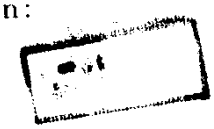
Comparative study between different techniques of vascular access in adult patients with chronic renal failure undergoing hemodialysis.

Essay

Submitted in partial fullfilment of Master Degree in:



General Surgery.

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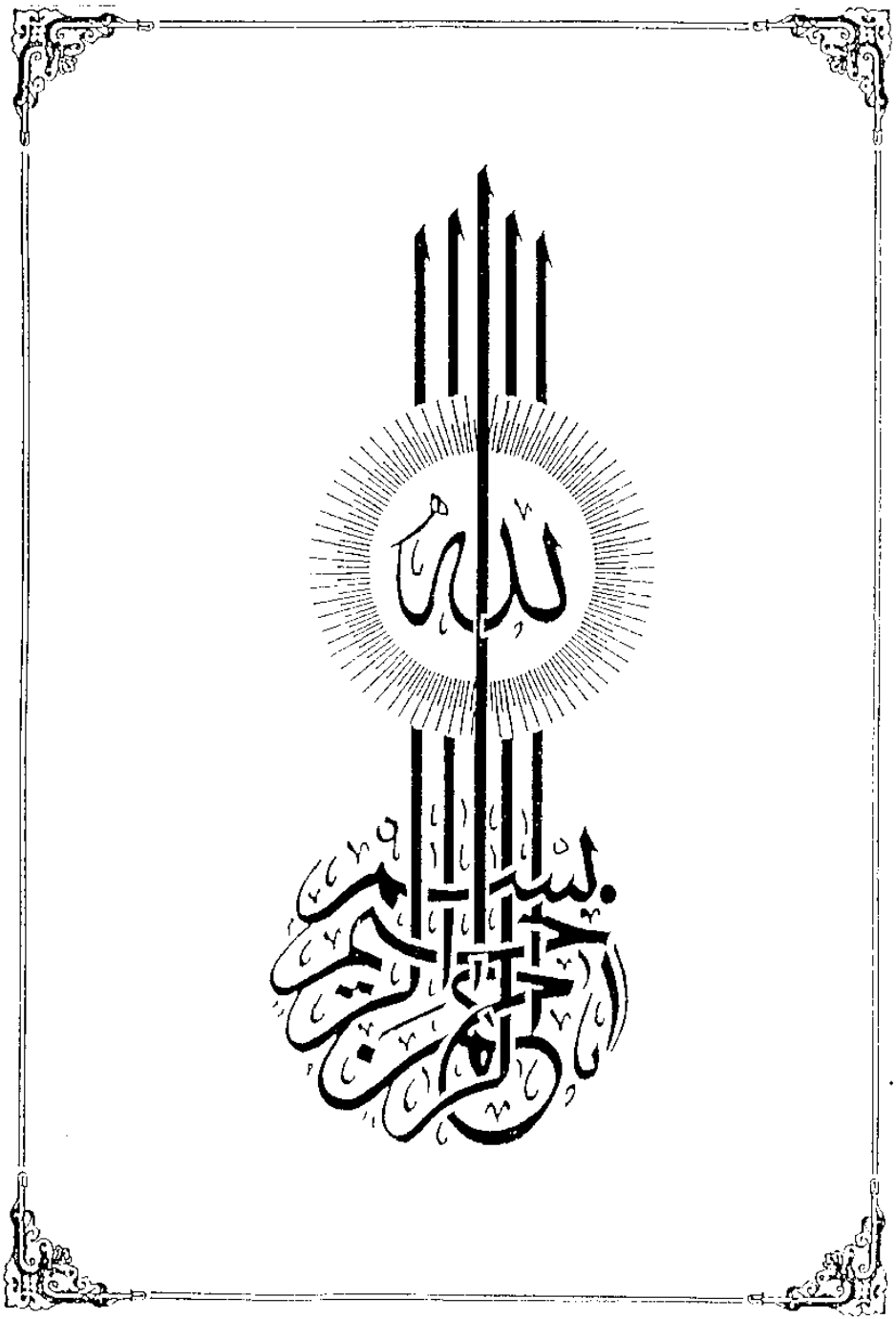
1986

AKNOWLEDGMENT

I wish to express my thanks to prof. MAHMOUD NAGUIB the head of the Surgery department for his support and kindness.

