Original article

Surgical vascular access in the porcine model for long-term repeated blood sampling

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Abstract. A simple technique for implanting a long-term jugular catheter in piglets under general anesthesia is described. We report our experience in 10 young female pigs with a body weight of 20-30 Kg. The surgical procedure involves implantation of a jugular central venous catheter (11Fr polyurethane) tunneled in the subcutaneous fat layer of the neck. This procedure may be performed in about 15 minutes. The maintenance of the catheter is described which allows several daily blood samples to be taken. This procedure reduces both the stress in piglets and the chance of catheter dislodgement due to the animals scratching or rubbing. Blood sampling can be easily performed with a low incidence of infection or thrombosis. (www.actabiomedica.it)

Key words: Pig, vascular access, venous catheterization

Introduction

Blood samples and parenteral therapy give rise to execution problems in the porcine model because of animal size and lack of physical restraint (1). In addition, superficial veins lying below an extensive fat layer are extremely fragile, making it difficult to locate them (2).

Different anatomical regions (Tab. 1) where blood samples can be drawn, have been previously described (3). These regions are exploitable when it is necessary to draw moderate or single blood samples, since the venous-puncture induces a spasm which subsequently collapses the vein (especially in piglets) (4). At the same time, the stress induced by an aspiration syringe may give a complete collapse of the venous wall and consequently stops blood flow. Under these circumstances it is better to administer a dripping technique (magna auricular vein). Phlebitis arises during parenteral therapies especially for long-term therapies or hypertonic solutions. In these cases, assuming the necessity of physical restraint, veins are easily damaged by chemical phlebitis (5) and may cause pain to the animal (6).

Table 1. Anatomical regions for sampling in pigs

Presternal and abdominal region
Mammary Vein
Jugular fossa
External Jugular Vein
Orbital Area
Venous Orbital Sinus
Shoulder tip end Area
Accessory Cephalic Vein
Auricle
Auricular magna Vein
Internal side hough
Medial saphenous vein

Therefore, we considered the necessity of collecting multiple blood samples repeatedly in a short time (7, 8) guaranteeing animal safety, and improving qualitative and quantitative analyses in laboratories (9, 10). We also took into account the possibility of

setting total parenteral therapy with hypertonic solutions (9). For the reason mentioned above, we tested a new surgical vascular access technique.

Material and methods

Interventions were carried out on 10 young *Landrace* sows weighing from 20 to 30 Kg. Food was withheld for 24 hours and water for 8 hours before the operation. During transport from the farm to the animal breeding department each piglet was placed in a cage (60 cm wide, 130 cm long, and 50 cm high) and acclimatized to its new surroundings. It is essential to reduce animal stress due to physical restraint or excitement through premedication with ketamine 6 mg/Kg, droperidol 0,02 mg/Kg and Fentanyl Citrate 0,004 mg/Kg. All drugs were given intramuscularly through an 18G needle-catheter. Upon arrival to the animal breeding department, ketamine 15 mg/Kg was administered in order to sooth animal. The animal was then placed on the operating table in a dorsal recumbent position and after opportune limb fixation, an intravenous anesthetic premedication of 3mg/Kg of ketamine, 0,01 mg/Kg of droperidol and saline or glucosate liquid infusion was administered: this was performed through venous flexible catheter 22G in the magna auricular vein. Anesthesia was induced with Sulfate Thiopental with a dose ranging from 2,5 mg/Kg to 5 mg/Kg and muscle relaxation was obtained with pancuronium bromide 0,125 mg/Kg. Anesthesia was maintained using a thiopental sulfate drip, fentanyl intravenous 0,008 mg/Kg and curare 0,04 mg/Kg.

A sterile operative field around the cervical region (usually on the right side) was created, and the thick layer of subcutaneous fat tissue was incised using electrosurgery lancet. Such incisions should be performed close to the lateral margin of the platysma muscle at the intersection with the interscapular-clavicular muscle, proceeding 5 cm in a caudal direction. When the primary fascial plane is reached it is better to open the peaucier muscle medially. This dissection can allow the exposure of the internal jugular vein with an average diameter of 5 to 8 mm. Using blunt dissection (11) the vein was loaded with two non-absorbable ligatures (silk 2-0). The vein was incised with vascular scissors, and a polyurethane central venous catheter 11F was introduced for a length of 10 cm max and the ability of aspiration and injection was controlled through a syringe. We then tied the upper ligature and the caudal one was used to fix catheter to the vein. The catheter was "tunneled" into subcutaneous tissue from the cranial apex of the insertion to the posterior region of the auricle where it was externalized (Fig. 1). The same catheter was fixed to the skin, through non absorbable suture (silk 0). The surgical incision was repaired using interrupted absorbable stitches.

Use and maintenance of access: the intravenous catheter in the internal jugular may be used immediately after insertion for the administration of liquids and drugs. It is possible to administer hypertonic and/or normal solutions with high flow (up to 500 cc/min), high dosages of drugs and blood (12).

If the catheter is no longer necessary for parenteral feeding, it may be closed by introducing 0,5 cc of heparin and protected by medication (13, 14). In the case of blood sampling some precautions should be taken: the first 5 cc of blood should be withdrawn and discarded prior to taking the required sample blood.

After sampling blood, heparin must be injected into the small tube, and the stop cock should be closed. Such interventions may be carried out by a single person with the animal held in a standing position (15): this appears to be painless and requires no sedation or anesthesia for the pig.

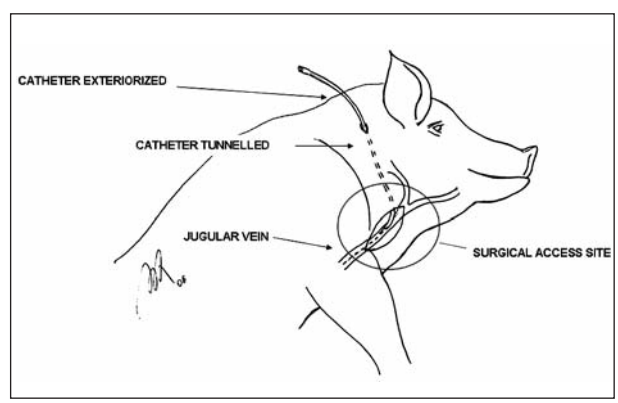

Figure 1. A picture that shows venous catheterization in pig.

Results

We showed no complications during the surgical operation. This vascular access may be used for the entire period of experimentation if meticulous precautions are used and its maintenance is respected. This procedure allowed repeated blood sampling over several weeks and did not pose any major difficulties or problems. Catheters continued to be functional without infections or dislodgment.

Conclusions

This procedure appears technically easy to perform and doesn't require ultrasound guidance (16). The average time for preparing the access was less than 15 minutes. This kind of access allowed the collection of several blood samples shortly after the intervention. The necessity of animal restraint was reduced and stress for animal was also consequently reduced. Further advantages include the fact that the procedure may be carried out by a single person and also a high reliability and quality of laboratory analyses. Considering that the catheter is posterior to the auricle, the animal cannot damage the access functionality (scratching, rubbing), but only a poor usage or incorrect maintenance from the operators may interfere with its proper function (thrombosis, infection). Therefore this access must be considered an improvement for medium or long term treatment during experimentation in the pig or other medium or large sized animals.

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