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EXPERIMENTAL VASCULAR CATHETERIZATION IN DOGS

(With 2 Tables and 8 Figures)

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القسطرة التجريبية للأوعية الدموية في الكلاب

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تم زراعة قسطرة دائمة في كل من الوريد الوداجي والشريان الفخذى في الكلاب باستخدام قساطر مختلفة النوع والقطر ـ وفي نفس الوقت تم تغيير المحلول المستخدم في الغسيل اليومي لهذه القساطر . وقد تم متابعة وفحص هذه الأوعية الدموية لمعرفة مدى التغيير الذى يحدث في جدرها عند استخدام مثل هذه القساطر.

SUMMARY

Permanent vascular catheters were implanted into the jugular veins and femoral arteries using different types of catheters with different diameters and also the flushing solution used for daily washing of these catheters was different. The catheterized jugular veins and femoral arteries were tested daily for its patency and examined radiologically for recording the changes that may take place in the vascular wall.

INTRODUCTION

The increasing availability and awareness of the value of blood gas analysis, serial hematologic examination, electrolyte inbalance and direct arterial blood pressure monitoring call for effective techniques for long term vascular catheterization. Several types of catheters are available. BAKER et al. (1968) and DARIF and RUSH (1983) used a silicone rubber tubing to be implanted into the internal, external jugular vein, brachial and femoral veins of monkeys. Silastic catheters were used for venous catheterization in sheep (SNOW and TYNER, 1969), rabbit (BAZARAL and HAMBURGER, 1970) and pigs (WEIRICH et al., 1970 and WINGFIELD et al., 1974).

The use of polyethylene catheters for brachial, femoral, renal, uterine, carotid and splenic arterial catheterization were recorded by JACKSON et al. (1960); BUCH et al. (1965) and BROWN et al. (1985).

The aim of the present study is to choose the most suitable catheters used for permanent arterial and venous catheterization in dogs. It is also aimed to study the effect of flushing solution for washing the catheters on its patency as well as the vascular radiological changes accompanying its implantation.

MATERIAL and METHODS

The work was performed on 28 clinically healthy dogs of both sexes. The age of these animals were between 2-4 years and they were about 15-20 Kg. body weight. The animals were randomly assigned to 4 equal groups according to the type of the catheter used, its diameter and the type of flushing solution used (Table 1).

The animals were prepared for aseptic opertion and premedicated with intramuscular injection of chlorpromazine hydrochloride in a dose of 1 mg/Kg b.wt. General anaesthesia was induced by intravenous injection of thiopental sodium until the main reflexes are abolished and the animal become in a deep surgical stage.

Operative technique :

A skin incision 4-5 cm. long was performed over the jugular vein and by blunt dissection of the subcutaneous tissue, the vein was exposed. Two threads of 2/0 mersilk (Ethicon-L.T.D.U.K) were passed around the freed part of the jugular vein. The cranial part of the vein was ligated and its caudal part was elevated by mersilk thread. The venous catheter was filled with normal saline solution and passed through a small skin incision which had been made on the animal's back (between the dorsal margin of the two scapulae) towared the exposed jugular vein. Through a transverse incision in the wall of the vein, the catheter was inserted and pushed for a suficient distance caudally in the direction of the heart. The catheter was fixed by the caudal mersilk ligature.

A skin incision 3-4 cm. was performed over the femoral artery. The artery was dissected and freed from its surroundings for about 2-3 cm. Two thread ligatures of 2/0 mersilk were passed around the freed segment of the femoral artery to be catheterized. The distal silk ligature around the artery was ligated. With the use of a long hollow metal rod, 75 cm. long and 1 cm. diameter which was closed and pointed from one end and opened from the other end, the arterial catheter after its filling with normal saline was inserted within the lumen of this metal rod. The rod was pushed from the skin incision present on the animal's back and passed subcutaneously till the freed femoral artery. The metal rod was removed leaving the catheter tunneled subcutaneously. A transverse incision in the wall of the artery was performed. The catheter was inserted inside the lumen of the femoral artery and the proximal silk ligature was tightened firmly around the arterial wall to secure the catheter within the artery.

The subcutaneous tissue and skin incisions at jugular vein and femoral artery were closed as usual. The catheters were washed and flushed daily after aspiration of the staying mixture of blood and saline solution. The animals were examined for detection of any lameness in the pelvic limbs. Under the effect of chlorpromazine hydrochloride, the implanted catheters were examined radiologically. The X-ray

films were carried out by injection of a radiopaque material (Urografine 76%, schering AG, Berlin/ Bergkmen) 20 ml ampoule in each catheter. The X-ray apparatus was adjusted to work on 60 KV. and 12 MA.

