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CANINE AORTOFEMORAL BYPASS: A NEW TECHNIQUE FOR THE EVALUATION OF PROSTHETIC IMPLANTS

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Two canine preparations have generally been used for the experimental evaluation of prosthetic arterial implants. The more popular of these has been replacement of either the distal thoracic aorta or distal abdominal aorta with short segments of prosthetic material. The general acceptance of this method among investigators reflects the ease and rapidity of implantation as well as the negligible operative mortality associated with this procedure. The main criticism of this method has been the inability to implant sufficiently long prosthetic segments to adequately distinguish true arteriogenesis from the intimal ingrowth that normally occurs from each anastomosis.

To overcome this drawback, others have proposed the use of longer prosthetic segments by implanting a bypass between the upper thoracic and lower abdominal aorta. First described by McCune and Blades,[1] and later popularized by Szilagyi,[2] this method permits the implantation of prosthetic segments, 18 to 26 cm in length allowing evaluation of arteriogenesis in the central portions of the prosthesis. Technical drawbacks associated with this technique limit its widespread application by many investigators. The method is time consuming and is associated with a high operative mortality.

The initiation of investigations in this laboratory involving vascular graft infections resulted in the need for an experimental model in which a long segment of arterial prosthesis could be implanted and at the same time provide easy access for bacterial inoculation and subsequent culture. A unilateral aortofemoral bypass was found to be ideally suited for this purpose. Because of the ease of implantation and the ability to insert long prosthetic segments, this preparation is a good method to evaluate prosthetic arterial implants.

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METHOD

Adult mongrel dogs, weighing 10–20 kilograms were anesthetized with intravenous sodium thiamylal and intubated. Continuous anesthesia is maintained with methoxyflurane. The abdomen and left groin are then prepped and draped.

Two incisions are utilized. The lower abdominal aorta is exposed through a midline incision and the distal aorta below the renal arteries is mobilized and controlled. The left femoral artery is then exposed through a vertical left groin incision and mobilized for a distance of 5 cm distal to the inguinal ligament. A subcutaneous tunnel is created laterally along the inguinal ligament, carried through the lateral abdominal musculature and continued retroperitoneally to the level of the aorta (Figure 1).

Prior to graft implantation, the animal is heparinized. The distal anastomosis is performed in an end-to-side fashion 1–2 cm below the inguinal ligament using 5-0 arterial suture. The prosthesis is placed in the abdomen through the previously prepared tunnel and anastomosed in an end-to-end fashion to the proximal stump of the aorta 3 cm below the renal arteries with 5-0 arterial suture. The distal aortic stump is then ligated.

Following clamp release, the heparin is reversed with protamine sulfate. Both incisions are closed in layers and the skin approximated with a subcuticular suture. The wounds are sealed with collodion and receive no special care postoperatively.

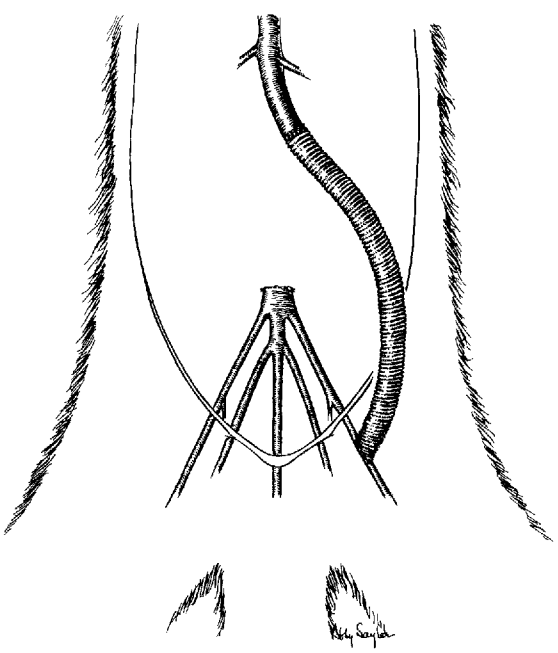

FIG. 1. Artist's illustration of canine aortofemoral bypass.

RESULTS

An aortofemoral bypass has been placed in over 50 dogs. Depending on the size of the animal, this method permits the insertion of prosthetic implants 6–8 mm in diameter and 15–25 cm in length. Woven, knitted and velour prostheses have all been successfully implanted. While either femoral artery can be used for the distal anastomosis, we have routinely used the left femoral artery since it avoids the inferior vena cava.

To maintain patency of the prosthesis an adequate distal run-off is required. This is accomplished by making both limbs of the animal dependent on the graft for arterial perfusion. We experienced early graft failure and thrombosis when only one extremity was perfused. When the entire infrarenal aortic flow was diverted through the prosthesis with perfusion of both lower limbs and pelvis, long-term patency was maintained.

With experience, the insertion of an aortofemoral bypass can be carried out in 2 hours or less with a negligible mortality. The only significant complication has been the occasional development of a groin infection resulting in either graft thrombosis or disruption of the femoral anastomosis. This appears to be the result of externally introduced contamination of the femoral incision. The use of a subcuticular suture and sealing the incision with collodion have usually prevented this complication.

Because of the nature of the experiments in which this model was employed, most dogs were maintained for several weeks and then either sacrificed or utilized in other investigations. Aside from the occasional graft thrombosis or

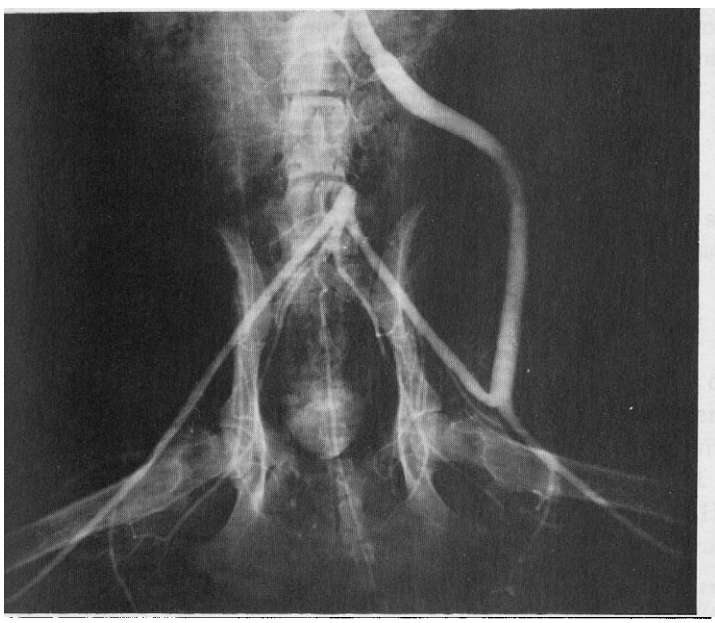

FIG. 2. Aortogram demonstrating patent canine aortofemoral bypass at 2 months.

anastomotic disruption secondary to infection, most prostheses were patent at the time of sacrifice. In those animals in whom longer survival was permitted arteriography has demonstrated patent grafts for up to 2 months (Figure 2). In many dogs subcutaneous pulsation of the graft has been observed for longer periods of time (4 months). The subcutaneous position of the distal portion of the prosthesis enables patency of the bypass to be readily assessed by palpation.

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