MINIMAL INVASIVE AXILLARY LYMPHADENECTOMY: EXPERIMENTAL MODEL IN PIGS

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INTRODUCTION

Breast cancer remains an important health issue, showing an increased incidence since of 32% compared with 1990 data, mostly due to effective cancer control effort such as mammography.¹ This has lead to an increase in early stage disease, most of which will face breast-conserving surgery (lumpectomy), mastectomy or lymph node dissection. Modern surgical procedures for breast cancer aim at maintaining a high esthetic aspect of the surgical site, if possible with breast preservation, thus employing minimally invasive surgical techniques to achieve this goal.²-⁵ One drawback of this approach though is axillary dissection, because classical axillary dissection transforms a minimally invasive surgery into major regional surgery, due to the need for extensive lymphadenectomy.⁶-⁸ So surgeons would either ignore this step of surgical procedure or the axillary nodes would be treated by non-surgical methods:

One drawback of this approach though is axillary dissection, because classical axillary dissection transforms a minimally invasive surgery into major regional surgery, due to the need for extensive lymphadenectomy.⁶-⁸ So surgeons would either ignore this step of surgical procedure or the axillary nodes would be treated by non-surgical methods:

Material and methods: Five pigs weighing 30-35 kg were used. Standard laparoscopic equipment was employed. A 10mm incision of the mid-axillary line coupled with a 12mm trocar was used to provide access for the 10mm endoscope at 30°. CO₂ was insufflated through the trocar to create a working chamber. Mostly blunt dissection was performed, using a colorant lymphatic, dissection is precise and hemostasis can be performed with great accuracy, offering a clean operative field. Laparoscopic surgery skills represent a plus, but are not mandatory since the learning curve is very fast. Résumé:

This model provides a safe and precise method for axillary lymphadenectomy and should represent a training model for every surgeon before clinical application.

Key Words: axilla, lymphadenectomy, endoscopic, minimally invasive
This experimental model was developed as a first step toward the true minimal invasive approach of axillary lymph nodes dissection and can serve as an excellent training model before applying this technique in the clinic.

**MATERIAL AND METHODS**

Experimental surgery was performed at the Pius Branzeu Center for Laparoscopic Surgery and Microsurgery, Victor Babes University of Medicine and Pharmacy Timisoara, using its experimental surgical theatre for large animals. The working post was equipped with a large animal operating table, complete laparoscopy tower, anesthesia machine with mechanical ventilation, electrosurgery unit and halogen operating lamp. (Fig. 1)

Figure 1. Working post from the experimental surgery operating theatre, Pius Branzeu Center.

Five common-breed pigs, weighing 30 to 35 kg were selected. All animals were treated in compliance with the Policy for the Use of Animals in Teaching and Training, issued by the Federation of European Laboratory Animal Science Associations (FELASA) and all experiments were approved by the University Animal Ethics Committee.

Anesthesia was induced in the animal facility, by intramuscular administration of Ketamine 5mg/kg and Xylazine 5mg/kg. In the surgical theater, an ear vein was cannulated and Thiopental 5mg/kg + Listenon 2mg/kg was administered intravenously. After anesthesia induction, endotracheal intubation was established and anesthesia was maintained with a mixture of Halothane 0.6-2% and 100% O2 (3 l/min).

The pigs were positioned in supine position on the operating table, with the upper limb in abduction, exposing the axillary region. (Fig. 2) After positioning, the animal was draped. Clean but not sterile technique has been used.

Figure 2. Working position with animals placed supine and the front limbs in abduction for exposure of the axilla.

The same standard laparoscopic surgical instruments have been used for all experiments, consisting of one 10mm diameter Hopkins II telescope with a 30° view, connected to a 3 chip video camera, one 12 mm and two 5 mm diameter standard trocars. Additionally to the laparoscopic scissors, an endoscopic dissecting forceps connected to a bipolar cautery was employed.

