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Relationship between BMI and three different devices used in urinary incontinence procedures and anatomical structures in fresh cadavers. A pilot study

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ABSTRACT

Objective: To demonstrate the needle positioning during three types of slings in relation to anatomical structures in fresh cadavers and to evaluate if this positioning is influenced by body mass index (BMI).
Methods: TVTr sling (retropubic), TVT-O sling (transobturator) and mini-sling (TVT-Secur™) were performed in ten fresh cadavers, followed by dissection of the pudendal (genital) area (external evaluation) and abdominal cavity (internal evaluation). The distance between the devices used in each technique and specific anatomical structures (vessels and bowel) was measured.
Results: The mean distance between TVTr needles and the closest segment of the bowel was 5.0 ± 1.1 cm. The mean distance between the TVTr needles and iliac vessels was 8.55 ± 1.59 cm, and this distance was inversely proportional to BMI. However, the both correlations were not significantly ($p < 0.05$). The mean distance from TVT-O needle to obturator vessels and nerve was 2.25 ± 0.34 cm. This distance was inversely proportional to BMI, but it was not statistically significant.
Conclusion: Our data suggested that BMI may be not an important factor for influencing the relationship between the devices and anatomical structures in three different slings in fresh cadavers.

Introduction

Retropubic tension-free vaginal tape (TVTr), a minimally invasive midurethral sling technique introduced in 1996 by Ulmsten and Petros [1], has modified the treatment of female stress urinary incontinence (SUI) [2], decreasing the surgical time and complications compared to Burch surgery [3]. Nevertheless, this surgical technique can lead to a number of intra-operative complications [4], such as bladder perforation [5], bowel injury [6] and hemorrhage [5,7]. Thus, a transobturator approach was developed to reduce anatomical damage [8].

In 2003, de Leval [9] introduced the TVT transobturator inside-out tape (TVT-O). This surgery minimizes the risks of bladder, bowel and vessel perforation [10]. However, this approach may lead to groin pain, hematoma, and the risk of damage to the obturator nerve and vessels [4,11,12].

In 2006, a new incision-free, mini-sling method, known as tension free vaginal tape secure system (TVT-S) [13] was developed for reducing complications. Nevertheless, cases of bladder perforation and hemorrhage have been reported [14,15], and studies have shown that TVT-S was less efficient than the other methods [16].

None of those procedures (slings) is risk-free, probably because they involve blind needle manipulation. Some factors are related to the safety of these procedures, such as surgeon's experience and proper positioning of the patient. According to the literature, none of these complications are related to body mass index (BMI) [17] and there is a lack of studies analyzing the anatomic aspects of these procedures in terms of BMI.

Since obesity is an increasing health problem worldwide and there is a positive association between obesity and an increased prevalence of stress urinary incontinence (SUI), we thought that it would be very important for the surgeon to be aware of the influence of BMI on anatomical aspects of midurethral sling surgeries. The proper appreciation of the needle path and the distance between the needle and important structures, such as bowel, nerves and vessels is crucial to avoid serious injuries.

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The aim of this study was to demonstrate the needle positioning during TVTr, TVT-O and TVT-S in relation to anatomical structures in fresh cadavers and to evaluate if this positioning is influenced by BMI.

Methods

From January 2011 to January 2012, midurethral retropubic sling (TVTr™, Ethicon Inc., Somerville, NJ), transobturator sling (TVT-O™, Ethicon Inc., Somerville, NJ), and mini-sling (TVT-S™, Ethicon Inc., Somerville, NJ) procedures were performed in ten fresh cadavers in the Gynecology Discipline of Obstetrics and Gynecology Department at the Universidade de São Paulo, São Paulo, Brazil. After the procedures, the pelvis and abdominal cavity were carefully dissected to describe the needle trajectory in relation to pelvic anatomical structures. If any anatomic variation was found during dissection, the cadaver was excluded from the analysis. The study was approved by the appropriate Institutional Review Board. The family of all cadavers provided a signed consent for participation prior to the beginning of this study. The BMI is a value resulted from the body mass (weight) divided by the square of the body height. BMI is expressed in units of kg/m^2 [18].

All procedures were performed by only one well trained surgeon in the same fashion at Sistema de Verificação de Obitos da Capital – Universidade de São Paulo, Brazil (Autopsy Services). TVTr was first performed, followed by TVT-O and TVT-S in the same cadaver. Afterwards, abdomen and pelvic dissection were carried out. This sequence of procedures was adopted so the relation between needle trajectory and specific anatomic structures could be less affected.

