

Surgical Treatment of Varicocele in Children With Open and Laparoscopic Palomo Technique: A Systematic Review of the Literature

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Abbreviations and Acronyms

CLP = classic laparoscopic Palomo
COP = classic open Palomo
CP = classic Palomo
MP = modified Palomo

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Purpose: We systematically reviewed the results of varicocelectomy by Palomo procedure in children and adolescents.

Materials and Methods: We performed a search of the English literature through the MEDLINE® database and the Cochrane Central Search library. The key words used were “varicocele and children” and “varicocele and adolescents.” Of 264 articles published with data on varicocele surgery in children and adolescents 27 concerned the classic Palomo procedure and 20 dealt with the modified Palomo technique, in which the testicular artery was spared. Laparoscopic Palomo varicocelectomy was compared with the open Palomo technique.

Results: Totals of 1,344 and 496 patients were treated with the laparoscopic and open Palomo techniques, respectively. The rates of hydrocele in the open and laparoscopic groups were 9.7% and 6.9%, respectively ($p = 0.81$). The rate of recurrence was 2.9% in the open group and 4.4% in the laparoscopic group ($p = 0.146$). A modified Palomo procedure was used in 715 operations and the classic technique in 1,454. Hydrocele was diagnosed in 3.2% of patients in the modified group and 7.7% in the classic group ($p < 0.001$). Varicocele recurred in 4.2% of patients undergoing the modified procedure and 3.4% of those undergoing the classic procedure ($p = 0.506$). Mean \pm SD testicular catch-up growth was $54.7\% \pm 38.9\%$ in the modified group and $66.7\% \pm 19.9\%$ in the classic group ($p = 0.584$). Three studies documented improvement of the quality of semen examination postoperatively compared to a control group of uncorrected cases. No study evaluated the rate of fertility after varicocelectomy.

Conclusions: The rate of hydrocele is high with the classic Palomo technique and less with the modified technique. The rate of varicocele recurrence is around 3% to 4% with both procedures. The percentage of testicular catch-up growth is variable.

Key Words: adolescent; child; testicular hydrocele; urologic surgical procedures, male; varicocele

THE reported incidence of varicocele in children and adolescents is 10% to 15%.¹ Varicocele is generally accepted as the most common cause of subfertility in men. The guidelines for man-

aging varicocele in children are still not clearly defined, but the major surgical indications are testicular loss of volume followed by testicular pain. It is generally accepted that the rate of

testicular catch-up growth postoperatively is about 80%.² Methods of repair include the classic Palomo technique with high mass ligation of the spermatic vessels, modified Palomo procedure with preservation of the testicular artery, and inguinal and subinguinal techniques with or without artery sparing. The ideal procedure should eliminate the varicocele with low rates of recurrence and hydrocele formation, as well as a low rate of testicular compromise.

Varicocelectomy by Palomo repair remains an often used procedure because of the low recurrence rate, easy performance, low cost and low rate of testicular atrophy. In the last decade with the popularity of laparoscopy several studies have been published on the classic and MP techniques.³⁻⁵ However, there is some criticism for the Palomo procedure regarding the high rate of hydrocele formation mainly on long-term followup.⁵ We systematically review series evaluating the results of varicocelectomy by Palomo technique in children and adolescents.

MATERIALS AND METHODS

This systematic review was based on an English literature search using the MEDLINE database and the Cochrane Central Search library. Crossing the word "varicocele" with the words "child," "children," "pediatric" and "adolescents," all abstracts found were read. Only articles with data regarding children or adolescents (younger than 18 years) who underwent varicocelectomy by open or laparoscopic technique were selected for analysis. Of 264 studies published with data on varicocele surgery in children and adolescents 47 involved the Palomo procedure and fit our inclusion criteria. We separated the articles into classic Palomo technique, in which the testicular artery, veins and lymphatics are ligated (27), and MP technique, in which the testicular artery is preserved (20). In the case of any contradiction of data a referee made a third revision and the final decision. Seven articles that evaluated the results of varicocelectomy by Palomo technique in children, adolescents and patients older than 18 years were excluded from our review.