RESULTS

Patency of the implanted catheters :

In the first group, the venous catheters remained patent for an average of 7 days while the arterial cathethers remained patent for an average of 4 days. The flushing solution in this group was normal saline. The same types of catheters were used in the second group but heparinized saline solution was used for flushing of the catheters. The venous and arterial catheters remained patent in this group of animals for an average of 20 and 10 days respectively.

In the third group, the venous catheters remained patent for an average of 8 days and the arterial ones for an average of 9 days. Saline solution was used for flushing of the catheters in this group. In the last group, the venous and arterial catheters remained patent for an average of 11 and 16 days respectively. In this group, the same types of catheters were used as in third group but the flushing solution was heparinized saline. The patency of the implanted catheters in each dog in the different groups are shown in table (2).

Angiographic picture :

The angiographic examination revealed the presence of some changes in the vascular wall of both jugular vein and femoral artery. Dilatation of the caudal part of the cranial vena cava (4th day) was observed (Figs. 1 & 2). Newly formed blood vessels were observed arising from the jugular vein on the 8th day postoperatively (Fig. 3). After two weeks, vascular anastomosis were observed around the jugular vein (Fig. 4). A radiolucent area (properly a thrombus) appeared in the cranial vena cava on the 24th post-operative day (Fig. 5).

The radiological views of the implanted femoral artery showed an increase in the size of the femoral and external iliac arteries with newly formed blood vessels arising from it after the 8th day post-operatively (Figs. 6 & 7). Rupture of silicone femoral catheter (which has a thin and weak wall) in one case was recorded during injection of the contrast media (Fig. 8).

DISCUSSION

Vascular catheterization can be used for monitoring of the blood pressure, multiple blood sampling, serial haematologic examination, pH & blood gases analysis, haematocrit and acid-base analysis. An indwelling intravenous catheter used to induce anaesthesia, administration of drugs that might cause local irritation and for administration of electrolytes, vitamins antibiotics as well as prolonged fluid therapy.

In agreement with BAZARAL and HAMBURGER (1970), WEIRICH et al. (1970) and RILEY and CRANAGE (1976), it was found that the use of silicone catheters to be implanted into the femoral arteries of dogs in this study had many advantages. This was due to the property of being very flexible, can resist high temperature and can be autoclaved with safety, in addition to minimal thrombogenicity. Silicone rubber catheter proved to remaine functional for a longer period of time (Table 2).

From available evidence we found that it was advantageous to flush the catheters with sterile physiological saline solution and then fill them with heparinized saline solution 1:1000 at 24 hours intervals after aspiration of the staying mixture of blood and heparinized saline solution present inside the catheters. This result closely agrees with that recorded by HAMILTON (1965) in which he first flushed the silicone rubber catheter implanted into the jugular veins and carotid artery of dogs with saline solution, and then the lumen of these catheters were filled with heparinized saline solution. However, finding of INDAR (1959) in which he stated that there was no need for using anticoagulants for flushing the catheters was quite different.

Concerning the catheter patency or duration of implantation, SNOW and TYNER (1969) stated that larger diameter cannulae remained patent for longer time if compared with small diameter cannulae. This finding contrasts the present result, in which the arterial catheter CH (6) used in group 3 & 4 remained patent for longer time if compared with the arterial catheters CH (8) used in gorup 1 & 2.

In the present study we observed that catheter pateney was dependant upon 3 main factors. First of them was the catheter type, we found that silicone catheters remained patent for longer period of time (15-21 days). The catheter diameter was very important in which the smaller diameter catheters remained patent for extended period of time (10-15 days) as compared with the larger diameter catheers (3-10 days). Also the flushing solution used has a great role in maintaining the catheter functional for longer periods. It was advisable to flush the catheters with sterile saline solution and then the catheters were filled with heparinized saline solution 1:1000 at 24 hours intervals.

The angiographic pictures obtained in the present study revealed the presence of some changes in both jugular vein and femoral artery. These results were in agreement with that reported by OLSON and ANVER (1979). On the other hand WITZEL et al. (1973) and HENDERSON et al. (1985) mentioned that lameness was observed after catheterization of the femoral artery as a results of impairment of circulation produced as a result of ligation of the vessel wall before the site of catheter insertion. These results are not in agreement with that obtained in our study because of newly formed blood vessels arised from jugular vein and femoral artery were clearly observed (Figs. 3, 4 & 7).

