A REVIEW ON

AUTOTRANSFUSION IN OPEN HEART SURGERY

Thesis

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LIST OF ABBREVIATIONS

ADP	Adenosine diphosphate.
ACD	Acid-citrate-dextrose.
ACT	Activated clotting time.
AIDS	Acquired immune deficiency syndrome.
ATS	Autotransfusion system.
CMV	Cytomegalovirus.
CPD	Citrate-phosphate-dextrose.
ECC	Extracorporeal circulation.
ECF	Extracellular fluid.
EIA	Enzyme immunoassay.
FDPs	Fibrin degradation products.
FFP	Fresh frozen plasma.
HB_sAg	Hepatitis B virus surface antigen.
HBV	Hepatitis B virus.
HTLVIII	Human T-cell lymphotropic virus type III
Ig	Immunoglobulin.
LAV	Lymphadenopathy associated virus.
PT	Prothrombin time.
PTT	Partial thromboplastin time.
Rh	Rhesus factor.
TT	Thrombin time.
USP	United states pharmacopiea.

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INTRODUCTION AND AIM OF THE WORK:

Modern cardiac surgery became possible with the development of the heart-lung machine. The frequency of such surgery has much increased nowadays.

One of the physiological disturbances in extracorporeal circulation (E.C.C.) is blood volume loss. If blood flow is held constant during perfusion, there will be a gradual decrease in the venous reservoir which requires transfusion replacement. The loss of blood volume might be explained by loss at the surgical site as well as sequestration into dissected tissues. If blood volume replacement does not occur, perfusion of tissues is not optimal and metabolic acidosis follows.

A number of blood substitutes are used in the absence of blood; they include plasma, dextrans and hetastarch. Dextran 40 may be used as plasma expander, hypersensitivity reactions to this agent have been reported. There comes a point at which red cells are needed in order to maintain adequate oxygenation to the tissues. So blood transfusion is indispensable and is routinely used in big quantities in these operations. It usually requires 45 minutes to perform satisfactory typing and cross matching of blood for transfusion. Occasionally a patient is encountered who, for religious reasons, refuses blood transfusion (Cooley et al., 1964). Also many serious hazards are associated with the operation of blood transfusion, including risks of mismatched blood, hepatitis, alloimmunization and other well known complications. Transfusion of large quantities of stored blood accounts for some of the post-perfusion complications. Also due to massive quantities they are receiving, they are liable to have bleeding as a result of dilution of labile coagulation factors and platelets. To overcome the blood transfusion hazards and to provide fresh blood at a short notice, some workers start to think about transfusing the patient's own blood.

Autotransfusion was introduced in the latter part of the nineteenth century as a useful adjunct during major operations by Miller and Duncan (Frederick & West, 1978). After extensive laboratory trials, autotransfusion was used in open heart surgery (Klebanoff, 1978).

However, special techniques for blood conservation during open heart surgery are worth noting. Various methods are used in a trial to improve this procedure.

Therefore, our aim of work is to throw light on the various methods of withdrawing autologous blood. Also to re-evaluate the different techniques used. To outline some of the hazards and advantages of such methods.

REVIEW

OF

LITERATURE

EXTRACORPOREAL CIRCULATION

Historical Note:

The historical aspects of cardiopulmonary bypass for cardiac surgery are not easily described, for it is almost impossible to know who first had the idea of diverting the circulation to an oxygenator outside the body and pumping it back to the patient's arterial system, inorder to allow surgery within the heart.

References to extracorporeal gas exchange in blood go back to the last part of nineteenth century. However, serious consideration of the use of pump-oxygenator for cardiac sugery had to await the development of modern anaesthesia and modern surgical techniques. Quickly, the field of intracardiac surgery using a pump oxygenator and a degree of hypothermia for cardiopulmonary bypass began to expand, and today it is practiced in all parts of the world (Kirklin et al., 1983).

Collection and Return of Blood to the Patient:

a) Venous Drainage:

Systemic venous blood is returned to the oxygenator through two flexible plastic canulae which are inserted into the superior and inferior venae cavae through separate right atrial incisions and then joined to create a single drainage channel. Alternatively, a single canula is placed in the right atrium. Blood flows freely into the oxygenator under the infleunce of gravity. The venous pressure distal to the sites of cannulation, should be low. If the venous pressure remains elevated, oedema will accumulate and capillary damage will occur, so causing bleeding into the tissues which is obvious post-operatively as petechiae on the chest wall or subconjunctival haemorrhage.

b) Intracardiac suction:

The heart does not empty completly and there is a considerable volume of blood within the cavities of a distended heart. Handheld suckers are used to return this blood to the oxygenator and to keep the surgical field dry, but blood which is contaminated with clot or debris from the heart should be discarded. There is a blood filter incorporated in the system. The intracardiac suckers should be used as little as possible to avoid haemolysis.

c) Left Ventricular Vent:

Undesirable left ventricular distension is eliminated by using a separated drainage tube or vent. Blood returned through the vent and intracardiac suckers, passes through a filter and a defoaming unit, before it enters the oxygenator. A reservoir is often included, to accomodate the large volume of blood which may be encountered when the heart is first opened (Arom et al., 1977).

d) Arterial Return:

Oxygenated blood is returned to the patient through a cannula in either the ascending aorta, or one femoral artery, usually the left. This is generally the narrowest part of the circuit. The cannula should be as short as possible and as large as the diameter of the vessel permits (Ionescu and Wooler, 1975).

e) Coronary Perfusion:-

The coronary arteries are usually perfused during bypass by blood which flows in a retrograde direction from the site of cannulation to the closed aortic valve, but this supply is interrupted if the aorta is cross-clamped (Maloney and Nelson, 1975).

Oxygenators:

Types of oxygenators are:

1. Rotating disc oxygenators:

A series of thin, stainless steel or polycarbonate discs are mounted on a spindle. The entire assembly is suspended in a cylindrical chamber which is about one-third filled with a suitable priming fluid. It is not used any more.

2. **Bubble oxygenators:**

This term includes a number of different devices which all operate on a similar principle. Oxygen is bubbled in a chamber containing blood. Many of them are made of disposable materials and are supplied pres-terilised.

3. **Membrane oxygenators:**

A semipermeable membrane is closely folded in such a way that a large surface area is provided within a compact frame. Blood damage and the generation of gas bubbles are minimised, and these devices are therefore used for prolonged extracorporeal support, as well as during surgery (Clark et al., 1979).

Arterial Pumps:

Various types of pumps have been used to return blood from the oxygenator to the patient, but the roller pump is the only design which has remained popular. Pumps with large bore tubing and slowly rotating rollers are preferred because these features minimise damage to both the blood and to the walls of the tubing. The pressure at which blood is returned to the arterial system must be monitored carefully; a large pressure gradient across the arterial cannula increases red cell destruction. Ideally, the pressure gradient between the pump and systemic vessles should not exceed 100 mmHg. or so once perfusion has started (Edmunds, 1982).

Filtration:

The need for filtration of blood, returned from the cardiac cavities, has been described already, but filtration is also required before blood can be delivered from the oxygenator to the patient. Recently, small pore filters have been used to eliminate micro-emboli. Examples of these emboli are: platelet aggregates, fibrin strands, adherent leucocytes and blood clots. The filters consist of either dacron wool or polyester mesh. Their use is associated with both clinical and laboratory evidence of diminished embolic damage following bypass (Ionescu, 1981).

Assembling and Priming the Extracorporeal Circuit:

The sterile circuit is assembled in the operating theatre. Dextrose 5% is generally used to flush the circuit and a small residue (about 200 ml) may remain and form part of the priming volume. The ends of a