We first compared the results of the COP and CLP techniques, and then we compared the results of CP and MP. The results of continuous variables were reported as mean \pm standard deviation, and in these cases the statistical difference was calculated using Student's *t* test. The statistical difference of percentages was calculated by chi-square, and *p* value was considered significant at less than 0.05.

RESULTS

Of the studies included in this review we found only retrospective series and 1 randomized controlled trial.

Classic Open Palomo vs Classic Laparoscopic Palomo Technique

A total of 1,830 surgeries were included in the analysis, with 1,344 and 496 operations performed by CLP and COP, respectively. Mean \pm SD patient age was 12.74 years (12 ± 1.47 in the COP group and 13.1 ± 0.74 in the CLP group, *p* = 0.66). The operation was left in 1,378 cases and right in 42, and was not stipulated in 410. Three patients had an isolated right varicocele. There was no difference in the operated side between the COP and CLP groups. Only 1 article stated that the procedure was performed by a single surgeon, with 7 documenting different surgeons and the remaining unspecified. According to surgery indication, 715 varicoceles (72.4%) were operated on because of high grade, 216 (21.9%) due to testicular hypotrophy, 47 (4.8%) because of scrotal pain and 10 (1%) due to varicocele recurrence. No patient underwent the operation due to sperm alteration or infertility. The indication for surgery was not stated in 842 patients (46%).

Eight studies evaluated the average surgical time, 7 in the CLP group and 1 in the COP group. Mean \pm SD surgical time was 53.5 ± 12.02 minutes for CLP and 30 minutes for COP (1 study). The longest surgical time was 120 minutes in the CLP group. No study evaluated patient satisfaction with surgery.

Only 9 studies analyzed intraoperative complications. There were 4 conversions to open surgery in patients undergoing CLP, 2 due to problems with abdominal insufflation and 2 because of technical difficulty. In the CLP group there were 2 intraoperative complications, consisting of 1 lesion of the testicular artery and 1 lesion of the genitofemoral nerve. Transient numbness of the ipsilateral anterior thigh was reported in 3 patients. There was no complication or evidence of infection reported in the COP group.

Postoperative hydrocele was evaluated in 1,454 surgeries and was detected in 112 (7.7%). There was no statistical difference in the rate of hydrocele between the COP and CLP groups (9.7% vs 6.9%, *p* = 0.81). The highest rate of hydrocele was 18.8%. Varicocele recurrence was analyzed in 1,301 surgeries and was found in 3.4%. Rates of recurrence were 2.9% for COP and 4.4% for CLP (*p* = 0.146). Eight studies documented the rate of testicular catch-up growth postoperatively. The rate of catch-up in both groups ranged from 37% to 100% (average 71%). Four studies documented less than a 70% rate of testicular catch-up growth.

Modified vs Classic Palomo Technique

MP was used in 715 operations (628 laparoscopic, 87 open) and CP was used in 1,454 (1,344 laparoscopic, 496 open). In the MP group the indication for sur-

gergy was high varicocele grade in 325 patients (45.5%), testicular hypotrophy in 189 (26.4%), testicular pain in 82 (11.5%) and unspecified in 119 (16.6%). Mean \pm SD surgical time was 38.5 ± 10.72 minutes for CP and 36.7 ± 7.78 minutes for MP ($p = 0.831$). The longest surgical time in the MP group was 60 minutes. There was no major surgical complication in the MP group and no conversion from laparoscopic to open surgery.

Hydrocele was diagnosed in 20 of 617 patients (3.2%) in the MP group and 112 of 1,454 (7.7%) in the CP group ($p < 0.001$). Varicocele recurred in 24 of 592 patients (4.1%) in the MP group and 44 of 1,301 (3.4%) in the CP group ($p = 0.506$). Mean \pm SD testicular catch-up growth was $54.7\% \pm 38.9\%$ in the MP group (range 0% to 100%) and $66.7\% \pm 19.9\%$ in the CP group ($p = 0.584$). The catch-up growth rate was evaluated in 8 and 9 studies in the MP and CP groups, respectively. Four studies in each group documented a catch-up rate of less than 70% in the hypotrophic testis. Mean \pm SD followup was 14.5 ± 10.79 months in the CP group and 17 ± 7.2 months in the MP group ($p = 0.575$).

