ORIGINAL RESEARCH

The Intraoperative Anatomic Difference Between the Use of a Standard Cystoscope when Compared to Standard Operating Microscope as an Innovative Approach of Performing a Subinguinal Varicocelectomy with Intraoperative Vascular Doppler: Preliminary Result of a Novel Technique

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Objective: The varicocoele exist in approximately 35-40% of primary male factor infertility while two to 10 percent of cases presents with pain.[1] Most surgeons favor subinguinal microscopic varicocoelectomy because it offers superior improvement in semen parameters and reproductive outcome with the least complication rate. This study aimed to show an innovative surgical technique in the management of men with varicoceles.

Methods: Subinguinal varicocelectomies were performed by a single surgeon on all patients starting with a standard cystoscope stabilized by a customized mechanical holding system attached to the operating bed. All the presumed vascular channels, vas deferens and lymphatics were isolated and marked with vascular loops and surgical ties. After all the presumed vessels were tagged, the standard operating microscope was brought to the operative field and full microsurgical dissection was carried out.

Results: Ten varicocelectomies were performed on six men with a mean age of 30.5 years. 13 arteries, 84 veins, and 20 lymphatics were identified by the cystoscope while 18 arteries, 93 veins, and 29 lymphatics were identified by the standard operating microscope. Comparing the two modalities, 72%, 90%, and 69% of the arteries, veins, and lymphatics, respectively, were correctly identified by the cystoscope when compared to the latter.

Conclusion: Subinguinal varicocelectomy using a standard cystoscope could be offered as an alternative surgical approach in men with varicoceles as it can identify veins comparable with that of the standard operating microscope. In addition, a standard cystoscope can also identify, to some degree, lymphatics and arteries during surgical dissection. This innovative surgical technique can serve as a valuable option in the treatment of men with varicoceles.

Key words: varicocelectomy, microscope, cystoscope, veins, arteries, lymphatics

Introduction

Varicocele exists in approximately 15% of the general male population.[1] It is considered as the most common etiology of primary and secondary male factor infertility in 35% and 80% of cases, respectively.[2,3] However, its main pathophysiology remains largely undiscovered. When clinical palpable varicocele coexists with impaired semen quality, surgical repair may

potentially restore spermatogenesis and fertility. Both the European Association of Urology (EAU) and American Association of Urology (AUA) recommended surgical varicocelectomy in infertile men with palpable varicoceles and abnormal semen parameters.[4,5] Meanwhile, about 2% to 10% of patients with varicoceles present with pain and up to 80% of them will have improvement and/or resolution of their symptoms after varicocelectomy.[6]

To date, there have been limited randomized, controlled, prospective clinical studies that compare various techniques to determine the gold standard for the treatment of varicocele in infertile men. Consequently, the best surgical approach for varicocelectomy is still unknown. However, most surgeons favor subinguinal microsurgery.[7,8] In a randomized clinical trial comparing the different varicocelectomy techniques, subinguinal microsurgical varicocelectomy provided the best outcome in terms of semen parameters improvement and reproductive outcome with the least complication and recurrence rate.[9] Nearly half (43.2%) of clinicians (n= 574) are routinely using operating microscope according to a global practice survey conducted from 59 countries.[10] In a local survey among Filipino urologists, only 4.58% of respondents use microscope in performing varicocelectomy. This is mainly due to a lack of exposure to microsurgery training and due to a limited number of hospitals equipped with standard operating microscope thus limiting the practice of microsurgical varicocelectomy.

The main purpose of this study is to present an innovative approach of performing varicocelectomy using a standard cystoscope connected to a camera system that is more readily available and more affordable that may possibly serve as a valuable alternative option to a more expensive, less available standard operating microscope. In addition, it demonstrates the intraoperative anatomic difference during surgical dissection using a standard cystoscope compared to a standard operating microscope.

Methods

This study is a descriptive comparative observational study which was conducted in 2021-2022. The study protocol (REC-2020-61) was submitted to and approved by the Ethics Review Board of the hospital. All patients were provided with written informed consent.

Patients

A total enumeration of patients with varicoceles who met the inclusion/exclusion criteria. Inclusion Criteria (All Criteria): >18 years old, clinically-palpable varicoceles with abnormal semen parameters, intractable scrotal pain; Exclusion Criteria (At least one): Subclinical varicocele, recurrent varicocele, concomitant cryptorchidism) were included in the study. This study was conducted in a one-year time period from the time of approval in 2021.

