The Human Umbilical Cord: a Model for Microsurgical Training

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Abstract Microsurgery continues to be a fundamental technique in many surgical subspecialties. In the past, many models have been utilized for microsurgery training. We are proposing the human umbilical cord as a training model, which is cheap, available and practical. This model can be used both for junior trainees to achieve good microsurgical skills before operating on human being and it can also help surgeons to maintain their skills.

Keywords Human · Umbilical · Cord · Microsurgery · Training

Dear Sir,

Microsurgery is an important surgical field and microsurgery training continues to be fundamental in many surgical subspecialties. For over a century, many models were suggested for microsurgical training. This is including organic and inorganic models and viable and non-viable tissue. We are presenting a novel model that can be useful in training of residents and juniors on microsurgery skills and also help surgeons to maintain their skills.

The umbilical cord is a lifeline between the fetus and the placenta and contains two arteries and one vein (Fig. 1). The vessels lie in a supporting myxomatous tissue derived from the mesoderm, the “Wharton’s Jelly”. In the plastic surgery department at Cairo University Hospital, we utilized the umbilical cord as a microsurgery-training model after acquiring a written

consent from the mothers. The umbilical cord was brought from the obstetric unit and harvested, under strong restrictions regarding HIV, Hepatitis viruses and other pathological infections to prevent infection transmission.

The umbilical cord was prepared by washing with saline and milking to evacuate it from any residual blood. This is followed by dissection of the vessel (Fig. 2) starting from the cord’s end to overcome the difficulty faced by the presence of the white supporting myxomatous tissue “Wharton’s jelly”. There were no significant difference in the dissection of the artery and the vein. 1.7 mm was the diameter of the vessels. Anastomosis was done using end-to-end (Fig. 3) and end-to-side (Fig. 4). Testing of patency was done after each anastomosis by two methods: injection of methylene blue (Figs. 3 and 4) and performing a longitudinal incision along the site of anastomosis to visualize the suture line. Injection of methylene blue has resulted in major leakage in some anastomoses as in Fig. 4, which needed additional secure suture. Performing a longitudinal cut in the anastomosis was done as an additional test for patency and to exclude transfixation of the anterior and posterior walls by sutures.

The placenta was previously used for microsurgery training and was described by Goldstein [1] in 1979 but the umbilical cord was not described before in the literature as a model for microsurgery training. The human umbilical cord as a model for microsurgery training resembles the clinical situation in the presence of a three-dimensional lumen, which gives the chance for learning all microsurgery skills. Although gauze [2] and microsurgical training card [3] are practical and economical tools, yet they differ from our model in that they lack the resemblance of human vessels. Our model differs from polyurethane vessels [4] in that they are

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Fig. 1 A cross section of an umbilical cord showing 2 arteries and 1 vein

easily afforded by all students and are available in all obstetric units. It is also surrounded by Wharton's jelly which makes it more resistant to dryness and dissection can be postponed for few hours. If compared with animal models, it has the advantage that there is no need for anaesthesia or an animal lab. Patency can be easily tested by methylene blue injection or by performing a longitudinal slit across the suture line (Fig. 4).

In clinical practice dissection of the vessels and preparation is an essential part of microvascular anastomosis and this is a clear disadvantage of this model. Another disadvantage is the lack of active blood flow and the lack of the opportunity to address certain anastomotic problems, such as thrombosis. However this cheap, model offers the trainee the opportunity of handling

Fig. 2 An umbilical cord with a dissected artery

Fig. 3 An umbilical cord with an end-to-end anastomosis. The figure also shows methylene blue injected to examine both the patency and leakage at the site of anastomosis

human body vessels and if their supply is not a problem, it is a reasonable method.

Although it is an ethical requirement to obtain a written consent from the mother before using the umbilical cord, it can be a useful model in initial training of residents and juniors on microsurgical techniques of Handling of microsurgical instruments, Microdissection, cutting and preparing vessel ends, suturing and tying knots and anastomosis techniques. As any other surgical skills, microsurgery needs maintenance. With the economical problems and the lack of space in many hospitals the umbilical cord can be a good solution.

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Fig. 4 An end-to-side anastomosis showing leakage at the site of anastomosis when injecting methylene blue dye

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