PORCINE MODEL AND ONCOPLASTIC TRAINING: RESULTS AND REFLECTIONS

Modelo porcino e formação oncoplástica: resultados e reflexões

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The breast cancer surgery needs a specific formation in oncoplastic and reconstructive procedures that enable the mastologist to train it before its performance in humans[1-4]. This formation needs a training model whose anatomic and technical bases are similar to those of humans, for reproducing the most complex surgical procedures step by step. The porcine model is an option for this formative need due to its anatomic similarity with human beings, manageability of young models and provided cost[4]. Thus, its use has facilitated the formation in different scopes of the digestive, cardiovascular and organ transplant surgeries. However, the proposal of a training based on animal model needs a critical analysis of its anatomical agreement with human beings, its economical and ethical viability, and its assessment by students. I will try to discuss these aspects in this editorial based on my experience in training surgeons and mastologists for the last 15 years in Spain and Latin America, to analyze what has been the contribution of the porcine model in the acquisition of technical skills and their use in the clinical practice. Thus, I will discuss the ethical conflicts that arise from the use of non-human animals in the surgical training to analyze their justification and future alternatives.

EVOLUTION OF THE SURGICAL FORMATION IN MASTOLOGY

The classical model for the mastologist formation in breast cancer surgery has been based on the theoretical description and on the analysis of surgical interventions. Thus, the first editions of our course during the years of 2004–2008 included the combination of theoretical classes and live surgery. Live surgery was cut after the fourth edition ended due to three reasons. On one side, its high time consumption required the simultaneous combination of two operating rooms or the inclusion of theoretical classes during the intervention with the aim of optimizing the teaching journey. This fact resulted in a second consequence that was the technical complexity regarding two live surgeries and the coordination of simultaneous activity to them. Finally, the availability of videos specific to each surgical technique that enabled the inclusion of all technical steps in an analysis of 10–15 minutes decreased the need of live surgery. In our experience, this last fact caused the end of live surgery in our courses and enabled each student to be provided with videos of the main technical procedures to be used in the hospital. Recently, these videos are available online whether through the *YouTube* channel or through the *Oncoplastic* App, or even through the *Moodle* platform of the course, which has enabled to generalize its teaching goal to beyond the course. It can be used by residents or any specialist requiring this piece of information. However, even though the theoretical classes and this multimedia support have improved the mastologist formation, a hands-on training was still required for more complex technical procedures, such as the myocutaneous flaps. In 2012, we conducted the first practical workshop for dissecting flaps of the latissimus dorsi muscle and TRAM in the porcine model after evaluating its anatomical and technical viability as a training model during the year of 2011. The students' positive assessment of this first initiative encouraged us to include it as another model in the training program of our courses in Spain and Latin America.

THE PORCINE MODEL

The use of pigs as a training model for the latissimus dorsi muscle flap is based on the studies of Millican and Poole[5], who described the anatomy in this animal and its comparison with human beings in 1985. We have recently published our experience of using the porcine model to expose its anatomical description and the students' assessment after its use[6]. The main potential of this model was its similarity

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to human beings. Thus, the structure of the latissimus dorsi muscle in pigs is similar to that in humans regarding its situation and anatomical relation. The surgical dissection allows to release the muscle surface and define the muscle limits in comparison with the other muscles. Like in humans, dissection in the medial direction enables trapezius identification, flap separation from the thoracic wall, and visualization of the intercostal perforators. Students have highlighted these similarities to humans in different technical aspects, including mobilization of the muscle from the thorax, section of the lumbar perforators, identification of the thoracodorsal pedicle, and section of the muscle tendon. Nevertheless, they highlighted a larger difficult of the porcine model for identifying the muscle anatomical limits, especially its medial border, and the paleness of the muscle fibers that limited its dissection.

In the TRAM flap, the muscle anatomical structure in the pig is similar to that of humans, except in an anatomical variant of this animal: presence of the major oblique muscle as the first abdomen muscle plane. Once the muscular body is released, its section continues below the cutaneous island flap and the ligation of the epigastric vessels. After this maneuver, the flap can be mobilized in the cephalic direction, such as carried out by humans. Students highlighted its similarity with human models regarding the dissection and release of the rectus capitis anterior muscle, as well as its mobilization to the receptor area. However, they highlighted poorer porcine model adherence of the cutaneous island to the aponeurosis of the rectus capitis anterior and higher fragility of the peritoneum in the muscle posterior sheath. Most of the students considered the TRAM technique more affordable in this model in comparison with the dorsal muscle flap.

The practical workshop cost was higher in Spain ($ 335/student) than in Mexico ($ 130/student), which indicates that the type of facility and the economic level of the country have a significant impact on the final budget.

