USE OF CRYOPRESERVED RAT ARTERIES FOR MICROSURGICAL TRAINING

NATALIA R. LAUSADA, V.D.,* E. ESCUDERO, M.D., R. LAMONEGA, M.D., E. DREIZZEN, M.D., D.Sc., and J.C. RAIMONDI, M.D.

Silastic tubes are used as training material for performing microvascular anastomoses. However, silastic texture differs from that of actual blood vessels. In the present work, we evaluate the use of preserved rat arterial segments for training in microvascular anastomoses. One-centimeter-long rat arterial segments were obtained from femoral, carotid, and abdominal arteries, preserved in cold saline solution, and frozen. Trainees performed microvascular anastomoses using the aforementioned material and answered questions about texture, consistency, and wall resistence to the needle, comparing preserved arterial wall and silastic tubes. They were also asked whether the arterial pedicles had a consistency and texture similar to normal vessels, and if they were a more reliable method for practicing microsurgery techniques than synthetic materials. They preferred frozen arterial pedicles over silastic tubes. We conclude that arterial cadaveric segments are a suitable biologic material for microsurgical training. Since they can be obtained from other experiments, this is an effective way to reduce the number of animals bred and sacrificed for teaching purposes. © 2005 Wiley-Liss, Inc. Microsurgery 25:500–501, 2005.

Microsurgical techniques are taught worldwide through microsurgical courses that are similar in their context and steps.[1–5] During the training course, the surgeon acquires control of his/her hands and gets used to magnification, instruments, and sutures. The initial practice usually starts with instrument handling and knot-tying practice, using surgical gauze. Then, the trainees use silastic tubes, 2 and 0.6 mm wide, to perform end-to-end and end-to-side anastomoses with 9-0 and 10-0 nylon monofilament sutures. They subsequently practice microvascular venous and arterial anastomoses in small laboratory rodents.[1,2,4–8] In the present work, we tested the value of using preserved frozen rat arterial segments as training material for teaching microvascular surgical techniques.

MATERIALS AND METHODS

Cadaveric arterial pedicles from adult male Wistar rats were used, i.e., carotid and femoral arteries and abdominal aortas from the origin of the renal vessels to the iliac bifurcation. Vascular pedicles were preserved in saline solution at −20°C in Eppendorf tubes. Each 1-cm-long pedicle was attached to a cork board with a 27-gauge needle in each corner. All animal experiments were performed according to guidelines set by the National Institutes of Health (NIH publication no. 86-23, revised 1985).

Course Development

The course consisted of 10 sessions, each approximately 4 h long. Sessions included hands-on demonstration practice under magnification, and video presentations. The initial sessions consisted of an introduction to microsurgery and laboratory procedures; laboratory rat health monitoring, handling, and basic injecting techniques; drug dose calculations; rodent anesthesia; preoperative management; and postoperative care. These lessons were complemented with practice with 9-0 nylon monofilament sutures on either 1-mm-wide silastic tubes or frozen arterial segments of rat. Different techniques, such as end-to-end, end-to-side, and side-to-side anastomoses between vessels with different diameters, were performed. At the end of the activity, the vessels were cut through so that the vascular anastomosis could be viewed from the inside. The time taken on each procedure was measured. Surgeons were asked whether these arterial pedicles had a consistency and texture similar to those of a normal vessel, and if they provided a more reliable method to practice microsurgery techniques than synthetic materials. Once the surgeons were able to perform a vascular anastomosis in less than 40 min, they started working with a living rat model. In the last steps, special emphasis on venous anastomoses was taken.

RESULTS

Twenty surgeons of different specialties were trained in microsurgery during 2001–2003: five general surgeons, four vascular surgeons, three orthopedic surgeons, three plastic surgeons, two ophthalmologic surgeons, two gynecologists, and one neurosurgeon.

One-centimeter-long arterial segments were supplied to the trainees in order to perform the procedures. The

Laboratorio de Trasplante de Organos, Facultad de Ciencias Médicas, Universidad Nacional de La Plata, La Plata, Buenos Aires, Argentina

*Correspondence to: Natalia Lausada, Laboratorio de Trasplante de Organos, Facultad de Ciencias Médicas, Universidad Nacional de La Plata, Calle 60 y 120, La Plata 1900, Buenos Aires, Argentina. E-mail: nlausada@atlas.med.unlp.edu.ar

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infrarenal aorta, which has a diameter of about 1.5–2.0 mm, is an excellent material to work with under 4× magnification (loupes). Carotids 0.8–1.2 mm wide and femoral arteries 0.9–0.6 mm wide were anastomosed under surgical microscope magnification. Anastomoses were performed with 8–9/0 sutures with either continuous or interrupted sutures. The material did not rip, and very closely mimicked living tissue's resistance to the needle. We obtained a 100% (n = 20) favorable opinion about the material. At the end of the course, 80% (n = 16) of trainees were able to perform both artery and venous anastomoses. Four surgeons did not achieve the neccesary skills to perform a venous anastomosis, which was the most difficult procedure to learn.

DISCUSSION AND CONCLUSIONS

In the last decade, authors have taught microsurgery through didactic models in which different materials are used during the firsts lessons, e.g., surgical gloves,[5,9] PVC rat,[10] surgical gauze,[11] and silastic tubes.[3,8] However, none of these models is a real match for actual vessels, since they are different in terms of softness and resistance to the needle. Cold-preserved cadaveric rat artery is a low-cost material that can be obtained from any healthy small laboratory rodent which has been sacrificed for other research purpose. Pieptu and Luchian[12] described the importance of loupes-only microsurgery in free flaps for vessels more than 1.5 mm wide such as the latissimus, serratus, (para)scapular, fibula, radial forearm, rectus abdominis, dorsal penis, omentum, and jejunum. Preserved abdominal aorta is an excellent material for performing microsurgery under loupes. The new trends to reduce and refine the number of living models in research induced us to use cadaveric rat vessels. Fanua et al.[13] reported that the trainee usually needs to work with approximately eight rats to become familiar with basic microsurgery techniques. We do not deny the importance of living models, but we believe that small healthy rodents sacrificed for research purposes could provide excellent material for practicing microsurgery techniques for the novice surgeon, instead of animals specially bred for that purpose. Other authors described training systems that involved the passage from practice with synthetic materials to practice with cadavers, such as chicken wing arteries[14] and preserved canine arterial segments.[6,15] Cold-preserved cadaveric rat arteries have several advantages: they are cheap, convenient to manage, and easy to obtain, and neither specific facilities to maintain living animals nor anesthesia is needed. This alternative training model is useful not only for young surgeons wishing to learn microsurgical techniques, but also for more experienced surgeons who need to maintain or improve their skills.

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