I gratefully aknowledge my deep indebtedness and profound thanks to my supervisors, prof. NABIL ELMEHAIRY and prof. ABOU BAKRE EL SEDDIK MOUSTAFA for their profound guidness in bringing this work forward.



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Chapter 1:

History:

Renal failure in the acute and chronic form is a very common disease all over the world.It is the final outcome for many diseases affecting the urinary tract wether endemic , infectious or autoimmune.

It was considered a rapidely fatal disease until the emergence of hemodialysis,first successfully performed on 1944 by Kolff et al.The machine simply works by drawing the patient's blood outside his body,diffuses creatinine,urea and other toxins to a running solution in the apparatus across a semipermeable membrane then returning the blood back to the patient.

However , although most of the patients survived and overcomed acute failure, and the main cause of death was complicated cardiovascular hypertensive diseases, long standing acute & chronic failure cases used to die due to stopping dialysis because of exhaution of the available routes to the vascular tree all over the body , as each setting required a new access.Even trials of permenant cannulation failed with mean life span of 8 days.

Cannulation of large veins solved some of these problems temporary, double lumen cannulae with in - out ports usually applied to the femoral vesseles, however , they carried the risk of infection ,septiceamia and thrombosis which limited their usefulness. (Shaldon 1961)

Thus the main problem against institution of regular dialysis was the institution of a vascular acess which :

- Ensures high blood flow rate to the apparatus (250-300 ml/min)-
- Allows repeated cannulation over relatively short intervals without the risk of losing access (phlebitis, thrombosis, fibrosis).
- Convinient, well tolerated by the patient and compatible with normal living activities which is the main aim of dialysis treatment.

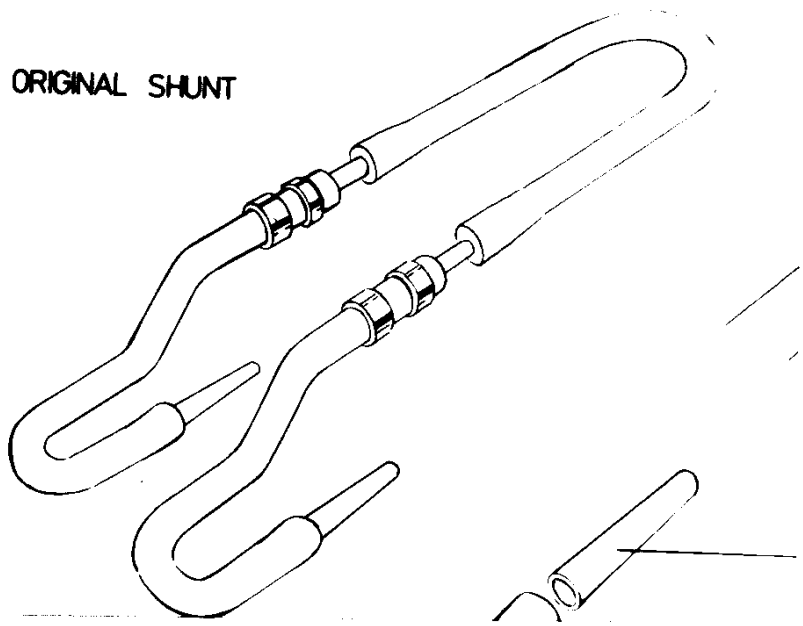
Quinton, and Scribner (1960) took a very wide step twards solving this problem.On 1960 they introduced the idea of connecting an extremity artery to a neighbouring vein through an external device,thus the first A-V connection was born.

During rest the high rate of arterial flow to the vein ensured its patency and dialysis flow used to be carried out through both tubes,drawing the blood from the arterial line and returning it through the venous.

