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Recurrence rates in pediatric patients undergoing microsurgical subinguinal varicocelelectomy with and without testicular delivery[☆]

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ABSTRACT

Background/purpose: The purpose of the study was to determine if testicular delivery during microsurgical subinguinal varicocelelectomy (MSV) reduces varicocele recurrence rates in pediatric patients. Testicular delivery during MSV enables ligation of the gubernacular veins, which is thought to reduce the likelihood of varicocele recurrence. However, recent studies have suggested that testicular delivery during MSV does not offer any beneficial effect and, therefore, may be optional or unnecessary.

Methods: A total of 58 pediatric patients with grade II (nine, 15.5%) or III (49, 84.5%) varicocele met inclusion criteria. Of these 58 patients, 25 (43%) underwent MSV with testicular delivery and 33 (57%) underwent MSV without testicular delivery. Varicocele recurrence, testicular size change, and complications including edema, pain, paresthesia, hydrocele, and testicular atrophy were assessed to evaluate the effects of testicular delivery during MSV.

Results: Recurrence rates were 20% and 6.1% in patients who underwent MSV with and without testicular delivery, respectively. Univariate analysis of primary endpoints demonstrated significantly decreased recurrence, scrotal pain, and temporary paresthesia in patients who underwent MSV without testicular delivery compared to those with testicular delivery. Multivariate analysis also demonstrated that recurrence was significantly associated with testicular delivery.

Conclusions: Testicular delivery to enable ligation of the gubernacular veins during MSV resulted in a higher recurrence rate in pediatric patients. Further investigation including prospective studies with long-term follow-up is needed to determine if testicular delivery during MSV is an unnecessary procedure in pediatric patients.

Level of evidence: 2

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A survey of U.S. Pediatric Urologists in 2014 revealed that the most common surgical approaches to varicocelelectomy were laparoscopic (38%) followed by microsurgical subinguinal varicocelelectomy (MSV, 28%) [1]. In 1985, Marmar et al. first reported the results of varicocelelectomy without testicular delivery via microdissection of the spermatic cord at the external inguinal ring [2]. Seven years later, Goldstein et al. introduced microsurgical inguinal varicocelelectomy (MIV) with testicular delivery for ligation of the gubernacular veins to reduce the incidence of testicular artery injury and varicocele recurrence [3]. Since the introduction of the microsurgical technique, microsurgical varicocelelectomy (i.e., MIV or MSV) with testicular delivery has been regarded as the treatment of choice in adults for more than two decades. However, ligation of the gubernacular veins

and both the internal and external spermatic veins leaves the deferential veins as the only route for draining venous blood from the testis and epididymis. As a result, the deferential veins can be overloaded following varicocelelectomy. In 2006, Ramasamy and Schlegel compared varicocelelectomies with and without testicular delivery in adult men, and they found that varicocelelectomy without testicular delivery had equivalent, if not more, beneficial effects on semen parameters without affecting varicocele recurrence rates [4]. Controversy still exists regarding the role of the gubernacular veins in varicocele pathogenesis. The gubernacular veins can contribute in part to varicocele recurrence but can also be a beneficial route of venous blood drainage from the testis after ligation of internal and external spermatic veins and prevent overload of the deferential veins. To our knowledge, there are no published studies in pediatric patients comparing the efficacy of varicocelelectomy with and without testicular delivery (i.e., with or without ligation of the gubernacular veins). We hypothesized that testicular delivery during MSV in pediatric patients might be unnecessary and detrimental in terms of patient outcomes, namely varicocele recurrence. To test this hypothesis, we compared the results of MSV with and without testicular delivery in pediatric patients with varicocele.

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Table 1
Patient baseline data.

	MSV with TD	MSV without TD	Total	P-value
No of Patients	25	33	58	
Mean Age (years)	12.8 ± 3.08	13.2 ± 3.19	13.1 ± 3.11	0.598
BMI (kg/m ²)	19.6 ± 2.8	20.1 ± 3.1	19.9 ± 2.7	0.551
Grade of Varicocele				0.773
II	4	5	9	
III	21	28	49	

MSV; microsurgical subinguinal varicocelectomy; TD; testicular delivery.

