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ORIGINAL ARTICLE

Microanatomy of the spermatic cords during microsurgical inguinal varicocelectomy: initial experience in Asian men

Xue-Ke Wang, Hong-Zhen Wang, Ding-Jun Fu and Ming-Kuen Lai

The microanatomy of the inguinal spermatic cords has never been reported in Asia. The purpose of this study was to describe the number and relationship of the veins, arteries and lymphatics in the spermatic cord and to clarify the location of the vas deferens in Asian men. Fifty-one patients receiving 79 primary microsurgical varicocelectomies performed by a single surgeon from April 2011 to July 2012 were studied. The number of internal and external spermatic veins, testicular arteries and lymphatic channels preserved during the inguinal microsurgical varicocelectomy were recorded. The relationship between the right and left vascular anatomy during bilateral varicocelectomies was evaluated. The data showed that mean numbers of 1.5±0.9 arteries, 5.6±2.2 spermatic veins and 3.6±1.9 lymphatics were identified during the repairs. The internal spermatic arteries were surrounded by a dense complex of adherent veins in 81.2% of the cases. The external spermatic vein or veins were found in 60.8% of the cases. The vas deferens may be contained within the internal spermatic fascia. The results suggest that the number of veins may be highly variable and less than those reported in the English literature, but there is some similarity in the inguinal microanatomy of the right and left spermatic cords. Further research is warranted to clarify our results.
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INTRODUCTION

Varicoceles exist in approximately 15% of the general male population, in 19%–41% of men with primary infertility and in 45%–81% of men with secondary infertility.[1–3] Although the exact cause of infertility in men with a varicocele remains unknown, randomized controlled trials demonstrate that varicocele repair can improve male infertility.[4,5]

Varicocele surgery includes retroperitoneal, transperitoneal, inguinal and subinguinal approaches. To decrease complications such as testicular artery injury, hydrocele and recurrence, microsurgical varicocelectomy has been recommended to identify and ligate the small spermatic veins and to preserve the artery and lymphatics.[6] The surgical repairs can be performed by an inguinal or subinguinal approach. Neither approach has been proven superior to the other in its ability to improve fertility.

It is necessary to identify the spermatic cord microanatomy. Some reports[7,8] describe the inguinal varicocele anatomy in American men. To our knowledge, there has been no report describing the intraoperative varicocele anatomy in Asian men. In the present study, we aim to investigate the numbers of venous, arterial and lymphatic structures and their relationship and to compare the right and left spermatic cords. We examined the differences between the previous report and our study.

MATERIALS AND METHODS

Patients

A total of 51 consecutive patients underwent microsurgical inguinal varicocelectomies were enrolled in this study. Of these, 28 men underwent bilateral repair, and 23 men had a unilateral left varicocelectomy for 79 varicocele units. Informed consent was obtained from each patient preoperatively.

Technique (Supplementary Video)

All of the microsurgical inguinal varicocelectomies were performed under general anaesthesia by the same surgeon. Briefly, the location of the external inguinal rings was identified by invaginating the scrotal skin with an index finger in a cephalad direction over the pubic tubercle, and this position was marked on the skin. A 2.5- to 3-cm incision was made over the inguinal canal. Camper's and Scarpa's fascias were incised using electrocautery. The external oblique fascia was opened and the spermatic cord was dissected near the internal inguinal ring. The spermatic cord was dissected with a pusher and surrounded by a Penrose drain. The dissection plane was close to the internal inguinal ring.

A Zeiss NC-4 operating microscope (Carl Zeiss, SIP: 6623502157) was brought into the operative field. Under ×10 magnification, the external and internal spermatic fasciae were sharply opened, exposing the internal spermatic vessels. The vas deferens, vasal veins and arteries were identified and preserved. A second Penrose was placed between the vas deferens and the internal spermatic structures. A 1% lidocaine solution was dripped onto the spermatic cord to aid in identifying the testicular artery or arteries. All of the identified arteries were dissected free from the adjacent veins and lymphatics. All of the veins, including the external spermatic vein, were doubly ligated with clips or 2-0 silk ties and divided. All of the identified lymphatics were preserved and counted.

Division of Urology, Xiamen Chang Gung Hospital, Xiamen 361028, China
Correspondence: Dr XK Wang (wxk3639@adm.cgmh.com.cn)
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During the dissection, the number of internal and external spermatic veins ligated was recorded, and these veins were categorized by size and location. The spermatic veins were measured with a microruler and classified as large (4 mm or more in diameter), medium (2–4 mm) and small (2 mm or less). The number of the internal spermatic arteries was also recorded. The relationship of the internal spermatic artery to the internal spermatic veins was classified as 'located within a complex of veins (artery adherent to two or more small or medium veins)' or 'isolated (anterior or posterior)'.

Statistical method

The results were expressed as the mean±standard deviation (s.d.). The difference between the right and left parameters was evaluated by *t*-test. The differences were considered significant if $P<0.05$.

RESULTS

All of the patients were referred to our institution for evaluation of male factor infertility and had clinically palpable varicoceles. The mean age of the men undergoing primary varicocele repair was 27.5±5.4 years (range: 18–39 years). Most patients (52.9%) underwent surgery for complaints of primary infertility. Secondary infertility was the presenting complaint in 9.8% of the infertile patients; testicular pain was the presenting complaint in 9.8%, and 25.5% had a varicocele found by physical examination. The preoperative clinical grading (grades I–III) of the varicoceles was based on a physical examination performed by one experienced examiner and compared with intraoperative microscopic findings. The varicocele grade distribution of the left-side varicoceles units ($n=51$) was as follows: none were grade I, 37.3% were grade II and 62.7% were grade III varicoceles. Of the right-side varicoceles ($n=28$), 50.0% were grade I, 50.0% were grade II and none were grade III varicoceles.