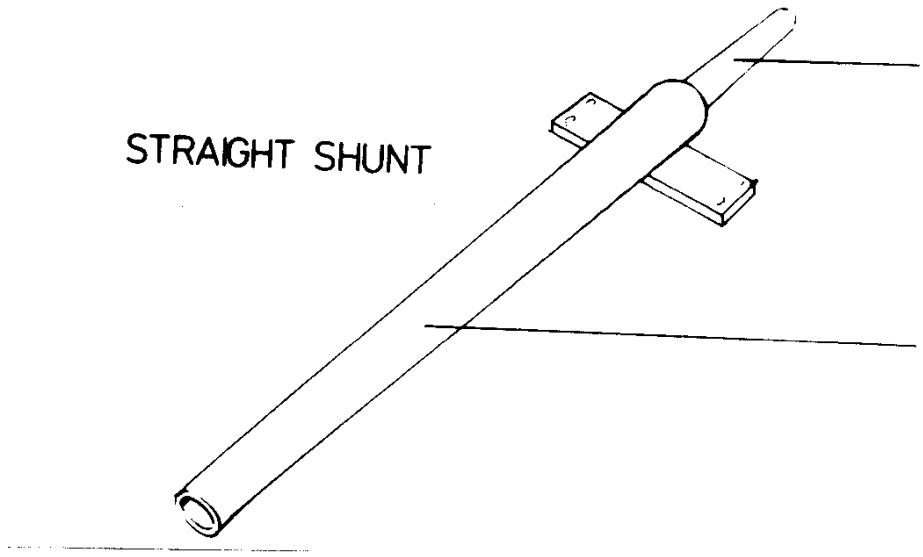
Brescia, Cimino, et al(1966) found that the forarm veins

after being connected to a peripheral artery through the external shunt,became thickened as if they were arterialized allowing high flow rates to be obtained from them,out and in,evenmore they found that repeated puncture and cannulation of any of them was easy and did not result in thrombosis as there was only minor damage due to thickening of their walls compared to normal peripheral veins.Thus on 1966 they described a new technique of A-V connection rather then the external shunt which was a direct anastomosis between the radial artery and a near by vein then cannulation of the forearm veins for dialysis begins on the following day.

Long term complications involving the use of shunts and fistulae arised and several technical modifications had to be described to overcome them for maintainence of a proper vascular access.These problems and the technical ways to deal with them are the subject of our essay.



Original shunt



Straight shunt

chapter 2:

Arteriovenous shunts:

The description of this technique for vascular access was a revoulutionary idea in the progress and success chronic hemodialysis.It entails connecting an artery with a neighbouring vein (originally radiocephalic) through two teflon cannula connected externally by a siliconized rubber tube.The tips of the cannulae were ligated to cut ends of the vessels and the whole device is curved in a U shaped pattern.

The arteriovenous shunting of blood as described solved many of the problems of conventional vascular access procedures:-

-It is constant and safe.

