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Temporary Aortic By-pass By Means Of A Mechanical Device

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TEMPORARY AORTIC BY-PASS BY MEANS OF A MECHANICAL DEVICE*
WALTER H. JANKE, M.D.**

In operations of the aorta, in which temporary occlusion of the thoracic segment is done, the presence or absence of adequate collateral circulation must be considered in order to avoid ischemia of the lower parts of the body and the further complications of renal and medullary damage.

The aortic coartation of the so-called adult type is almost the sole exception in which collateral circulation is usually maintained adequately, and the aortic clamping of the thoracic segment of the aorta is possible for a long period of time without danger of lower ischemia.

In other aortic operations the surgeon has three ways of avoiding the ischemia of the lower parts of the body: a) Short duration of aortic clamping, b) Use of Hypothermia, and c) Use of temporary by-pass systems.

a) Short duration of aortic clamping. The aortic clamping alone is used when it is possible to predict that it will not be necessary to clamp the aorta for a long period of time. This is, of course, the easiest and quickest way. Nevertheless, there can always appear unexpected complications which prolong the time of aortic occlusion.

b) Use of Hypothermia. This method prolongs the safe period of aortic occlusion, but the occurrence of ventricular fibrillation and other complications of hypothermia is a relative inconvenience.

c) Use of temporary by-pass systems. — By this means it is possible to prolong for a very long time the safe period of aortic occlusion. With this in mind homografts, heterografts, and plastic by-pass systems have often been used. A disadvantage, however, of suturing grafts that may be used in the by-pass systems is that some injury of the aorta itself may result which makes the operated area more difficult to repair. Another disadvantage is that the suturing procedure prolongs the operating time.

The purpose of this work is to describe the use in animals of a temporary by-pass by means of a mechanical device, with the view in mind of later human employment.

METHODS

This mechanical device consists of 3 pieces, (Figure 1) (a) Cannula with a fixed curved plate attached to the lower part, (b) Superior mobile curved plate, and (c) Nut.

The cannula is attached to a Tygon tube previous to the procedure, then the attached lower plate is introduced through a small aortic incision of 1 cm and the

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Temporary Aortic By-Pass

Figure 1
Mechanical device for temporary aortic by-pass. (a) Cannula with a fixed curved plate attached to the lower part. (b) Superior mobile curved plate. (c) Nut.

superior mobile plate is placed down, holding the aortic wall between the two plates, by tightening the nut.

Eleven healthy adult dogs were used. They were anesthetized by intravenous administration of sodium pentobarbital, and tracheal intubation was carried out. After heparinization, the femoral artery was cannulated and connected to a manometer for blood pressure recording.

Two incisions in the left thorax were made, one through the fourth, and the other through the seventh interspace. The aorta was dissected free from the origin of the subclavian artery to the first pair of aortic intercostal arteries, and two aortic clamps were applied.

The fixed curved plate of the lower part of the cannula was inserted into the aorta through a 1 cm. incision in the clamped aorta. The Tygon tube was clamped and the aortic clamps removed.

The same procedure was done in the lower part of the thoracic aorta after ligating one pair of intercostal arteries.

The time employed in the insertion of the cannulas varied between one and eight minutes, the average being five minutes. Some details not taken into account made insertion time longer in the first experiments. In the last three dogs, this time was shortened to an average of 2.5 minutes.

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In all the experiments, mean femoral blood pressure was observed: a) Before applying the by-pass, b) After cross-clamping the aorta, c) With by-pass in place, d) With by-pass and aortic cross-clamping. Results are shown in Table I.

<table>
<thead>
<tr>
<th>NUMBER OF DOGS</th>
<th>BEFORE BY-PASS</th>
<th>AORTA CLAMPED</th>
<th>WITH BY-PASS AORTA OPENED</th>
<th>BY-PASS ALONE AORTA CLAMPED IN THE MIDDLE</th>
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<td>*85</td>
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As can be noted in all the above mentioned experiences, the mean femoral blood pressure was maintained at an average of 70 mm. Hg., the lowest being 50 mm. Hg. which is within safety limits. In only two dogs blood was replaced (5 and 6); as can be seen in these experiments the blood pressure with the by-pass alone is very close to the pre-experimental level.

SUMMARY

In cases of operations of long duration on the thoracic aorta, it is often useful to employ a temporary by-pass system in order to avoid ischemia of the lower parts of the body. For this procedure homografts, heterografts, and plastic grafts has often been used.

The purpose of this work is to demonstrate in animals the use of a temporary aortic by-pass by means of a mechanical device with the view to latter human employment.

Experiences with eleven dogs are discussed in terms of ease of application and mechanical efficiency.

REFERENCES


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