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Internal spermatic veins

Overall, 5.6±2.2 internal spermatic veins were ligated per cord (**Table 1**) in this study. For bilateral repair ($n=28$), the mean numbers were 5.2±2.2 veins on the left and 5.7±2.4 veins on the right. The examination of the 23 left varicocele repairs showed that a mean of 6.0±2.0 veins were identified during the inguinal varicocelectomy. There were no significant differences in the mean number of internal spermatic veins in either left- or right-side varicocelectomies.

External spermatic veins

In 2.5%, 15.2%, 43.0% and 39.2% of the varicocele units, 3, 2, 1 and 0 external spermatic veins were identified, respectively.

Lymphatic channels

An analysis of the 51 varicocele units revealed a high variability in the number of lymphatic channels (range 1–8), with a mean of 3.6±1.9 lymphatics per varicocele unit. For the bilateral repair ($n=28$), the mean numbers were 3.4±1.8 lymphatics on the left and 3.9±2.0 lymphatics on the right. An examination of the 23 left varicocele repairs showed that 3.6±2.0 lymphatics were identified during the inguinal varicocelectomy.

Table 1 Evaluation of internal spermatic veins: mean±s.d.

	Right	*Left*	*Total*
No. of varicocelectomies	28	51	79
Mean No. veins/cord(range):			
Large	0.4±0.7	0.9±1.0	0.7±0.9
Medium	1.9±1.2	1.6±1.3	1.7±1.3
Small	3.4±2.3	3.1±1.9	3.2±2.0
All internal	5.7±2.4	5.5±2.1	5.6±2.2

Internal spermatic arteries

On average, we identified 1.5±0.9 internal spermatic arteries per varicocele unit (range 1–5). In 1.3%, 3.8%, 6.3%, 20.3% and 68.4% of the varicocele units, 5, 4, 3, 2 and 1 internal spermatic arteries were identified, respectively. For the bilateral repair ($n=28$), the mean numbers were 1.4±0.8 arteries on the left and 1.5±0.9 arteries on the right. An examination of the 23 left varicocele repairs showed that a mean of 1.4±0.8 arteries were identified during the inguinal varicocelectomy. Regarding the internal spermatic arteries, 81.2% were located within a complex of veins, and 18.8% of the internal spermatic arteries were isolated and anterior to the veins.

DISCUSSION

The goal of treatment of the varicocele is to interrupt the refluxing venous drainage to the testis while maintaining arterial inflow and lymphatic drainage. Postoperatively, testicular venous return is *via* the deferential and scrotal veins.[9] Techniques using optical magnification maximize the preservation of arterial and lymphatic vessels while decreasing the risk of persistent or recurrent varicocele.[10]

Compared with the subinguinal approach, the use of the inguinal approach is associated with fewer internal spermatic veins, easier microscopic dissection and clearer identification of the testicular artery pulsation.[7,8] Ramasamy and Schlegel[11] found that a varicocelectomy without testicular delivery has equivalent or more beneficial effects on semen parameters without affecting varicocele recurrence rates. Orhan *et al.*[12] thought that both inguinal and subinguinal approach microsurgeries were effective methods to use for varicocelectomy. We chose to perform the inguinal varicocelectomy without testicular delivery.

Beck *et al.*[13] reported that an average of 8.7 veins was found per cord, including 1.9 large veins, 2.2 medium veins and 4.7 small veins. We found a mean of 0.7±0.9 large veins, 1.7±1.3 medium veins and 3.2±2.0 small veins per cord. We believe that this difference may be due to several reasons. The first reason may be the choice of different surgical planes. The inguinal canal is approximately 4 cm in length, and the small internal spermatic veins drain into a large vein more proximally in the spermatic cord.[13] We believe that different surgical planes in the inguinal canal may account for the different veins counts. Because some operators performed testis delivery during varicocelectomy, the incisions were close to the external ring. We did not perform testis delivery intraoperatively, and we performed the varicocelectomy nearer to the internal ring, which may result in finding fewer small veins. The second reason may be an intraoperative difference between the vasal veins and the internal spermatic veins. Dilated vasal veins may be mistaken for spermatic veins. In our experience, the vas deferens may be contained within the internal spermatic fascia. This anatomy is similar to the subinguinal microanatomy.[9] We speculate whether there is a distinct fascial layer between the vas deferens and the internal spermatic vessels. The third reason may be a racial difference, which requires further studies for support.

This is the first report of the intraoperative spermatic cord microanatomy during an inguinal varicocelectomy in Asian men. More cases are needed to confirm our conclusion. The data demonstrate that in bilateral cases, there is a good concordance between the right and left

internal spermatic veins. In view of the highly variable microanatomy, these data might be useful for surgeons who perform varicocelectomies.

AUTHOR CONTRIBUTIONS

XKW performed the research. HZW wrote the paper. DJF analysed the data. MKL revised the paper.

COMPETING FINANCIAL INTERESTS

All authors disclose no financial interests and state that no potential conflicts exist.

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Supplementary Information accompanies the paper on *Asian Journal of Andrology's* website (http://www.nature.com/aja).

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