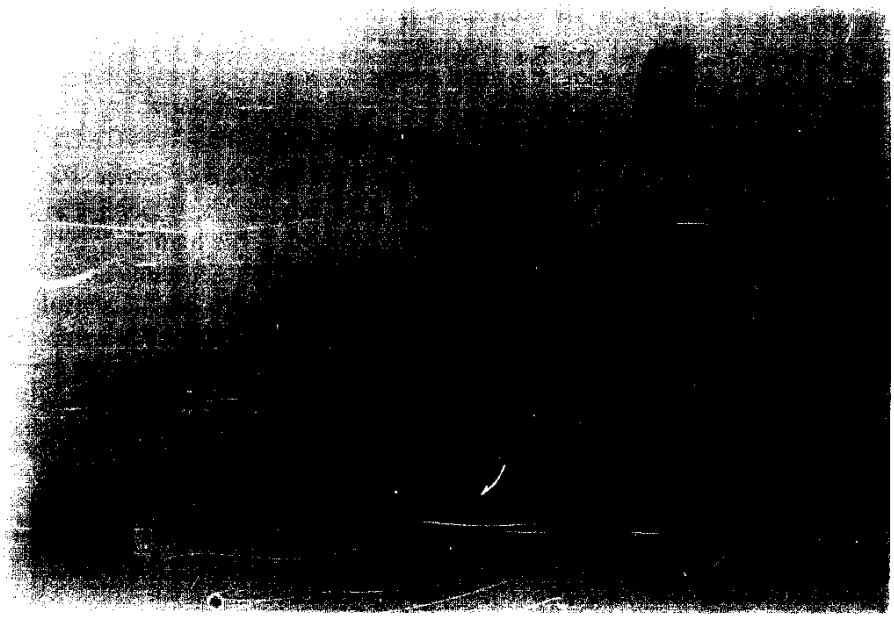
-It assured satisfactorily high rates of blood flow to combate with the dialysis apparatus requirements.

-More prolonged survival time,up to 24 months (Haminov 1975)and more than that for Thomas shunt.(Mandel et al 1977)

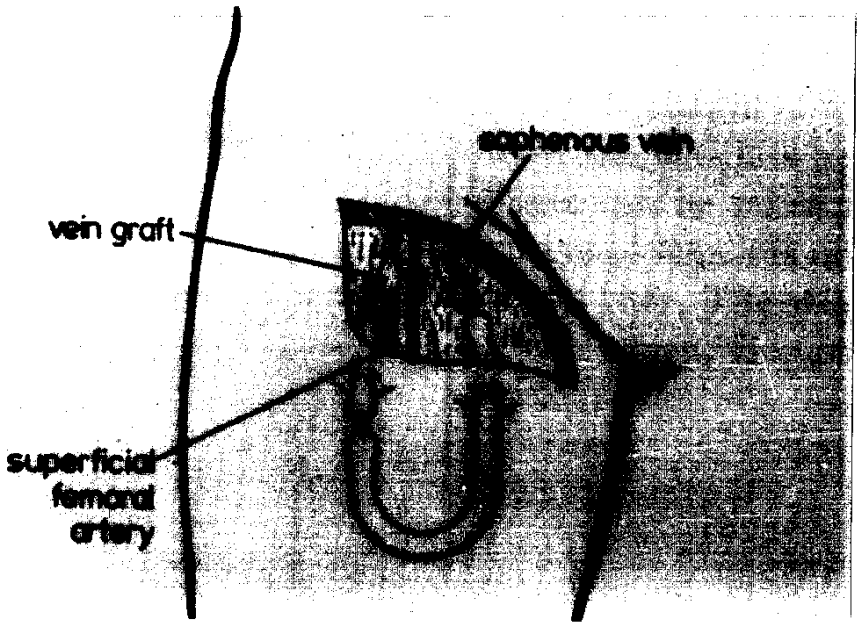
Types of shunts:

(1) Quinton Dillard and Scribner:

The first shunt described,curved,popular,easy to insert and



The Busselmier shunt



The thigh cannula

to remove,howevern needs more care as it is less stable and is more prone to obstruction which is less esay to handle mechanically because of the curvature.

(2) Busselmier:

Arised on 1973 as a technical modificaton of the original Quinton version.It is a curved shunt which gets inserted near completely under the skin except for two side branching entry ports which protrude from the skin surface.This is claimed to reduce the incidence of infection as less forigen material is exposed to the outside and also much less intimal damage occurs to the vessels upon using the shunt as more secur immobilization is acheived.Finally as the in- and out flow ports are side ways from the loop,transient drop in venous out flow upon connection to the dialyzer does not predispose to occlusion because recirculation through the loop does not decrease simultanously.

This shunt can be inserted in the forearm,the ankle or the groin,its insertion and removal requires formal operative preperations.

