ACUTE NORMOVOLEMIC HEMODILUTION USING DIFFERENT DILUENTS AND ITS EFFECTS ON HOMOLOGOUS BLOOD REQUIREMENTS.

RIBEUR

Submitted in Partial fulfillment of Master Degree .

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INTRODUCTION

Preoperative hemodilaution has been introduced into surgery in 1973 ^(1,2) as on alternative to the transfusion of homologous blood due to shortage in blood supply and the hazards of homologous blood. Whereas the general risks of blood transfusion have been reduced during recent years. The appearance of the Acquired Immuno Deficiency syndrome (AIDS) has had serious impacts on the transfusion services and the transfusion policy. In addition various prospective studies have suggested that transfusion of homologous blood can lead to recurrence of malignant disease ⁽³⁾.

During the last decades, Many techniques have proved to be useful for this purpose⁽⁴⁾. Acute normovolemic hemodilution⁽⁵⁾, acute preoperative plasma Pheresis⁽⁶⁾, reinfusion of shed mediastional blood⁽⁷⁾, and the use of pharmacologic agents such as aprotinin⁽⁸⁾ and the erythropoietin ⁽⁹⁾, all have been shown to be highly effective in reducing blood use during and after operations. Recent reports underline the efficacy of combining these techniques in a blood conservation program to further decrease blood use and therefore decreasing the risk of blood related infections ⁽¹⁰⁾.

REVIEW OF LITERATURE

INDICATIONS OF BLOOD TRANSFUSION

Blood transfusion is given to increase oxygen carrying capacity of the blood and to restore the intravascular volume. Theoretically increasing blood volume is not on indication for blood transfusion since volume can be augmented with administration of fluids that do not transmit infections (e.g. crystalloid and some colloids). Therefore, increasing oxygen carrying capacity is the only real indication for blood transfusion⁽¹¹⁾. Missmer suggests that oxygen transport can be sustained with a hematocrit as low as 20%(12). This assumes a normal intravascular blood volume and normal cardiovascular compensatory response (e.g. tachycardia). Recently a National Institute of Health consensus conference concluded that otherwise health patients with a hematocrit greater than 30% rarely require perioperative blood transfusions, where as these patients with acute anaemia with hematocrit less than 21% frequently require blood transfusion. They also recognized that patients with chronic anaemia (e.g. renal failure) may tolerate ahemoglobin concentration of less than 7g/dL. The ultimate definition of that hematocrit or hemoglobin at which blood should be given will have to be a clinical judgment based on many factors, such as cardiovascular status, age, anticipated blood loss, arterial oxygenation, mixed venous oxygen tension cardiac out-put and blood volume (13).

Review of Literature

The transfusion of blood or blood components is no more a type of substitution therapy, and supportive treatment. Blood transfusion remains one of the most dangerous therapies. So transfusion therapy should be undertaken only after careful clinical assessment in order to determine the nature and quantity of the fluid to be transfused⁽¹⁴⁾.

Transfusion may be required for any of the following indications.

1- To correct the blood volume as in hemorrhagic shock and extensive burn. Transfusion is absolutely necessary if the blood loss about 30% of the blood volume or more have been lost. In the operating room, the blood loss is estimated by weighing sponges and measuring the amount of blood in the suction apparatus. However, the estimated amount represents only about 70% of the true loss.

It is generally accepted that in a previously healthy adult, blood loss of 1000-1500ml can be replaced with plasma or erythrocyte or free solutions, known as" plasma substitutes" or volume expanders" without a significant risk to the tissue oxygen supply⁽¹⁵⁾.

2- To provide red blood cells in anaemias, hemolytic conditions and certain blood diseases, such as leukaemias and Hodgkin's disease, blood Transfusion is essential if the hemoglobin falls below 40%. Two units (1000ml) of whole blood will raise the

- hemoglobin by 2-3 gm/100ml and the haematocrit by 8- $9\%^{(16)}$.
- 3- To rise the white cell count in leucopaenia, agranulocytosis and hypersplensim.
- 4- To provide antibodies and raise the general resistance in severe infections such as septicaemia, pyaemia and gas gangrene, fresh blood or, plasma should be used⁽¹⁷⁾.
- 5- To replace the infants blood with Rh. negative blood in erythroblastosis foetalis⁽¹⁶⁾.
- 6- Extra corporal circulation⁽¹⁸⁾.

