Instruments and Techniques

Permanent Catheterization of Aorta and Pulmonary Artery in the Dog*

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Summary. A method is presented for permanent catheterization of the aorta and the pulmonary artery in dogs. The preparation of single vessel catheters and double catheters for simultaneous arterial and venous sampling is described. The catheters, made of S-50-HL Tygon tubing, are introduced into the aorta and the pulmonary artery through the omocervical vessels, leaving the cerebral circulation intact. Removal of the catheter by the dog, thrombophlebitis and vascular embolism have not been observed. The catheters have remained functional for up to one year.

Key words: Blood sampling - Dog - Permanent intravascular catheterization.

INTRODUCTION

In investigations on acid-base and electrolyte balance in intact conscious dogs, direct access to the arterial and venous system is required to allow sampling of arterial and mixed venous blood with minimal disturbance of the animal. Several methods for arterial and venous blood sampling in conscious dogs have been used, among them permanent catheterization most frequently. Various techniques for the construction and implantation of such catheters have been described [1–9, 11]. The main difficulties with chronically implanted catheters are short patency, thromboembolitis, sequelae of vascular embolism, removal of the catheter by the dog and obstructed blood flow in the vessel used for implantation. In the present paper a technique for the preparation and implantation of a vascular catheter is described which, in our experience, is well tolerated by the dogs and will remain patent for up to one year.

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MATERIAL AND METHOD

Preparation of the Catheter. Two different types of catheters are used: a single catheter for i.a. or i.v. implantation and a double catheter for combined arterial and venous implantations. For i.a. implantation, the catheter consists of a 60 cm piece of S-50-HL Tygon tubing (i.d. 0.8 mm; o.d. 2.4 mm) to which a strip of 1 x 5 cm PVC foil (thickness 0.3 mm) is glued with PVC glue (5% PVC in cyclohexanone) at 20 cm from the tip. Thus a flap of about 1 x 2 cm PVC foil is obtained on both sides of the catheter. For the external end of the catheter a PVC Luer type connector is glued in a 2 cm length of Tygon tubing (i.d. 2.4 mm; o.d. 0.4 mm) with PVC glue. This connector is fitted to the catheter at the end of the implantation procedure. For i.v. implantation, the strip of PVC foil is glued to a Tygon tube (i.d. 1.6 mm; o.d. 3.2 mm) of 70 cm length at 30 cm from the tip. The Luer connector for this catheter is also glued in a 2 cm length of Tygon tubing (i.d. 3.2 mm; o.d. 6.3 mm).

The catheter for a combined arterial and venous implantation, consists of a 60 cm piece of Tygon tubing (i.d. 0.8 mm; o.d. 2.4 mm) and a 70 cm piece of Tygon tubing (i.d. 1.6 mm; o.d. 3.2 mm), glued together over a distance of 5 cm at 35–40 cm from the external ends of the catheter. At a distance of 40 cm from the external ends, the catheter is fitted with a flap of 1 x 2 cm PVC foil on each side as described before. The Luer connectors for the external ends of the catheter are prepared as indicated above.

Catheters and connectors are sterilized using ethylene oxide.

Surgical Procedure. The following description holds for a combined arterial and venous implantation. After induction of general anaesthesia the dog is secured on the operating table, usually in left lateral position, and the implantation is performed on the right side. The right foreleg is stretched tailward to lower the clavicle and the neck is shaved from the clavicle headward over 15 cm. Under appropriate aseptic conditions a skin incision of 5 cm is made from the manubrium sterni along the border of the brachiocephalic muscle just lateral to the external jugular veins which is quite prominent in the described body position. The omocervical vein, which joins the external jugular vein posterolaterally, is exposed by blunt dissection to behind the brachiocephalic muscle just lateral to the external jugular vein, which is quite prominent in the described body position. The omocervical vein, which joins the external jugular vein posterolaterally, is exposed by blunt dissection to behind the brachiocephalic muscle. Parallel and just caudal to the vein, the omocervical artery is exposed by blunt dissection. After distal ligation of the omocervical vein with catgut, the venous channel of the catheter, filled with Angiografin, is inserted into the vein and guided into place under fluoroscopy with its tip in the pulmonary trunk and the flaps of PVC foil at the entrance site in the omocervical vein. If the catheter is too long, it is withdrawn and reinserted after appropriate shortening. When the catheter is in the desired position, the vessel is ligated around the catheter just tight enough to prevent bleeding. After
RESULTS AND DISCUSSION

The described double catheter for simultaneous arterial and venous sampling has been implanted in 9 mongrel dogs, weighing 20–30 kg. Three dogs, which had their catheters for the past 6 months, are still alive. The other dogs died from 5–11 months after the implantation. The catheter being still functional at the time of death. Three dogs died from intercurrent diseases (canine hepatitis, testis tumour), one was killed after an experiment and one because of old age. At autopsy no visible signs of damage to the vascular tree owing to the presence of the catheter were found.

Single arterial or venous catheters of the type described have been implanted in 5 dogs. Three dogs have died from intercurrent diseases (canine hepatitis) and 2 were killed after an experiment. The catheters, which had been in place for 4–11 months, were patent at the time of death. The post mortem findings were similar to those in dogs with double catheters.

The untroubled patency of the catheter and the absence of thrombophlebitis or sequelae of vascular embolism have to be attributed to the properties of the material used. Tygon tubing is flexible, smooth and chemically inert. The flexibility prevents direct mechanical damage to the intima of the vessels, while the characteristics of the wall of the tubing are such that thrombophlebitis or thrombus formation at the tip of the catheter do not occur.

The fact that catheter removal by the dog did not occur in our series can be attributed to 2 causes. Obviously the suturing of the catheter to the back of the brachiocephalic muscle is effective. With regard to a double catheter for arterial and venous sampling, the amount of tissue present between the arterial and venous channel of the catheter renders removal virtually impossible.

Verney and Vogt [10] have reported that unilateral complete occlusion of a common carotid artery results in an increase in mean blood pressure of more than 30 mm Hg by way of the pressor reflex. We have therefore chosen the omocervical vessels for the implantation of the catheter. These vessels are easily accessible and can be ligated without harm as they richly anastomose with surrounding vessels. When using the omocervical vessels for the implantation of catheters, blood flow through the common carotid artery and external jugular vein remains practically undisturbed.

The catheters are well tolerated both locally and generally and do not seem to hinder the dogs. They are used in various experiments but mainly in studies on electrolyte balance and extracellular fluid volume in intact conscious dogs. For rapid daily sampling of blood or prolonged continuous infusions in conscious dogs they have proved to be simple and reliable.

REFERENCES