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BRIEF COMMUNICATION

Subcutaneous Splicing of Intravenous and Intragastric Catheters[1]

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LUKAS, S. E. *Subcutaneous splicing of intravenous and intragastric catheters.* PHARMACOL BIOCHEM BEHAV **18**(2) 267–268, 1983.—A method is described for repairing silicone catheters that have been severed due to excess force by the animal or tension within the restraint system. The technique is particularly useful when the break in the catheter occurs under the skin. The entire repair process takes less than 20 minutes and can be performed under light anesthesia. This technique would be of benefit primarily in intravenous drug self-administration studies, but procedures employing chronic catheterization (e.g., intragastric, intraperitoneal) could also use this method.

Intravenous catheter Intragastric catheter Drug self-administration Primates Baboons

NUMEROUS pharmacologic, behavioral, and physiologic studies depend upon a chronically implanted catheter for the delivery of drugs or the withdrawing of blood. Silicone (e.g., Silastic®) elastomer medical grade tubing has become a popular catheter material because of its low tissue reactivity [8], maximal flexibility, and negligable propensity to kink [1,9]. Although silicone tubing is relatively strong, the small sizes (1.19–2.36 mm o.d.) used for intravenous catheters will snap when sufficient force is applied by the experimental subject. This is particularly true in drug self-administration studies employing monkeys as subjects. The subjects occasionally grab the catheter at the exit site (usually in the mid-scapular region) and pull until it breaks. If the catheter was anchored securely, the break will occur subcutaneously. Venous catheters that break under the skin do not typically present a great problem to the animal (e.g., excessive blood loss) since most intravenous catheters develop a clot at the tip. If, however, the catheter was in the stomach, gastric fluid could very easily leak out under the skin and cause great discomfort and infection.

The present report describes a procedure for repairing such breaks in silicone tubing using a stainless steel splice. In addition to being a relatively quick and simple procedure, the concept can be applied to most types of catheters.

METHOD

Subjects

Catheter repairs were performed on seven male dog-faced baboons (*Papio anubis*) weighing 19–31 kg that were subjects in intravenous and intragastric drug administration or self-administration studies [3–6]. Each animal was adapted to either a chair restraint [2] or harness/tether restraint [7] and housed individually in sound-attenuating chambers. A full description of the procedure and the construction of the intravenous and intragastric catheters has been previously reported [7].

Stainless Steel Splice Construction

Stainless steel hypodermic tubing (Small Parts, Miami, FL) of the desired gauge was cut to 2.5 cm lengths and mounted horizontally in a small vise. A drop of stainless-steel solder flux was applied (a 25 gauge needle on a syringe facilitates the accurate placement of the flux) 5 mm from the end. A small drop of stainless steel solder was then applied until a donut shaped blob (about 3 mm total diameter) is achieved. After it cools, the procedure is repeated on the other end of the splice (Fig. 1). The splice can then be either steam or chemically (e.g., benzalkonium chloride) sterilized.

Surgical Implantation of Catheter Splices

Animals were initially immobilized with ketamine hydrochloride (Ketaset®) at a dose of 5.0 mg/kg, IM. Salivation was minimized by administering atropine sulfate (0.05 mg/kg, IM). Subsequent doses of ketamine (2.0 mg/kg, IM) were given to maintain anesthesia for the duration of the procedure (about 20 minutes).

After locating the distal end of the section of the catheter remaining under the skin, a 10 cm diameter area around it was shaved and then scrubbed with a povidone-iodine solution (Surgi-dyne®). A 2–3 cm incision was made parallel to

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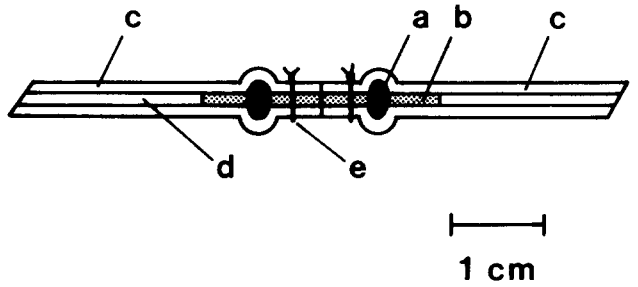

FIG. 1. Details of the stainless steel catheter splice. The stainless steel solder (a) encircles the hypodermic tubing (shaded, b). The silicone tubing (c) is inserted over the solder such that the silicone tubing lumen (d) fits directly over the splice. Silk ties (e) are used to firmly anchor the silicone tubing.

the subcutaneous path of the catheter at a point 2–3 cm proximal to the end of the severed catheter. The catheter and its track (fibrous tissue that surrounds the catheter) were exteriorized by blunt dissection. A small wedge was carefully cut out of the fibrous catheter track, and the free end of the catheter was pulled out of the track. A pair of hemostats were placed under the track to support it during the next phase of the procedure. The stainless steel splice was inserted into a piece of sterilized silicone tubing (Fig. 1) and anchored with 3-0 silk. The silicone tubing/splice assembly was then filled with physiologic saline and then similarly attached to the distal end of the catheter. The spliced catheter was then guided subcutaneously using a silver probe to exit through the skin of the animal's back. If desired, the original exit site can be used by inserting the probe back into the catheter tract. While the latter is usually easier to perform, the use of the original exit site is contraindicated when it or the tract is infected. The subcutaneous tissue and skin were sutured with 3-0 Dexon® and 3-0 Proline®, respectively.

RESULTS AND DISCUSSION

The present technique has been used successfully to splice 6 intravenous and 2 intragastric catheters in baboons. Animals rapidly recovered from the procedure, and in many cases, continued in the current drug self-administration study essentially uninterrupted. In addition, all animals tolerated the subcutaneous splice very well and did not scratch or pick at the site of implantation; swelling and inflammation were only rarely observed and quickly subsided.

All intravenous catheter splices have remained functional since implantation (1–9 months); one splice had been functional for 2 months at which time the animal was removed from the study for reasons unrelated to the catheter splice. One of the five animals with an intravenous catheter splice has undergone the procedure twice. Two days after the first implantation the animal broke the catheter again. The break, however, was located 2 cm proximal to the splice which was still intact and functional. Both intragastric catheter splices have been functional for 2 and 3 months, respectively.

Although this procedure has been successfully employed to splice intra-arterial catheters in two animals, this was possible only because the break in the catheter was discovered about 5 min after it occurred. Since polyvinyl chloride tubing is typically used for intra-arterial catheters it is necessary to heat the tubing in order to insert the splice past the solder.

In conclusion, the present splicing technique can be used to salvage broken catheters even when the break occurs subcutaneously. In addition, this technique can be used to reroute a subcutaneous catheter when the exit site has become infected and does not respond to conventional treatment. Finally, the flexibility and duration of pharmacological, behavioral or physiological studies which require intravenous or intragastric catheters can be markedly enhanced or increased with the application of catheter splicing techniques.

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