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LEGENDS

Fig. (1): Lateral radiagraphic view after 2 days post-operatively showed the catheterized jugular vein (1) and femoral arter (2) using a contrst. There was a dilation in th caudal part of the cranial vena cava (3) and vena azygus appears normal (4).

Fig. (2): Four post-operative days, the radiographic appearance revealed dilation of the vena cava (arrows).

Fig. (3): Newly formed blood vessels observed arised from the jugular vein (arrows) after 8 days post-operatively.

Fig. (4): The wall of the cranial vena cava was greatly changed (large arrow) and increased the vascular anastomosis around the jugular vein (small arrows) after 15 days from the operation.

Fig. (5): There was a radiolucent area in the cranial vena cava (arrow) observed at 24 days post-opertively.

Fig. (6): Catheter of the femoral artery using a contrast media (2), external iliac artery (3), deep femoral artery (4) and internal pudenal artery (5).

Fig. (7) The femoral artery was increased in size and new blood vessels were arised from it after 8 days from the operation (arrows). The abdominal aorta (6) appeared normal.

Fig. (8): Rupture of the femoral catheter and escape of the contrst media (arrow).

Table (1): Catheters and flushing solution used in different groups.

Group		Catheter used	Diameter	Flushing solution
I	A.	ERU plastic duodenal tube**	CH8	Normal saline
	V.	" " " "	CH10	" "
II	A.	" " " "	CH8	Heparinized saline
	V.	" " " "	CH10	" "
III	A.	XRO silicone gastroduodenal tube*	CH6	Normal saline
	V.	XRO gastroduodenal tube***	CH10	" "
IV	A.	XRO silicone gastroduodenaltube	CH6	Heparinized saline
	V.	XRO gastroduodenal tube	CH10	" "

A.: Arterial. V.: Venous.

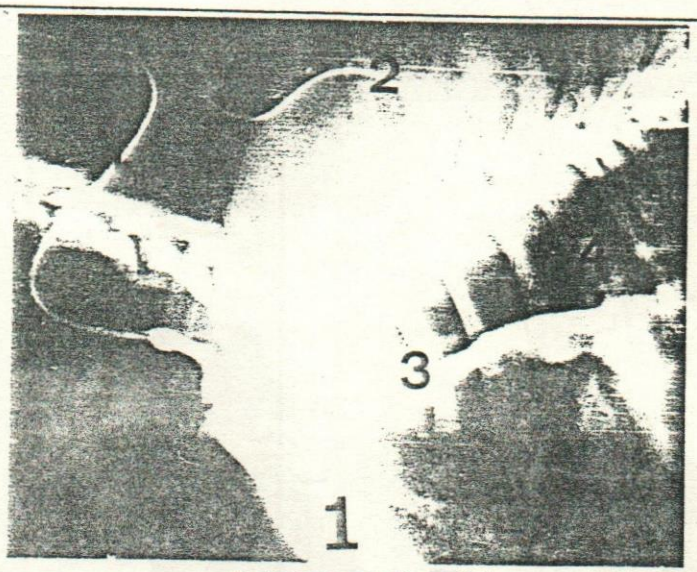
* Levin type, code 2391.06,VYGON, ECOUEN, France.

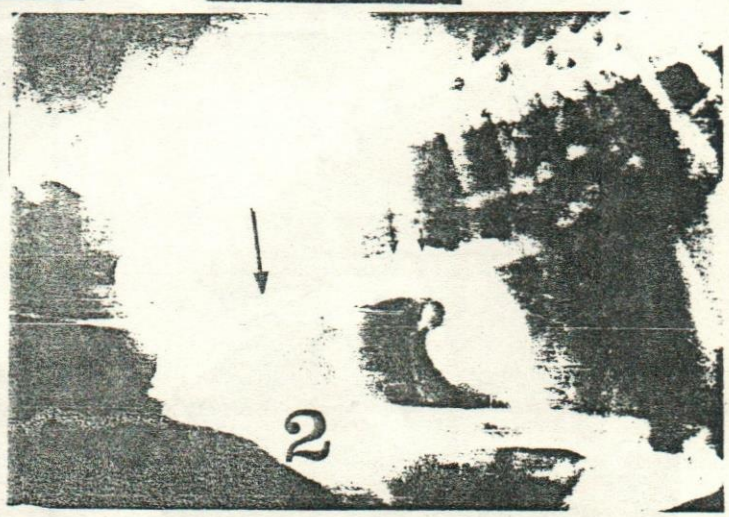
** Levin type No. 222300 Rusch, GmbH and Co.KG, W.Germany.