Surgical techniques

TVTr

The fresh cadaver was positioned in dorsal lithotomy and trendelenburg position. The anterior vaginal wall was incised vertically, approximately 1.5 cm under the mid-urethra, and the endopelvic fibromuscular layer was dissected off the vaginal epithelium laterally. A TVTr needle was then passed laterally into the vaginal incision toward the space of Retzius, exiting from the suprapubic incision. During the needle passage, the bladder was deviated in order to avoid perforation. A metallic device was inserted into the bladder catheter as a guide to move the bladder to the opposite side of the needle, in order to reduce the risk of bladder injury. The same was done on the contralateral side.

After this procedure, a longitudinal laparotomy was performed. The space of Retzius was dissected and the needle was identified (Fig. 1A). The distances from bowel (Fig. 1B) to needle and from iliac vessels to needle were evaluated.

TVT-O

The cadaver was positioned in dorsal lithotomy and trendelenburg position with the hips hyperflexed over the abdomen (Fig. 1C). This position was achieved after applying a continuous strength for 5 min due to post-mortem rigidity and it was absolutely feasible. A midline vertical incision was performed under mid-urethra. The vaginal epithelium was dissected off the underlying fibromuscular layer toward the ischiopubic ramus and obturator membrane was perfurated. A TVT-O guide to protect the urethra was inserted into the dissected tract toward the ischiopubic ramus up to the opening previously made in the obturator membrane. A helical needle was inserted over the TVT-O guide passed through the obturator foramen, exiting through the skin. The same procedure was repeated on the contralateral side.

After this procedure, a longitudinal laparotomy was performed and the needle was not visualized in the abdomen cavity. The obturator channel was identified, and a metallic instrument was inserted into the obturator canal, from the pelvic cavity toward the obturator foramen to simplify the identification of the position of obturator vessels and nerve. After that, in litotomy position, a pelvic incision was made at the level of obturator foramen on the right side. Obturator foramen dissection was performed from skin toward the obturator membrane, and the following structures related to the course of the needle were identified: adductor magnus muscle, external obturator muscle, and obturator membrane. The metallic instrument inserted into obturator canal was visualized and its distance from the tape (TVT-O) was measured with a ruler (Fig. 2).

TVT-S

TVT-S was performed in "hammock" (90°) position. The cadaver was positioned in dorsal lithotomy and trendelenburg position. A vertical incision in the anterior vaginal wall of approximately 2.0 cm was made under the mid-urethra. The vaginal epithelium was dissected off the underlying fibromuscular layer toward the ischiopubic rami bilaterally. Using the needle driver, the device was inserted into this previously dissected paraurethral incision toward the obturator foramen. The same procedure was performed on the opposite side. A final adjustment of the sling was performed and the inserters were disconnected from the mesh by a slight rotation.

A laparotomy was performed to determine where the device was located. After dissection of internal obturator muscle, the needles were identified (Fig. 3A) in all cadavers, without perforation of the obturator membrane. Then, obturator foramen dissection was performed externally (from skin toward the obturator membrane). An intact obturator membrane was observed (Fig. 3B).

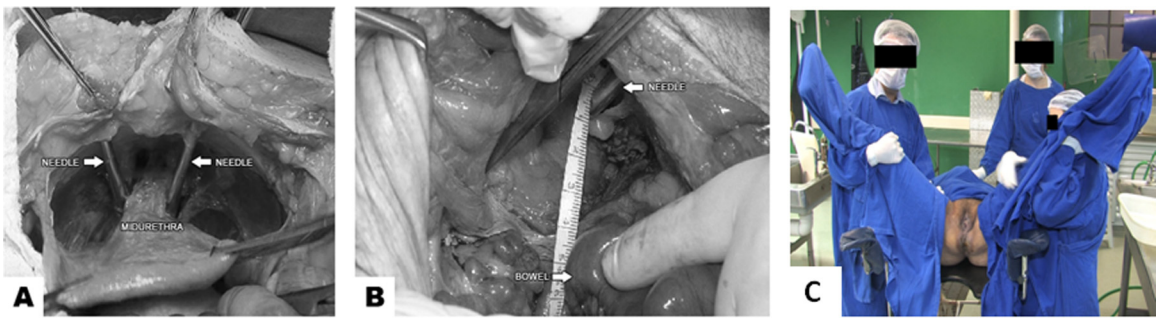

Fig. 1. (A) Laparotomy after TVTr, (B) distance from TVTr needle to bowel. TVTr, retropubic tension-free vaginal tape; (C) the fresh cadaver position: dorsal lithotomy and trendelenburg position.