A 10 mm incision was performed 1 cm cranial to the reflection line of the axillary skin from the thorax, approximately on the mid-axillary line. (Fig. 3)

Figure 3. Preoperative marking of the trocar insertion points: mid-axillary line for the endoscope and 2 cm lateral for the scissors, 2 cm medial for the forceps.
Blunt (digital) dissection of the subcutaneous fat was performed, until the finger enters the axillary space. A 12 mm trocar is inserted and CO2 is insufflated up to 10-12 mmHg, thus creating an “operating chamber”. (Fig. 4).

![Figure 4](http://www.tmj.ro)

A 10 mm laparoscopic 30 degree camera is inserted, and the operating chamber is enlarged with gentle lateral moves. Upon entering the operating chamber, fatty axillary tissue is first seen, the on-screen image resembling the fog. If the cold light source unit allows it, the intensity of the light should be reduced at this point. The next best step is to identify the medial axillary wall (m. dintatus). Following this, the operating chamber is enlarged with gentle moves. A second 5 mm incision is made, 2-3 cm above and medial of the first one, inserting a 5 mm trocar with dissection scissors connected to a monopolar cautery. A third 5 mm incision is made 2-3 cm above and lateral of the first incision, inserting a 5 mm trocar with a dissection forceps. Using the scissors one can enlarge the chamber and expose the medial wall of the axilla (down), and then step by step the other walls: anterior (skin and pectoral muscle), posterior and lateral. The axillary fat has a sponge-like consistency, with low density and thus very easy to dissect. Using step by step dissection progresses toward the apex of the axilla. Vessels can be easily identified and dissected, preserving important arteries and veins. Capillaries should be coagulated using the monopolar attached to either scissors or a hook cautery. At this stage CO2 inflation can be stopped since the operating chamber is now the axilla itself, which is kept wide open by the position of the front limb.

Bleeding is the most important incident and the presence of blood alters the quality of the image and should be thus avoided. Mounted pieces of cotton can be used to remove the blood as well as for blunt dissection. We did not find any need for rinsing/suction during the procedure.

Given that the dissection advances toward the apex, the axillary vessels and the brachial plexus will come into the operating field of view. First, the axillary vein will appear and behind (above) are the artery and the brachial plexus. All these structures divide the apex of the axilla into two compartments: above (anterior) and below (posterior). These structures must be dissected up to the muscular apex of the axilla. All the fat can be easily removed using the forceps. In the end, lavage/aspiration is mandatory to remove the traces of fatty tissue and blood. A pink–red color of the muscles indicates a clean operating site with no traces of fatty tissue left.

A short video of the surgical procedure can be found on the website of the Timisoara Medical Journal (http://www.tmj.ro), under the current Journal issue.

**RESULTS**

All five experimental animals were operated on both axillae. In all experiments, the procedure proved simple and fast to perform. Total operating time was initially over 60 minutes, but dropped to 25 minutes after the third procedure, with a mean operating time of 38 minutes. The entire content of the axilla was successfully removed in all procedures.

Post-operative mortality was zero. Post-operative recovery time was very short, effectively resuming to the animal recovering from the anesthesia, after which normal standing, eating and drinking habits were displayed with no signs of post-operative trauma or pain.

**DISCUSSIONS**

This experimental method of axillary lymphadenectomy allows for an easy dissection, mostly blunt. Only capillaries should be coagulated and monopolar coagulation is enough, attached to the scissors or to the forceps. One should not be attached to the goal of finding specific anatomical landmarks as it is more important to “visualize” the necessary outcome of the operation.15-18

Issosulfan blue or other lymphatic dye was unfortunately not available, which could have offered a better visualization of the lymphatic system and a more precise dissection.19 Even so, the visualization of axillary structures was very good.

Hemostasis is very precise being performed under the magnification provided by the endoscope, thus...
enabling control of even the most minute bleedings. Dissection around the large axillary vessels presents no risk if mounted pieces of cotton are used for a blunt dissection.20 Laparoscopic surgery skills are recommended, but not mandatory. The learning curve is very fast, allowing for a safe dissection after the first three experimental trials.

CONCLUSIONS

The described experimental model represents a surprisingly simple solution for minimally invasive lymphadenectomy, while maintaining the radical dissection from the oncologic point of view. The procedure is very safe due to excellent visualization of anatomical structures.

REFERENCES