*** Levin type, code 391-06, VYGON, ECOUEN, France.

Table (2): Patency of arterial and venous catheters in the different groups (in days).

Animal number	Group I		Group II		Group III		Group IV	
	Arterial	venous	Arterial	venous	Arterial	venous	Arterial	venous
1	3	11	9	30	7	7	13	13
2	2	8	3	30	9	8	17	10
3	3	7	7	15	11	6	21	13
4	7	7	14	23	7	7	11	11
5	10	10	16	16	15	9	10	10
6	1	1	7	13	12	9	15	9
7	3	7	16	11	6	8	18	12
Average	4	10	10	20	9	8	16	11



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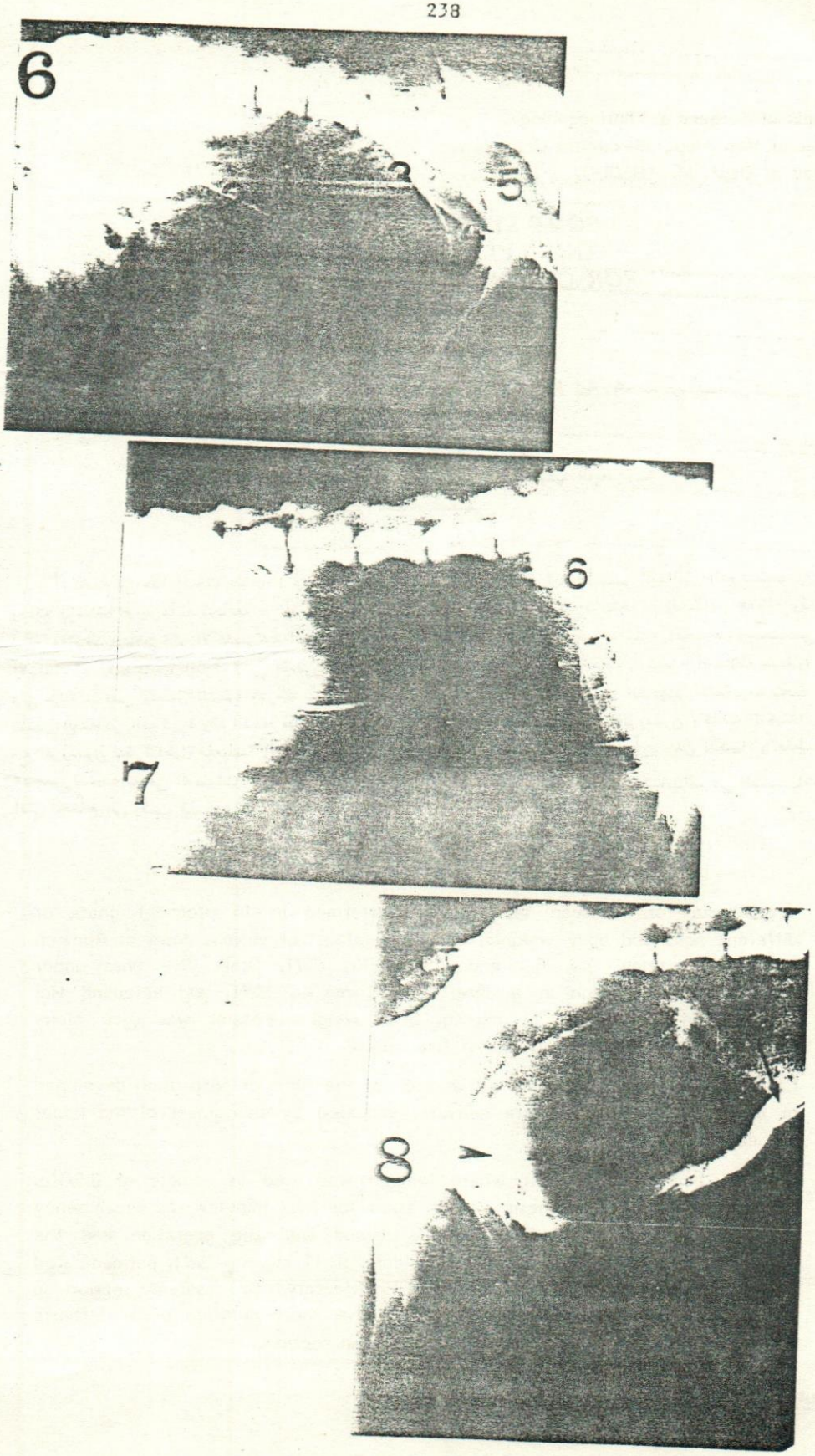
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