Instruments and techniques

A chronically implanted cuff for occlusion of dog’s pulmonary artery during exercise

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AUTHORS’ SYNOPSIS

A design for an easily-made, chronically implanted, inflatable cuff for total occlusion at will, during exercise of the pulmonary artery in the dog is reported.

The idea of occluding one or other pulmonary artery with an inflatable balloon is well tried. In most cases it is performed as an acute procedure intravascularly (Carlens et al., 1951; Franck et al., 1956; Brofman et al., 1957; Suzuki et al., 1969). However a few workers seem to have employed chronic devices placed extravascularly (Huang et al., 1971), but their precise design has not been described.

We needed to occlude totally either pulmonary artery in dogs while they were exercising on a treadmill. The short length of the main left and right pulmonary arteries in dogs makes the usual balloon constrictor unsuitable, and we developed a design of cuff, with exteriorized inflation tubes, which proved still satisfactory after three months implantation. The design is reported.

Construction

The cuff is made from two rectangular strips (40 mm x 10 mm) of silicone rubber sheet 0.25 mm thick. The strips are welded together with a silicone rubber adhesive. The outer strip is reinforced with a polyester mesh so that when tied around the vessel and air is forced between the layers, ballooning occurs only inwards. Only half of the cuff inflates, so that the vessel is squeezed from only one side. The cuff is secured around the vessel with two lengths of braided polyester suture which is embedded in the outer layer. The inflation tube is made of a suitably sized silicone rubber tube. It has a break-point at the skin exteriorization as a safeguard against inadvertent traction. Steps in construction are relatively simple (see Figs. 1, 2, 3, and 4).

Placement

The cuff and tube should be thoroughly washed in soap and water and sterile saline to remove particulate matter, and then sterilized in hexamethonium chloride for at least 20 min.

Thoracotomy through the fourth left intercostal space has been found most satisfactory. If cuffs are placed on both main pulmonary arteries, it has been found best to approach the right pulmonary artery inside the pericardium and to fix the right cuff first. The non-inflatable end of the cuff may be tailored by cutting short to the right length for fitting neatly around the pulmonary artery. The same end can also be grasped firmly with curved forceps without damage, to pass it round behind the vessel through the adventitious tissues.

The inflation tubes are passed through a separate incision in the chest wall and ligatured.
1. Thread woven into strip of polyester mesh

2. Strip of silicone rubber sheet cut 4 x 1 cm

3. Both stuck together with adhesive . . .

4. . . . and cured around suitable 1.5 cm diameter cylinder

5. Second strip of silicone rubber sheet stuck to first along half its length . . .

6. . . . and cured around suitable cylinder

7. Further adhesive added as in shaded area and cured on cylinder

8. Tube inserted and welded to make it airtight

9. Edges trimmed

**THE BREAK POINT**

**FIG. 1** Steps in the construction of the cuff.
A chronically implanted cuff for occlusion of dog's pulmonary artery during exercise

The external part of the tube is protected by a bandage around the neck. Antibiotic cover is given for 4 days.

Inflation and proving

The cuffs are inflated with air from a 10-ml disposable plastic syringe. An 18 gauge needle, with point removed, is pressed into the end of the inflation tube. The inflation pressure/volume required to effect total occlusion is noted and then exceeded by 20% on subsequent occasions to ensure a margin for safety.

The criterion for total occlusion is taken as zero oxygen uptake during differential spirometry using the method of Carlens et al (1951).

Six dogs have so far had a total of 38 cuff-weeks without complications. The longest was still satisfactory at elective removal after 3 months.

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References