(3) Straight shunt:

The absence of curvature in this shunt is belived to augment the blood flow,also it facilitates mechanical declotting when required.A stabilizing silicone wings (Ramierez 1966) add

more stability in the subcutaneous tissue. It needs some skill and perperation for insertion and removal.

(4) Thoomas shunt:

Another form of straight shunts designed to be connected to the common femoral artery & femoral vein. It consists of a sialastic cannula attached to a dacron skirt which is anastomosed to the femoral vessels in an end to side form. This shift of the blood from the atery does not endanger the limb vasculature,however,it entails greater risk of infection from its site with possible secondary hemorrage which is difficiOult to manage. It also needs great skill and operative preparation under general anasthesia for insertion , removal often needs patch material to cover the resulting defect in the vessel walls,which is very difficult if removed due to infection.

(5) Allen Brown shunt:

Is similar to Thomas shunt except that it has also a Dacron graft - tube instead of a skirt and a Dacron sleeve around the tube to facilitate fixation to the subcutaneous tissue for stabitity. Its small size enables it to be applied to peripheral vessels in an end to end manner.

(6) Thigh cannula :

Another form of sapheno femoral connection , described by Rae et al (1969), it utilizes vein graft rather than a skirt to be anastmosed to the artery-end to side . He used a segment of the long saphenous vein as the graft to which is attached the arterial cannula , and the venous cannula is attached to the proximal end of the cut saphenous vein. Both cannulae are connected externally with a siliconized rubber tube through two separate stabs. This technique is easier and if infection occured , removal of the shunt is not difficult, less hazardous and less possible secondary hemorrage. The author reports low infection rate , no cardiovascular complications , good rate of blood flow(250 ml/ min. in average) low clotting rate which when occurred can be managed by mechanical declothing and average patency rate of two years. A very similar technique was described by chavez and Bower in 1969.

Techniques of application:

Upper limb:

Anatomy:

The Radial artery:

Passes to the forearm across the supinator over the tendon

of insertion of pronator teres,the origin of the flexor pollices longus and in front of the lower third of the radius where it diappears beneath the tendons of abductor pollices longus and extensor pollices brevis to cross the anatomical snuff box.The radial nerve is lateral to its lower two thirds.

The Cephalic vein:

Arises from the radial side of the superficial venous arch.It runs up along the preaxial border of the forearm lateral and superficial to the artery.

Procedure:

Strict aseptic precautions are required , local anesthesia with proper premedication is usually satisfactory.The upper limb is the originally described site for sunt insertion with connecting the radial artery to the cephalic vein.

- The arm is better be selected as the non dominent side, injections and withdrawal of blood should stop for a period of time to prevent thrombosis of veins and to allow subsidence of phlebitic ones.

- The condition of collaterals should be examined by Allen test and angiography if necessary (Rutherford). However ,some authors (Giacchino et al 1979)claimed insignificance of these tests as always there will be good collateral circulation mediated by the interosseous arteries.

- suitable skin incision that allows good exposure of both vessels and some space distally for insertion of the cannulae through separate stabs away from the flexor crease to assure some freedom of movement. It may be longitidunal or transverse.
- Exposure of the artery , mobilization of an adequate segment (2-3 cm) from its surrounding venae communtance. Proximal double loop ligature is applied to control flow from and a distal one which is tied securely (3-4/0 silk).
- Small stab along the course of the artery is done for the exit of the shunt limb 1 cm distal to the incision to which it is connected by a subcutaneous tunnel.
- Small longitudinal arteriotomy is carried out , gradual dilatation of its lumen to fit the largest possible size of cannula tip.
- The cannula tip attached to the silastic tube , both filled with heparinized saline and clamped distally are inserted through the proximal stab and advanced to the lumen of the artery . This step should be done with care to avoid any intimal damage. Ligatures are tied to secure the cannula to the vessel , proximal ligature and clamp at the tube realeased, arterial flow noticed, tube refilled with heparinzed saline and clamped.
- The cannula can be inserted into the artery through the incision and then its distal end brought through the tunnel from the distal stab. This usually is applied to winged tubes.