# INCIDENCE OF ACCIDENTAL SPERMATIC ARTERY LIGATION DURING INGUINAL VARICOCELECTOMY WITH SEDOANALGESIA AND ITS EFFECTS ON SPERM CONCENTRATION, MOTILITY AND KRUGER MORPHOLOGY

## *SEDOANALJEZİ ALTINDA YAPILAN İNGUİNAL VARİKOSELEKTOMİ SIRASINDAKİ AKSİDENTAL SPERMATİK ARTER BAĞLANMA SIKLIĞI VE BUNUN SPERM KONSANTRASYONU, MOTİLİTESİ VE KRUGER MORFOLOJİSİ ÜZERİNE ETKİLERİ*

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*ABSTRACT*

***Purpose:*** *This study was designed to determine how often the testicular artery is accidentally ligated during varicocelectomy with local anaesthesia and to compare the impact of artery ligation and preservation on seminal parameters, particularly strict sperm mophology.* ***Method:*** *44 infertile patients with the diagnosis of varicocele were enrolled into the study. Semen analyses and testicular volume measurements were repeated after a minumum period of three months postoperatively. The change in seminal parameters after the operation was analysed in artery-ligated and preserved groups.* ***Results:*** *Spermatic artery injury was determined in 19 (43.1 %) out of 44 patients. In overall patients, preoperative sperm cencentration increased from an average of 41± 28 10⁶/ml to 53 ± 23 10⁶/ml ($p< 0.05$), forward motility (+4 plus +3 motility) increased from 51 ± 16 to 57 ± 12 ($p<0.05$) and preoperative 9 ± 7 % of normal sperm morphology (according to strict criteria) changed to an average of 8 ± 6 % ($p>0.05$). In the artery ligated group, a statistically significant difference was recorded in sperm concentration after varicocelectomy whereas both sperm concentration and motility improved significantly in the artery preserved group ($p<0.05$). The percentage of spermatozoa with normal morphology increased in neither groups ($p>0.05$). Testicular volumes did not reveal significant change in any groups postoperatively ($p>0.05$). The only difference observed between the two groups was the improvement in sperm motility in the artery-preserved group.* ***Conclusion:*** *Varicocelectomy in low grade varicoceles does not improve strict sperm morphology.*

***Key Words:*** *Varicocelectomy, Spermatic Artery Ligation, Strict Criteria.*

*ÖZET*

***Amaç:*** *Bu çalışma lokal anestezi ile yapılan varikoselektomi sırasında ne sıklıkla testiküler arterin aksidental olarak yaralandığını saptamak ve arter korunması ile bağlanmasının semen parametreleri ve özellikle strict sperm morfolojisi üzerine etkisini karşılaştırmak için dizayn edilmiştir.* ***Gereç ve Yöntem:*** *Varikosel tanısı alan 44 infertil hasta bu çalışmaya dahil edildi. Semen analizleri ve testiküler volüm ölçümleri postoperatif en az 3 ay sonra tekrar edildi. Arter bağlanan ve korunan gruplardaki seminal parametre değişiklikleri analiz edildi.* ***Bulgular:*** *Spermatik arter yaralanması 44 hastanın 19'unda (43.1 %) belirlendi. Olguların tümünde, preoperatif sperm konsantrasyonu ortalama 41±28 10⁶/ml'dan 53 ± 23 10⁶/ml'ye ($p< 0.05$) ,ileri hareketli (+4 ve +3 motilite) sperm oranı 51 ± 16'dan 57 ± 12'ye ($p<0.05$) ve strict kriterlere göre normal morfolojili sperm oranı 9 ± 7 %'den 8 ± 6 %'ye ($p>0.05$) değişiklik gösterdi. Arter bağlanan grupta,varikoselektomi sonrası sperm konsantrasyonunda istatistiki olarak anlamlı farklılık gözlenirken arter korunan grupta hem sayı hem de motilitede belirgin düzelme gözlendi ($p<0.05$). Normal morfolojili spermatozoa oranı iki grupta da artış göstermedi ($p>0.05$). Testis volüm ölçümleri postoperatif dönemde iki grupta da belirgin değişiklik göstermedi ($p>0.05$). İki grup arasında gözlenen tek fark arter korunan grupta sperm motiltesindeki iyileşmedir.* ***Sonuç:*** *Düşük gradeli varikosellerde varikoselektomi morfolojiyi düzeltmemektedir.*

***Anahtar Kelimeler:*** *Varikoselektomi, Spermatik Arter Ligasyonu, Strict Kriterler.*

## INTRODUCTION

With the introduction of in-vitro fertilization techniques, morphological evaluation of the spermatozoa according to the strict criteria drew particular interest. The published data show poor fertilization rates both in in-vivo and in-vitro

conceptions with the morphologically abnormal spermatozoa, particularly abnormal acrosomes (1, 2). However, no single drug improving sperm morphology has been reported up to now in the literature.