1. Materials and methods

In this prospective comparative study, a total of 70 pediatric patients (from 5 to 18 years old) with grade II (i.e., palpable on routine physical examination without the need for Valsava maneuver) or III (i.e., visible to the eye and palpable on physical examination) varicocele on their left testicle underwent MSV between June 2003 and February 2013. Fifty eight out of 70 patients were followed up for at least 12 months with a mean follow-up duration of 15.8 ± 3.5 months. Indications for surgery were a size discrepancy of more than 15% with grade III varicoceles (25.8%), a size discrepancy of more than 20% with grade II or III varicoceles (53.4%), and testicular pain with grade II or III varicoceles (24.1%). Nine out of 58 (15.5%) and 49 out of 58 (84.5%) patients exhibited grade II and grade III varicoceles, respectively. A single urologist, Dr. Young Kwon Hong, carried out all MSV procedures involving separation of spermatic cord and microdissection of internal spermatic compartment. Great care was taken to preserve the testicular artery and all lymphatics. Testicular delivery was performed after ligation of the external and internal spermatic veins, and the gubernacular veins bigger than 2 mm in diameter were divided and ligated.

Patients were allocated to MSV with or without testis delivery using simple randomization. Testicle size was measured on every visit before and after surgery with a Prader testicle orchidometer. Postoperative outcomes were assessed in terms of varicocele recurrence, changes in testicular size, and complications including edema, pain, paresthesia, hydrocele, and testicular atrophy. Reappearance of palpable or visible varicoceles with physical examination during the follow-up was defined as varicocele recurrence. Statistical analyses were performed using independent sample t-test to evaluate variables (age, BMI, testis size, varicocele grade), chi-square tests for comparison of postoperative complications (recurrence, edema, scrotal pain, temporary paresthesia, hydrocele, atrophy) and logistic regression analyses to evaluate multiple factors associated with varicocele recurrence with Microsoft Excel and IBM SPSS statistics V21.0 (Statistical Package for Social Sciences™, Chicago, IL, USA).

2. Results

The mean age and BMI of patients who underwent MSV with testicular delivery were 12.8 ± 3.0 years and 19.6 ± 2.8 kg/m², respectively. The mean age and BMI of patients who underwent MSV without testicular delivery were 13.2 ± 3.1 years and 20.1 ± 3.1 kg/m²,

respectively. There were no statistically significant differences in mean age ($P = 0.598$) or BMI ($P = 0.551$) between treatment groups (Table 1).

Of the 25 patients who underwent MSV with testicular delivery, 5 patients (20%) exhibited varicocele recurrence. Postoperative edema developed in four patients (16%) and resolved spontaneously within two months of surgery. Nine patients (36%) experienced scrotal pain postoperatively, which resolved after a short course of ibuprofen administration. Three patients (12%) experienced temporary paresthesia that resolved gradually over time. The mean size increase of the ipsilateral testicle after surgery was 3.9 ± 2.7 cm³.

In contrast, of the 33 patients who underwent MSV without testicular delivery, only two patients (6.1%) exhibited varicocele recurrence. Postoperative edema developed in two patients (6.1%). Three patients (9.2%) experienced scrotal pain postoperatively. None of the patients experienced postoperative paresthesia. The mean size increase of the ipsilateral testicle after surgery was 4.4 ± 3.4 cm³ (Table 2).

While there was no significant difference in size change of the ipsilateral testicle between patient groups ($P = 0.547$), significant differences were found in varicocele recurrence ($P = 0.034$), scrotal pain ($P = 0.050$), and temporary paresthesia ($P = 0.031$) favoring MSV without testicular delivery. There were no hydrocele and testicular atrophy in either group. Logistic regression analysis revealed that there were no significant differences in variables associated with varicocele recurrence (age, BMI, varicocele grade, follow-up duration) except the surgical technique utilized ($P = 0.041$).