AUTOLOGOUS BLOOD TRANSFUSION

Auto-transfusion is collection, storage and reinfusion of the patient's own blood⁽¹⁹⁾. The technique reduces the use of homologous blood and has applications in several areas of surgical practice⁽²⁰⁾.

Autologous blood can be collected prior to surgery and stored or it can be salvaged from blood in the intraoperative or postoperative peroids and reinfused immediately⁽²¹⁾. Autologous blood transfusion has become increasingly popular since the mid 1980 with the realization that autologous blood is safer for the recipient than homologous blood⁽²²⁾.

Techniques of auto-transfusion:

- I- Preoperative autologous blood donation:
- II- Acute normovolaemic hemodilution.
- III- Intraoperative blood scavenging and recycling in elective clean surgery or trauma.

I- Preoperative autologous blood donation :

Preoperative autologous blood programs collect and store whole blood, red blood cells, plasma and or platelet for retranfusions into the same person. The American Association of Blood Banks (AABB) established standards for autologous blood donors similar to those for homologous donation except that the usual minimum eight week interval between phlebotomies is eliminated. Donations are often scheduled weekly or even four

Review of Literature

days intervals with the last phlebotomy performed 72 hours or more before the operation. Most programs require hemoglobin level to be above 11gm/dL or hematocrit >34% before each phlebotomy and oral iron supplements are administered daily⁽²³⁾.

Procedure:

The physician refers the patient to a blood collecting facility for autologous donation. The physician then may prescribe therapeutic dose of oral iron e.g. ferrous sulphate, or ferrous gluconate. At the donation facility the patients is evaluated for fitness of autologous donation and the donation schedule is set. Many patients can give blood as frequently as every 3 days although one week is most common in general, the optimal donation period begins 4 to 6 weeks prior to surgery. The last blood donation is usually collected no later than 72 hours before surgery⁽²¹⁾.

Complications and risks

1-Vasovagal reaction:

Occur in about 2-5% of all donors autologous or homologous. Most vasovagal reaction consist of light headache due to transient hypotension and bradycardia and are self limited, in 10% of these reactions the patients loss consciousness. A vasovagal reaction may carry the risk of higher morbidity for patient with cardiac or cerebrovascular disease⁽²⁴⁾.

2- Anaemia:

If iron therapy is not administered.

Contraindications:

The haemoglobin concentration must be less than in excess of 11gm/dL. The patients with significant cardiac or respiratory disease which would interfere with their ability to compensate for the mild anaemia associated with procedure⁽²⁴⁾. Epileptics are exclude because the withdrawal of blood may provoke fit.

ACUTE NORMOVOLAEMIC HEMODILUTION

Since its introduction into surgical practice more than 20 years ago^(25,26). Preoperative hemodilution has become an essential component of the overall strategy to limit the use of homologous (bank) blood. Hemodilution entails removal of one or more units of whole blood from a patient while replacing the blood withdrawn with either a colloid or crystalloids. By using this procedure prior to intraoperative blood loss, fresh autologous blood is made available for later retransfusion. As a result of hemodilution blood subsequently lost during surgery contains proportionally fewer red blood cells per milliliter. Thus minimizing intraoperative loss of autologous erythrocytes⁽²⁷⁾.

Definition of Medical terms used with hemodilution:

Hemodilution implies dilution of the normal blood constituents. Occuring spontaneously after injury or blood loss or as a result of plasma replacement or expansion⁽²⁸⁾. Because the red blood cell (RBC) mass is most suitable to reveal changes in the ratio of the main blood constituents, the large vessel hematocrit (normal 36-45% in females and 42-50% in males) or systemic hemoglobin concentration (normal 12.3-15.3 gm/dL in females and 14-17.5 gm/dL in males) is used to define the degree of hemodilution. Both the hematocrit and the hemoglobin concentration reflect only the concentration of the vehicle transporting oxygen in the blood they do not represent

the critical parameter in hemodilution, which is the oxygen content (CaO_2) of arterial blood.

Limited or moderate hemodilution denotes a decrease of hematocirt from the normal value to 30% or slightly lower HCT 28% ⁽²⁹⁾. Whereas a reduction of hematocrit to 20% or below is termed extreme or severe hemodilution^(28,30).