Varicocele has been accepted as a major cause of male infertility and is excessively treated. Since we know that many men with varicocele have children, the exact patient profile that will actually benefit the operation remains to be identified. Due to the fact that reports about the effect of varicocelectomy on sperm morphology are scarce and contradictory (3, 4), we aimed to focus particularly on this parameter.

Since there is no available data about the incidence of arterial injury during inguinal varicocelectomy and its impact on semen parameters in the literature, we also looked for the answers to these questions at the same time.

**MATERIALS AND METHODS**

A total of 44 infertile men with the diagnosis of varicocele (meeting the inclusion criteria) were prospectively enrolled in this study between the years, 1999 and 2000. The patients selected for varicocelectomy were infertile for at least 18 months. All patients had a complete physical examination for the detection of a hypoandrogenic status. Patients with azoospermia, a history of inguinal or scrotal surgery and high FSH (any value above normal) level were excluded from the study. Varicoceles diagnosed by coloured Doppler ultrasonography (Toshiba 270 AK) and clinical Gr I varicoceles were included in the study group. Ultrasonographic diagnosis of varicocele was established when the diameter of the internal spermatic vein exceeded 2 mm and reflux was present. Testicular volumes were calculated in all of the patients both preoperatively and at the third postoperative month. Since patients with Grade II and III varicoceles constituted a small-sized group, they were not included into this study. Double semen analyses were performed with an interval of two weeks both pre and postoperatively.

Semen analyses were performed following 3-5 (Mean: 4.2 ± 0.2) days of sexual abstinence. All the semen analyses were performed by the same technician. Semen samples were collected in the laboratory by masturbation directly into the jar and kept in a heat chamber at 37 °C for liquefaction. The sperm concentration ( number of spermatozoa per mL) was counted in a Makler chamber by phase-contrast technique at a magnification of X200. After the initial examination of the undiluted sample, an appropriate dilution was made for the motility and morphology analysis. Motility of a hundred spermatozoa was classified according to WHO criteria at X400 magnification (5). Morphological evaluation was made according to the 'strict criteria' after staining with Spermac ® stain. One hundred spermatozoa were examined to determine the percentage of spermatozoa with normal morphology according to the strict criteria. Postoperative semen analysis was performed after a minimum period of 3 months postoperatively.

All varicolectomies were carried out under local anaesthesia with %2 prilocaine (without adrenaline). The approach was through an inguinal incision just superior to the external ring, which was palpated externally. Following dissection of the tissue layers, spermatic fascias were opened and the varicose veins were reached. After retraction of the vas deferens and its adherent vasculature, each vein was dissected carefully and a segment of 1 to 2 cm was removed between the ligated ends of the veins. Maximal effort was made to inspect the pulsation of the artery with the naked eye and not jeopardize them. The patients were discharged from the hospital on the same day of the operation and only analgesics were prescribed.

The removed segments were fixed in formalin solution and examined by the same pathologist to detect the presence of an artery adherent to the vein. Sections were prepared from every removed segment and stained with both Hematoxylin-Eosin and Elastin-Verhoeff (Fig. 1, 2). Its heavily stained internal elastic membrane allowed discrimination of the artery from the vein. All the slides were examined under the light microscope with 100x magnification. A specimen with an artery greater than 0.5 mm in diameter was accepted as positive for the spermatic artery injury.

The average was taken for the data collected from pre and postoperative semen analyses and used for statistical comparisons. The Wilcoxon signed rank test was used to

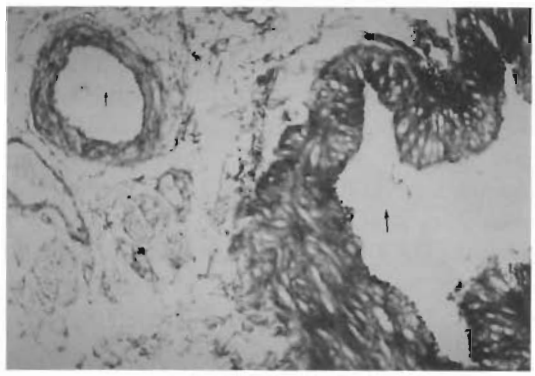

Fig. 1: Testicular artery (short arrow) with a diameter of 0.5 mm and neighbouring testicular vein (long arrow). (Hematoxylin and eosin, x100).