Fertility Rate

Three studies evaluated the quality of sperm post-operatively, with all 3 showing that the correction of varicocele in adolescents improved the quality of semen compared to a control group of uncorrected cases. No study evaluated the fertility rate after varicocelectomy.

DISCUSSION

Although the literature suggests that the major indications for varicocele correction in children and adolescents are testicular hypotrophy and testicular pain, we observed that high grade varicocele was the reason for surgery in the majority of patients. This finding suggests a great concern of the authors that in the future a high grade varicocele will have implications on the quality of sperm and fertility in these children and adolescents.

Our review revealed a 7.7% rate of hydrocele (range 0% to 18.8%) following the Palomo procedure. As expected, there was no difference between CLP and COP. However, hydrocele was demonstrated in 3.2% of patients (range 0% to 12.6%) when MP was used ($p < 0.001$). Ligation of the lymphatic trunks and consequential lymphostasis may explain the higher incidence after CP. In an attempt to preserve the artery MP may also spare lymphatic vessels, thus explaining the lower rate of hydrocele in this group. A high protein content in the hydrocele fluid has confirmed that lymphatic obstruction is an important cause of hydrocele.³

Two studies were excluded from our analysis of hydrocele because they dealt with patients older

than 18 years. In medium to long-term followup the authors reported rates of hydrocele of 22.8% and 28% for CP and MP, respectively.^{5,6} In the study by Hassan et al when only patients with longer than 6 months of followup were considered 29.8% had hydrocele.⁵ Half of the patients with hydrocele required surgery for this complication. Misseri et al, who retrospectively evaluated 67 classic Palomo surgeries, found a 24% rate of hydrocele with a followup of at least 6 months.⁶ When this rate of hydrocele was compared to Ivanissevich surgery (4 of 28 patients, or 14%) the difference was statistically significant. These authors also showed a 2-year post-operative delay in the occurrence of hydrocele, with only 30% of the patients requiring treatment.

A recently published study by Feber and Kass retrospectively evaluated 312 patients 7 to 21 years old who underwent a classic Palomo procedure.⁷ Average followup was 17.4 months (range 2 weeks to 17.4 years). The rate of hydroceles was 29% and the average formation time was 8 months. Only 17.6% of patients with hydrocele needed hydrocelectomy. Inclusion of these 3 studies in the analysis of this systematic review would increase the rate of hydrocele after the classic Palomo technique to 11.5%.⁵⁻⁷

Riccabona et al did not observe hydrocele formation in patients who underwent MP and found hydrocele in 13% of the CP group.⁸ With the intention of avoiding hydrocele formation some authors recommend a simultaneous scrotal incision with fenestration of the tunica vaginalis at varicocelectomy.⁹

The reason for the higher rate of hydrocele in some series may be that there was a longer and closer followup. It could also be due to thermal injury to surrounding tissue during vessel division. We could not find an explanation for the low rate of hydrocele reported in some series of CP procedures, and speculate that it may be due to inadequate followup. Because the size of hydrocele formation ranges from small to large, the indication for surgery is subjective. The rate of hydrocelectomy is biased by physician directed indication and patient wishes. Moreover, it seems clear that a significant number of patients with hydrocele will not require surgery. Our data reveal that in sparing the testicular artery the rate of hydrocele decreases. It is possible that attempting to save the artery spares the lymphatics and, in turn, diminishes the chance of hydrocele formation.

In this review the rate of varicocele recurrence or persistence was low, and there was no difference between COP and CLP (2.9% vs 4.4%), or between CP and MP (3.4% vs 4%). There was a wide range of recurrence among the studies (0% to 15% in CP, and 0% to 25% in MP), which suggests differences in followup or surgical technique. The rate of varicocele recurrence does not seem to increase in series with

longer followup.^{6,7} Persistence of varicocele after repair is related to a variable venous return from the testes. Additional venography does not seem to decrease varicocele recurrence.¹⁰ Some recommend ligation of the deferential veins if they are observed to be dilated during laparoscopy,³ although this procedure might expose the testis to a higher risk of atrophy due to deferential artery injury. Some authors believe that preservation of the testicular artery in MP may increase the rate of varicocele persistence.¹¹ However, the data found in this review demonstrate that the rate of recurrence is similar between CP and MP.