ETHICAL CONFLICT

There is currently an increasing controversy in our society on the use of animals for medical experiments and, especially, on the vivisection for the surgical training of surgeons. This ethical conflict became known during the XX century because of three points. The first one is that the society is aware that non-human animals share the sensitivity to pain and capacity of suffering with our species, which means breaking the non-harming principle during the investigation. The second argument is based on the moral value of non-human animals, in such a way that the more valuable the animal as an experiment model, the higher consideration it deserves. Finally, our societies have become more sensible to animal suffering during the surgical investigation or training, mainly in unnecessary experiments and in those without justification. In the other extreme, we find arguments that support the advantageous principle of animal

experiments and have been the basis of medical progress during the XX century, which will be fundamental to improve the treatment of Alzheimer, AIDS and great part of cancerous diseases in the future. In addition, we need models to perform complex procedures in the animal before they are conducted in humans. How can we solve this ethical conflict by facilitating our formation as mastologists and at the same time respecting the other non-human animal species? In my opinion, the solution to this ethical conflict should be based on the recommendations that W. Russel and R. Burch[7] wrote in 1959 regarding a responsible attitude on how scientists should perform animal experiments. These authors propose three working paths (the 3Rs) to alleviate this ethical conflict: *refinement, reduction, and replacement. Refinement* consists in finding a methodology that enables surgical training in the most favorable conditions for the animal and, thus, decreasing its awareness of suffering and pain. To do so, we need to conduct these formation programs in institutions (University, Training Centers) that guarantee the use of analgesics, anxiolytic substances, and anesthesia that enable minimal suffering and pain for these animals. This refinement should be simultaneously moved to the training model for obtaining a better mastologist's formation. The *reduction* consists in decreasing as much as necessary the amount of animals for training. Our model aims to optimize each animal at most for performing the highest amount of oncoplastic and reconstructive procedures by the highest possible number of students. Our model allows the participation of two students for the performance of four flaps and several oncoplastic procedures, thus decreasing the need of other animals to complete the formation. The *replacement* consists in replacing, whenever it is possible, the experiment in live beings by any other method that do not require animals. There are currently alternatives to surgical training based on the use of virtual techniques (simulators) or anatomical pieces with new materials that, as the breast surgery simulator[8], facilitate the *in vitro* dissection. We are currently without simulators or synthetic anatomical pieces that would enable to offer a surgical formation to our mastologists, but as soon as this technology is available, we have the ethical obligation of suspending our training in animals and replacing it by these new alternatives.

Our experience enables to conclude that the porcine model is appropriate for surgical training in latissimus dorsi and TRAM flap thanks to its anatomical similarity to humans. The model allows reproducing most of the technical steps in both flaps, which grants the training capacity before its performance in humans. This is a sustainable model because the exploitation of an animal by two mastologists and the joined performance of flaps and local procedures, especially those associated with the nipple-areolar complex, enables a model with a good cost-benefit relation for surgical training. Finally, I believe this option should be a transition until we find a new model that allows the mastologist training without using animals.

REFERENCES

1. Cardoso MJ, Macmillan RD, Merck B, Munhoz AM, Rainsbury R. Training in oncoplastic surgery: an international consensus. The 7th Portuguese Senology Congress, Vilamoura, 2009. Breast. 2010;19(6):538-40. https://doi.org/10.1016/j.breast.2010.03.030

2. Yunaev M1, Hingston G. Oncoplastic breast surgery: a regional Australian 2012 fellowship experience. ANZ J Surg. 2013;83(9):624-9. https://doi.org/10.1111/ans.12318

3. Zucca Matthes AG, Viera RA, Michelli RA, Ribeiro GH, Bailão A Jr., Haikel RL, et al. The development of an Oncoplastic Training Center - OTC. Int J Surg. 2012;10(5):265-9. https://doi.org/10.1016/j.ijsu.2012.03.009

4. Bodin F, Diana M, Koutsomanis A, Robert E, Marescaux J, Bruant-Rodier C. Porcine model for free-flap breast reconstruction training. J Plast Reconstr Aesthet Surg. 2015;68(10):1402-9. https://doi.org/10.1016/j.bjps.2015.06.006

5. Millican P, Poole D. A pig model for investigation of muscle and myucutaneous flaps. Br J Surg. 1985;38:364-8.

6. Acea Nebril B, García Novoa A, Bouzón Alejandro A, Centeno Cortes A. Porcine model for training in oncoplastic breast surgery technical. Description and results of its application in a training course in oncoplastic and reconstructive techniques in breast surgery. J Plast Reconstr Aesthet Surg. 2019;72(6):1030-48. https://doi.org/10.1016/j.bjps.2018.12.049

7. Russell W, Burch R. The Principles of Humane Experimental Technique. United Kingdom: Universities Federation for Animal Welfare; 1959.

8. Zucca-Matthes G, Lebovic G, Lyra M. Mastotrainer new version: realistic simulator for training in breast surgery. Breast. 2017;31:82-4. https://doi.org/10.1016/j.breast.2016.08.009