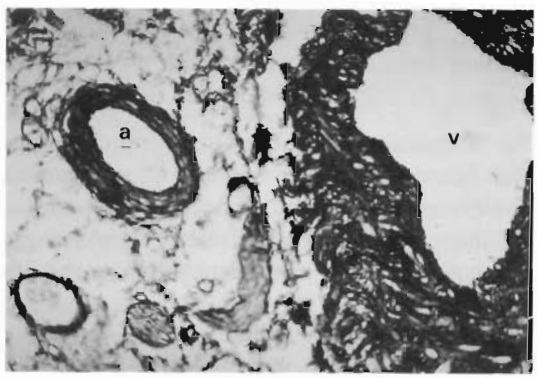


Fig. 2: Heavily stained internal elastic membrane of the testicular artery (a), neigbouring vein (v). (Elastin-Verhoeff, x 100).

measure levels of statistical significance in most of the analyses. Paired-t test was used in the overall group. All the statistical analyses were performed using the computer software, SPSS 7.0 (statistical package for social sciences).

## RESULTS

The existence of spermatic artery injury was proved in 19 out of 44 (43.1 %) patients by the pathological examinations. In 9 (47 %) patients, 2 separate arteries were found to be ligated whereas in the remaining 10 (53 %) patients, one artery was ligated during inguinal varicocelectomy.

Table - 1: The properties of the study group.

| | |
|---|---|
| Age | 20-38 years (mean: 25.4) |
| Duration of infertility | 1.5-7 years ( mean: 3.4) |
| Left varicocele | 36 |
| Bilateral varicocele | 8 |

The properties of the artery ligated and preserved groups were not different from each other in respect to duration of infertility, patient age and the time at which postoperative semen analyses were performed. The properties of the study group are presented in Table 1.

The effect of varicocelectomy on seminal parameters in both artery ligated and preserved groups were summarized in table 2. Regarding all patients, a significant improvement in both sperm concentration and progressive motility (+4 and +3) was recorded but none in morphology. Contrary to the artery-ligated group, a

Table - 2: Comparison of the preoperative and postoperative semen parameters in both artery ligated and preserved groups (Wilcoxon signed rank test, paired-t test*)

| | Preoperative (Mean ± SD) | Postoperative (Mean ± SD) | p |
|---|---|---|---|
| All patients ( n:44)* | | | |
| Sperm concentr. ($10^6$/ ml) | 41 ± 28 | 53 ± 23 | <0.05 |
| Progressive motility (%) | 51 ± 16 | 57 ± 12 | <0.05 |
| Normal morphology (%) | 9 ± 7 | 8 ± 6 | >0.05 |
| Artery-ligated group (n:19) | | | |
| Sperm concentr. ($10^6$/ ml) | 33 ± 27 | 41 ± 37 | <0.05 |
| Progressive motility (%) | 56 ± 16 | 58 ± 13 | >0.05 |
| Normal morphology (%) | 9 ± 8 | 7 ± 5 | >0.05 |
| Artery-preserved group (n:25) | | | |
| Sperm concentr. ($10^6$/ ml) | 47 ± 30 | 60 ± 38 | <0.05 |
| Progressive motility (%) | 47 ± 15 | 57 ± 11 | <0.05 |
| Normal morphology (%) | 10 ± 6 | 9 ± 7 | >0.05 |

statistically significant increase in progressive motility was also seen in the artery-preserved group. The improvement in the percentage of normal morphology evaluated according to the 'strict criteria' was found to be in significant in all groups. However, in some patients morphological abnormalities increased although the difference was not significant (paired t-test, $p>0.05$).

Testicular atrophy did not develop in any of the cases in the postoperative period. Comparison of the preoperative testicular volumes with the postoperative measurements did not reveal any significant difference in any group ($p>0.05$).

**DISCUSSION**

Although the association of low semen quality and male infertility has been widely studied (6), investigations on this subject still continue. A sperm density of 20 x $10^6$/mL was adopted by WHO as a guideline to diagnose male infertility (3), but in a recent population-based study of 430 first-pregnancy planners, a sperm concentration of 40 x $10^6$/ mL was found to be strongly related to likelihood of pregnancy when compared with a lower sperm density (7). Progressive motility and straight-line velocity were also reported to have a significant value for determining fertility (2, 8).

With the introduction of assisted reproductive technology, a better parameter that would predict the fertilization capacity of spermatozoa was investigated. Kruger proposed a new classification system that evaluates sperm morphology called 'strict criteria' (9). A set of properties was determined for an ideal sperm and even a minor change in these characteristics led to the decision of abnormality for those spermatozoa. Using this 'strict criteria', a success rate of 7.6 and 64 % was reported for the sperm morphology 4 % and 4-14 % respectively, in in-vitro fertilization (10).