Instruments

Cystoscope and a Camera System

A standard cystoscope (straight forward telescope 0°, diameter 4 mm, length 30 cm, autoclavable, fiber optic light transmission incorporated) was utilized in this study. A French 21 sheath connected to a telescope bridge with 1 lockable channel housed the cystoscope. The cystoscope was connected to the camera head of the existing laparoscopy tower with a 1080p resolution (Figure 1a). The video captured was transmitted in a full high-definition monitor. A fiber optic light cable (diameter 4.8 mm, length 300cm) with straight connector was attached to the light source. A customized autoclavable mechanical holding system mounted on the operating room bed rail held the cystoscope vertically (Figure 1b). This consists of a mechanical holding arm with the adjustable articulating stand and extension rod with clamp jaw to reach adjustment of the articulated stand with lateral clamp for height and angle adjustment of the articulated stand. This allowed the cystoscope to be optimally positioned thereby minimizing any interference during the surgical procedure. A clamping cylinder boarded the cystoscope and it allowed vertical movement and rotation of the cystoscope. An actual set up of the subinguinal varicocelectomy using a standard cystoscope is shown in Figure 1c.

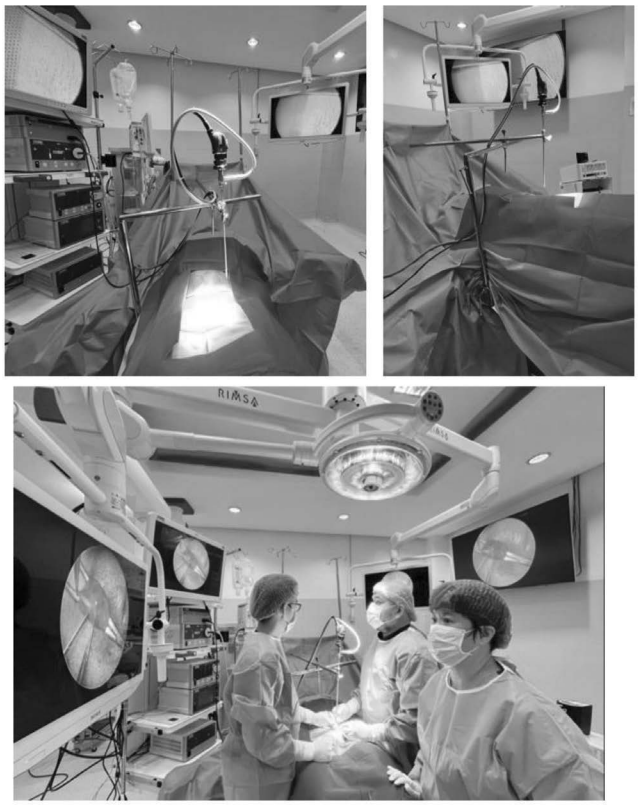

Figure 1. (a) Cystoscope connected to the camera head of the existing laparoscopy tower with a 1080p resolution, (b) Customized autoclavable mechanical holding system attached on the operating room bed rail, (c) whole set up of subinguinal varicocelectomy using a standard cystoscope.

Techniques

The subinguinal microsurgical varicocelectomy technique was carried out to all patients who consented to be part of the study by a single surgeon. Approximately 2-cm incision over the external inguinal ring was made. The spermatic cord was identified and encircled with penrose drain or secured with a clamp. The standard cystoscope was utilized initially in all cases. All the presumed vascular channels, vas deferens and lymphatics were isolated and marked with vascular loops and surgical ties (white vascular loop: vas deferens, blue vascular loop: artery, black tie: veins and white tie: lymphatics). After all the presumed vessels were tagged, the standard operating microscope (Zeiss TIVATO 700 with advanced surgical visualization of 1080p or 4K camera and a large external monitor) was brought to the operative field (Figure 2).

A full microsurgical dissection was done, and appropriate tags were applied if there were additional structures identified. An intraoperative vascular doppler (8 MHZ Surgical Doppler System) was used to confirm the preservation of the arteries. To conclude the surgical technique, all cremasteric veins, external spermatic veins and internal spermatic veins were ligated while the vasal vein, arteries and lymphatics were preserved. Thereafter, approximation of the subcutaneous tissues and skin closure using subcuticular technique followed.

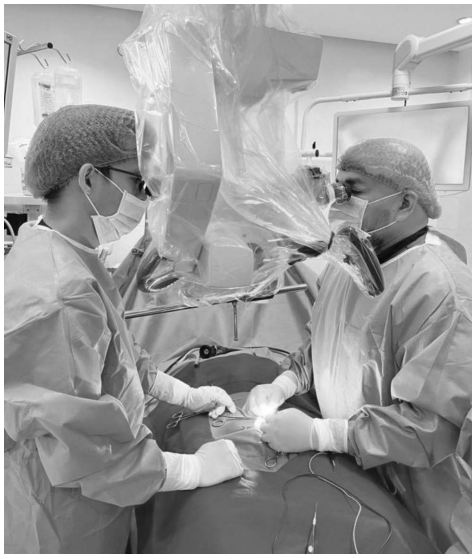

Figure 2. Standard operating microscope with 1080p or 4K camera used during the procedure.

Results

A total of six subjects with a mean age of 30.5 years were included in the study. Four of them had bilateral varicoceles while two had unilateral varicoceles which was equivalent to 10 varicocelectomies performed. All subjects had clinically significant grade 2-3 varicoceles. Sixty seven percent (67%) of the cases consulted due to male factor infertility while the remaining 33% was due to intractable pain.