Of the seven patients who experienced varicocele recurrence, three underwent redo surgery (MSV), one underwent varicocele embolization, and three with grade II varicoceles were monitored over time with follow-up visits.

3. Discussion

Clinical varicoceles are present in approximately 15% of the general male population, in up to 35% of men with primary infertility, and up to 75% of men with secondary infertility [5,6]. Varicocele is the primary cause of correctable male infertility. Indications for varicocelectomy include infertility, persistent pain, and significant testicular asymmetry in children or adolescents. The ideal method of varicocele treatment remains controversial. Varicocele embolization is a nonsurgical option. In a retrospective study conducted by a Canadian group, including 41 pediatric patients who underwent varicocele embolization, the success rate and recurrence rates were 95% and 10%, respectively [7]. In a most recent study done by a Switzerland group [8], the results were comparable, yielding a technical success of 93% and a recurrence rate at 13%. Compared to the main surgical methods, embolization has an equivalent technical success rate. Given the idea that the testis remains in situ without testis delivery in varicocele embolization, we can also compare the results of that procedure with our results without testicular delivery, finding that the recurrence rate is slightly higher in embolization group (10%–13% versus 6.1%).

Surgical options for varicocele repair include the traditional inguinal (Ivanissevich) or high retroperitoneal (Palomo) approaches, laparoscopic repair, and microsurgical repair via an inguinal or

Table 2
Postoperative complications, testicular growth, and recurrence.

	MSV with TD	MSV without TD	Total	P-value
Edema	4 (16%)	2 (6.1%)	6 (10.3%)	0.227
Pain	8 (36%)	3 (9.2%)	11 (18.9%)	0.050
Scrotal Paresthesia	3 (12%)	0 (0%)	3 (5.2%)	0.031
Hydrocele or Testicular Atrophy	0 (0%)	0 (0%)	0 (0%)	Not significant
Size Change	3.9 ± 2.7 cm ³	4.4 ± 3.4 cm ³	4.2 ± 3.2 cm ³	0.547
Recurrence	5 (20%)	2 (6.1%)	7 (12.0%)	0.034

MSV; microsurgical subinguinal varicocelectomy; TD; testicular delivery.

subinguinal incision. Each technique has its own advantages and disadvantages, and discordant results have been yielded by a number of studies [9]. Complications associated with varicocele repair include hydrocele formation, persistence or recurrence of the varicocele, and, in rare cases, testicular atrophy. Of the surgical approaches to varicocele repair, microsurgical varicocelectomy (i.e., MSV or MIV) is the gold standard in adults and is widely utilized in pediatric patients because of its high success and low complication rates [10–12]. MSV involves microdissection of the spermatic cord at the subinguinal level. The subinguinal approach offers easy access to varicose spermatic veins and collaterals without entering the external oblique aponeurosis, resulting in less pain but more veins to be ligated compared to the inguinal approach. Use of a surgical microscope allows for the meticulous dissection of the internal spermatic cord and the preservation of arteries, lymphatics, and nerves. Following ligation of the internal and external spermatic veins, venous return from the testicle is still theoretically possible via the gubernacular veins, which may contribute to varicocele recurrence [13]. Delivery of the testicle through the inguinal or subinguinal incision allows for ligation of the gubernacular veins and external spermatic collateral veins. For this reason, many studies support the concept of testicular delivery for the ligation of the gubernacular veins during MSV [3,14–16]. However, a study performed by Carbone and Merhoff reported excellent results utilizing microsurgical varicocele ligation without testicular delivery: Of the 139 adult men who underwent the procedure only one patient experienced varicocele recurrence (0.7%) and only four patients experienced complications (2.9%) [17]. In 2006, Ramasamy and Schlegel compared varicocelectomies with and without testicular delivery in 165 adult men. Their results demonstrated a significant increase in motile sperm after varicocelectomy without testicular delivery ($P < 0.05$) for grade II and III varicoceles. Furthermore, men who underwent varicocelectomy without testicular delivery exhibited a significant increase in testosterone levels (323 to 471 ng/dL on average, $P < 0.05$), whereas men who had testicular delivery showed no significant changes. Thus, their results suggest that varicocelectomy without testicular delivery did not affect varicocele recurrence rates and was equally, if not more, beneficial for improving semen quality compared to varicocelectomy with testicular delivery [4].