Although there is a consensus on the efficacy of strict sperm morphology in in-vitro fertilization rates, conflicting reports exist about the impact of strict sperm morphology on in vivo conception rates. A recent study enrolled 373 couples who underwent 792 intrauterine insemination (IUI) cycles and reported the rates of 30.6, 21.1 % for the cumulative cycle fecundity and baby take-home, respectively after three cycles (11). The authors mentioned that sperm morphology and inseminating motile count were of no prognostic value. Nevertheless, they also observed that when the inseminating motile sperm count decreased below 1x $10^6$ sperm, strict morphology turned out to be a valuable prognostic parameter. No pregnancy was reported with the strict sperm morphology of less than 4 %, in this subgroup. Karabinus did not observe any impact on strict sperm morphology on IUI pregnancy rates and reported pregnancy rates of 6.5 % ± 3.9 %, 7.1 % ± 2.5 % with the strict sperm morphology of < 5 % and 20-29 % respectively (12). Contrary to these studies, Lindheim reported that couples with a favorable sperm morphology were 28.3 times as likely to achieve a pregnancy within four cycles of IUI and controlled ovarian hyperstimulation as those with unfavorable sperm morphology in the presence of normal sperm concentration and motility (13).

The detrimental effect of varicocele on sperm morphology was initially reported by Mc Leod (14). He mentioned a 'stress pattern' of abnormal sperm morphology characterized by increased numbers of tapered, immature and amorphous cells. Schlesinger reviewed 12 studies investigating the efficacy of varicocelectomy on semen parameters. He recorded an improvement in sperm count in most of these studies whereas an increase of motility and morphology was recorded in only 5 of these studies (15). However, there is no consensus on the efficacy of varicocelectomy on semen parameters. A recent meta-analysis of the randomized controlled clinical studies involving 385 patients showed no significant treatment benefit (16).

Nevertheless, none of these morphologic assessments were done using the 'strict criteria'. There are few studies analyzing the efficacy of this operation on sperm morphology as measured by Kruger's strict morphologic criteria, and the results did not reach an ultimate decision. Levin reported an improvement in strict sperm morphology (17) while Seftel reported the opposite (4). Schatte recently reported an improvement in all three semen parameters; sperm motility, average sperm density and total number of sperm with normal strict morphology (3). He particularly reported a significant improvement in normal head strict morphology.

Our study supports Seftel's conclusions and we did not record any improvement in strict sperm morphology either in artery-preserved or transected group. Moreover, we observed a worsening in sperm morphology, which might be a transient situation. Failure to respond to varicocelectomy may be explained by the presence of coexisting insults or irreversible injury to the testicles (18, 19).

Histological studies of 17 adult spermatic cords obtained from cadavers revealed the presence of a mean of 2.4 spermatic arteries (range 1 to 3) in the proximal inguinal canal (20). However, no data exists about the incidence of accidental spermatic artery ligation during inguinal varicocelectomy with local anaesthesia where loop magnification is not used.

Varicocelectomy is most commonly performed under local anesthesia by the inguinal approach at our hospital, due to its low cost and shorter patient-bed occupation. The patients tolerate the procedure well. Besides these advantages, discrimination of the spermatic artery is not possible in most of the cases due to tissue edema and vasoconstriction. Our study revealed that testicular artery preservation was not possible in a great majority of cases ( 43.1 %) even though maximal efforts were made during the inguinal approach.

There are few studies concerning the efficacy of spermatic artery-preservation during varicocelectomy and some of them reported a positive influence on semen parameters. These studies were carried out with loop magnification to preserve lymphatics and the spermatic artery (21, 22). Matsuda reported an improvement in sperm density in the artery-preserved group and in both sperm density and motility in the artery-ligated one, when Palomo's approach was used (23). In this study, it was decided that the testicular artery should be preserved when the pulsation of the artery was confirmed under direct vision. However, the proponents of artery ligation during varicocelectomy advocated this approach, due to its low postoperative recurrence rate (24). They mentioned that leaving a small patent vein around the artery would probably result in the recurrence of varicocele, which has been reported to be as high as 21 to 28 % (25, 26). Nevertheless, the left patent veins are regarded as being responsible for this recurrence and reflux through the cremasteric vein, which is not accessible by the Palomo approach, can also lead to recurrence of the varicocele (27). Although testicular atrophy following artery-ligated varicocelectomy is very rare, due to the vascular communications among the testicular, cremasteric and vasal arteries (28), such an event will be a very dramatic complication for a young infertile male. Cayan advocated microsurgical high inguinal varicocelectomy due to its low recurrence rate (2.11 %) when compared with the conventional approach (15.51 %) (29). He also observed a significant increase in sperm motility in the group in which the microsurgical approach was used.

In conclusion, we report that the spermatic artery is injured in most of the cases during inguinal varicocelectomy when loop magnification is not used. The only difference in semen parameters is the improvement of sperm motility in the artery-preserved group when compared with the artery-ligated group. Varicocelectomy does not ameliorate strict sperm morphology in both groups.

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