Using the standard cystoscope, 13 arteries, 84 veins, and 20 lymphatics were identified. Upon use of the standard operation microscope, 18 arteries, 93 veins, and 29 lymphatics were identified. When comparing both findings, 72% of arteries, 90.3% of veins, and 69% of lymphatics were correctly identified by using the standard cystoscope.

Discussion

Varicocele is the abnormal dilatation and tortuosity of the pampiniform venous plexuses within the spermatic cord.[11] Testicular hyperthermia is a known pathologic reason causing the detrimental effect of varicocele on reproductive outcome. Although other primary proposed hypotheses were presented such as venous pressure, testicular blood flow, hormonal imbalance, toxic substances, and reactive oxygen species (ROS).[12] Response of the testis to heat stress, hypoxia and inflammation subsequently produce excessive amount of ROS.[13] This also inactivates enzymes and proteins necessary for spermatogenesis. Men with varicoceles can also present with scrotal pain. The probable mechanisms for this include compression of the surrounding neural fibers by the dilated venous complex, elevated testicular temperature, increased venous pressure, hypoxia, oxidative stress, hormonal imbalances, and the reflux of toxic metabolites of adrenal or renal origin.[6]

An ideal varicocelectomy procedure should have optimal results with minimal complications, such as varicocele recurrence or persistence, hydrocoele formation and testicular artery injury.[14] In a study conducted by Liu X et al (2013), injury of the spermatic artery remains 24% (12/50) in the loupe-assisted procedure, and 45.7% (32/70) using traditional open surgery.[15] The incidence of accidental testicular artery ligation in microsurgical varicocelectomy is approximately 1% after evaluating 2,102 cases of microsurgical varicocelectomy that was confirmed intraoperatively by observation of pulsatile twitching of the ligated vessel stump under 25x magnification.[16] In the present study using a standard cystoscope, the authors did not encounter any incidence of spermatic artery injury, and the identification rate for arteries was 72.22% (13/18). Only 9.67% (84/93) of spermatic veins were missed using the standard cystoscope which is lower than 22.9% (43/188) of spermatic veins missed using a magnifying loupe in a study conducted by Hao Zhang et al.[17] The study yielded a comparable result with the use of operating microscope in terms of identification of spermatic veins. According to a study by Richter et al (2001), hydrocoele formation is the most encountered complication at varicocelectomy by urologists and andrologists, reported in 40.4% of patients, in spite of the use of some form of optical magnification by 70% of surgeons.[18] Testicular edema, hydrocoele formation and reduced testicular function were reported to be due to the division of lymphatics at varicocelectomy.[19] In the present study, 68.97% (20/29) of lymphatics were correctly identified by the standard cystoscope. However, there was one structure identified as vein in the standard cystoscope but it turned out to be lymphatic vessel under the standard operating microscope. There was also one lymphatic vessel that was to be incorrectly ligated with a vein under the standard cystoscope but was identified separately under the standard operating microscope yielding a 6.89% (2/29) incorrect identification of lymphatics under standard cystoscope which is lower compared to a 14.3% (18/126) of incorrect identification in the loupe-assisted varicocelectomy conducted by Hao Zhang et al.[17] Present study findings showed that concomitant use of intraoperative vascular doppler during microsurgical varicocelectomy increased the accuracy of preservation of arteries although there was no added benefit in identification in the initial result. Comparing it to a study by Cocuzza et al (2010), they found out that the use of intraoperative vascular doppler allowed more arterial branches to be preserved, and more internal spermatic veins to be likely ligated.[21]

This study has its own limitations. Although all the varicocelectomies were performed by a single surgeon, the authors had a limited number of cases. In addition, the microsurgical technique using the standard operating microscope was always performed after the standard cystoscope approach. As a result, the accurate number of vessels including arteries, veins, and lymphatics that a standard operating microscope alone could identify could not be reported. The study only had 1 set of patients for comparison. A proper randomized controlled trial comparing the two approaches would be a better study design for this hypothesis. The need for customized mechanical holding system, video system and the ability to adjust or adapt the hand and eye coordination while looking at the monitor while performing the microsurgery are also important considerations in doing this innovative approach.

Overall, no difficulty was experienced with the use of standard cystoscope connected to a camera system held on an autoclavable mechanical holding system. The study will be further conducted to include more subjects and with separate randomized groups to enhance the power of the study.

Conclusion

Subinguinal varicocelectomy using a standard cystoscope could be offered as an alternative surgical approach in men with varicoceles as it can identify veins comparable with that of the standard operating microscope. In addition, a standard cystoscope can also identify, to some degree, lymphatics and arteries during surgical dissection. This innovative surgical technique can serve as a valuable option in the treatment of men with varicoceles.

Author Disclosure Statement

The present study is in no way related to any company or individual but solely an interest of innovative surgical management for varicoceles.

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