Although these studies suggest that testicular delivery is not necessary during MSV in adult men, there are no studies, to our knowledge, comparing MSV with and without testicular delivery in pediatric patients. In their retrospective study, Kim et al. examined varicocele recurrence rates in 138 adult and pediatric patients who underwent MSV without testicular delivery. Their results demonstrated a total recurrence rate of 4.3% [18]. However, this study did not compare MSV with and without testicular delivery and did not directly compare recurrence rates between adult and pediatric patients. In another study including both adult and pediatric patients, Park et al. compared the operative time and surgical difficulty of MSV with testicular delivery between adults and children. They demonstrated no significant differences in surgical difficulty and found that there was a lack of gubernacular vein enlargement in prepubertal boys [19]. Thus, their results suggest that testicular delivery during MSV may not be necessary in pediatric patients. In their comprehensive review of MSV techniques in children, adolescents, and adults, Mirilas and Mentessido stated a preference for MSV without testicular delivery and concomitant ligation of the gubernacular veins. They justify this preference by noting

that ligation of the gubernacular veins in addition to the internal and external spermatic veins leaves only the small deferential veins for venous drainage, and that the venous blood flow from the testis and epididymis might surpass the draining capacities of the remaining deferential veins [9].

As demonstrated by our results, varicocele recurrence is one of the most common complications following microsurgical varicocelectomy. Compared to MSV with testicular delivery, our results demonstrate a significantly higher varicocele recurrence rate in pediatric patients who underwent MSV with testicular delivery. Recurrence rates may be dependent on a number of factors including the age of the population studied, varicocele grade, approaches and techniques employed, the definition of recurrence utilized, and the follow-up period. In addition, BMI can also contribute to varicocele recurrence. To this end, a recent study revealed that a BMI score lower than 25 kg/m² significantly increased the recurrence rate following varicocelectomy ($P = 0.027$, OR = 1.25) [20].

To our knowledge, this study is the first to compare MSV with and without testicular delivery for ligation of the gubernacular veins in pediatric patients. Although we have employed the standard of care, the recurrence rates in our study were relatively higher than those in previous studies (Table 3). Of the seven recurrences experienced, three were grade II and four were grade III. The four patients who experienced grade III recurrences underwent redo varicocelectomy or embolization.

4. Conclusions

Testicular delivery for ligation of the gubernacular veins during MSV may be associated with increased varicocele recurrence in pediatric patients. Further investigation including prospective studies with long-term follow-up is needed to determine if testicular delivery during MSV is an unnecessary procedure in pediatric patients.

Author contributions

CI Choi: Data collection, Data analysis, Manuscript writing.

KC Park: Data management, Data analysis.

TH Lee: Data collection.

YK Hong: Project development, Data analysis, Manuscript writing and editing.

Conflicts of interest

None.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Informed consent

For this type of study, formal consent is not required (waived).

Table 3
Results of studies without testicular delivery.

Study	Population	Delivery of testis	Number of Patients (TD/NTD)	Magnification	Approach	F/U (month)	Recurrence Rate
Ramasamy and Schlegel	Adult	TD + NTD	165 (55/110)	microscope	inguinal	3, 6, 9, 24	0%
Carbone, Jr. and Merhoff	Adult	NTD	139 (0/139)	microscope	subinguinal	22	0.70%
Kim et al.	Adult and Pediatric	NTD	138 (0/138)	microscope	subinguinal	12	4.30%
This study	Pediatric	TD + NTD	58 (25/33)	microscope	subinguinal	16	12.0% (20.0/6.1)

TD; testicular delivery; NTD; without testicular delivery.

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