Even with the possibility of being underreported the number of surgical complications is low with the Palomo technique, whether considering the laparoscopic or open procedure. Several nerves, including the ilioinguinal, genitofemoral and obturator, can be injured during the laparoscopic procedure. In a study by Chrouser et al 4.8% of the patients presented with transient numbness of the ipsilateral anterior thigh, which resolved or stabilized within an average of 8 months.¹² Chrouser et al suggest that possible explanations for nerve injury are cauterization heat, direct compression by a surgical clip and microtrauma during dissection.

According to our data, testicular catch-up growth was similar between the MP (54.7%) and CP (66.7%) groups. Four series on each procedure documented catch-up of less than 70%. Because of this variability in testicular catch-up growth, the indication for varicocelectomy only in cases of testicular asymmetry, at least in relation to Palomo technique, should be reevaluated. The increase in testicular volume postoperatively may be a result of recuperation of testis function. However, testicular edema after interruption of lymphatic drainage can also be responsible for an increase in testicular volume. There is no collateral drainage of the testicular lymphatics into the inguinal nodes.¹³ Partial or complete division of the testicular lymphatic vessels may lead to lymphostasis.¹⁴

Kocvara et al evaluated 86 children with grade 2 to 3 varicocele. Of these patients 22 underwent non-lymphatic sparing varicocelectomy, 23 underwent lymphatic sparing varicocelectomy and 41 received conservative treatment.⁴ All patients were examined before treatment and 1 year postoperatively or after entering the protocol. The surgically treated patients were also examined 6 weeks postoperatively. Testicular size was evaluated by ultrasound. Luteinizing hormone and follicle-stimulating hormone serum levels were determined. At 6 weeks and 1 year postoperatively volume increase in the left testis was significantly higher in the nonlymphatic

sparing group compared to the lymphatic sparing group. Left testicular hypertrophy (at least a 10% increase in size over the right testicle) was encountered in 20% to 32% of the patients. Testicular biopsy in 4 patients with hydrocele after varicocelectomy showed marked edema of intertubular tissue and locally reduced spermatogenesis.

Because of the findings of testicular enlargement as early as 6 weeks postoperatively, and because of the testicular edema and a varying degree of tubular atrophy found in the biopsy, Kocvara et al concluded that this edema is most likely responsible for the increase in testis size.⁴ Because of this theoretical "false" catch-up and the low rate of testicular catch-up growth found in this systematic review, it might be a better choice in patients with grade 3 varicocele to anticipate a decline in testicular function and operate before the testis decreases in size.

The end point for the evaluation of varicocelectomy results should be fertility rate. However, no study has evaluated the fertility rate following the Palomo procedure in children and adolescents. Three studies evaluated improvement in sperm examination postoperatively. All of these series compared adults with varicocele corrected during adolescence and uncorrected cases. All 3 studies concluded that the quality of sperm examination was better in patients who underwent varicocelectomy. Lastly Pozza et al reported that there was normalization of 34.8% in sperm examination in adolescents after the Palomo procedure.¹⁵

In this systematic review we found that the series evaluating results of varicocelectomy by Palomo technique were of poor quality. All of these studies were retrospective and there was only 1 randomized clinical trial, which was of poor quality. Podkamev et al conducted a randomized clinical trial but the criteria of randomization were not stated.¹⁶ There was a wide discrepancy in the allocation of the patients between the laparoscopic (434) and open (220) groups. Also, as in many published studies, followup was not discussed.

CONCLUSIONS

The rate of hydrocele is high (7.7%) with the CP technique, and it seems to increase with extended followup. These results suggest that the hydrocele rate is underestimated. Sparing the testicular artery reduces significantly the rate of hydrocele. The rate of varicocele recurrence is similar (3% to 4%) in CP and MP. The percentage of testicular catch-up is variable but the means are only 55% and 67% in MP and CP, respectively. Studies evaluating results after varicocelectomy should improve in quality and focus in assessing fertility rates.

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