International Urology and Nephrology (2019) 51:1933–1939
https://doi.org/10.1007/s11255-019-02228-9

UROLOGY - ORIGINAL PAPER

Positive effects of the inclusion of open-mouth pressure for elimination of blood in microscopic subinguinal varicocelectomy

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Received: 6 April 2019 / Accepted: 5 July 2019 / Published online: 7 August 2019

Abstract

Purposes Primary varicocele (PVC) may cause testicular hypofunction and scrotal pain. We believe that the currently used procedure microscopic subinguinal varicocelectomy (MSV) can be further improved to provide more benefits to the patients.

Methods In total, 100 patients who were diagnosed as having PVC grade II or III with venous reflux based on ultrasound results, along with scrotal pain and visible scrotal varicose veins, were enrolled; they were randomly divided into two groups. When the experimental group underwent MSV, stagnant venous blood in the internal spermatic vein close to the testis was drained using manual pressure, whereas the control group was treated with routine MSV procedure. The patients' psychological condition, symptoms, prognoses, scrotal appearances, and other related indexes were evaluated before and after the surgeries, and the results were compared.

Results Scores on days 1–3 after the surgeries were significantly different between the two groups ($P < 0.05$) for the Hamilton Depression Scale (HAMD) after viewing the scrotum immediately after the surgeries, the Hamilton Anxiety Scale (HAMA) after viewing the scrotum immediately after the surgeries, and the average visual analog scale (VAS). No significant differences were found between the groups for other evaluation indexes ($P > 0.05$).

Conclusions The use of open-mouth pressure for elimination of blood reduces postoperative filling of dilated scrotal veins, reduces the visual stimuli to patients immediately after surgery, significantly improves the anxiety and depression of patients, helps to maintain positive mental condition in patients after the surgeries, and increases their confidence in recovery from the disease. It also leads to better pain relief within a short period after the surgery and maximizes surgical benefits for the patients.

Keywords Microscopic subinguinal varicocelectomy · Elimination of blood · Psychological assessment

Introduction

PVC involves the abnormal expansion, elongation, and distortion of the pampiniform venous plexus in the spermatic cord, and may result in scrotal pain and discomfort and progressive testicular hypofunction. The occurrence of PVC is 20–25% in normal males and as high as 40% in males with infertility. PVC is the most common cause of male infertility [1, 2]. Patients with relatively severe PVC have a worm-like vein mass in their scrotum, which is found during physical examination. This mass is clearly visible inside the scrotal skin, and has been termed a "bag of worms" in the literature [3]. Up to 10% patients may experience pain and discomfort in the scrotal area [4]. Among the available therapeutic methods, microsurgery has gained increasing popularity, primarily owing to its low recurrence rate.

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As a common disorder in males of child-bearing age, PVC has adverse effect on the physical and psychological state of patients. It has been shown that patients with PVC and infertility in China are more susceptible to psychological disorders such as anxiety and depression than individuals without these conditions [5]. Psychological studies have shown that negative psychological state can lead to the aggravation of pain and discomfort in patients with some diseases. Therefore, it can be speculated that PVC patients with negative psychological state may suffer from more severe pain and discomfort. In addition to the psychological effects, metabolic waste stasis in the venous blood surrounding the testicles, backflow of adrenal hormones, and elevated local temperature and pressure caused by stagnant blood may affect the function of the testes.

In clinical practice, during the first-ward round after an operation, many post-MSV patients asked why the "bag of worms" still exists. The patients' emotional states were observed during the questioning process, and it was found that most patients showed increased fear and anxiety, and many did not understand the situation.

To avoid this situation and reduce the impact on patients' psychological trauma and postoperative recovery, modifications were made to the procedure, with the aim of reducing the visual and tactile impacts post-surgery. Improvements were made to the surgical procedure during MSV; when ligating the vein in a spermatic cord, the stagnant venous blood in the internal spermatic vein was drained at the segment close to the testis. The operation has been dubbed open-mouth pressure for elimination of blood (OMPEB). This improvement reduces the immediate filling in a filling and expanding spermatic vein, weakens the visual stimulation, reduces the venous pressure around the testicles, and drains the metabolic waste and backflow hormones remaining around the testicles.

Comparison of the psychological and clinical symptoms, the prognoses of the patients, and changes to scrotum appearance after different types of surgery indicated that the improved operation is superior to the standard approach. Hopefully, this small improvement to the surgical procedure can maximize the surgical benefits for PVC patients.

Materials and methods

Object of research

This study was designed as a clinical cohort study. The research was approved by the Ethics Committee of our hospital. A total of 100 varicocele patients who were admitted to the Hospital for MSV between September 2018 and February 2019 were enrolled. All patients were experiencing scrotal pain and visible scrotal varicose veins.

Diagnostic criteria

The diagnostic criterion used involved Color Doppler Flow Imaging (CDFI) suggesting varicocele. The clinical indications were as follows. In a calm state, at least three spermatic veins were detected in the spermatic venous plexus, and one of the veins had an inner diameter greater than 2 mm, or had a significantly increased inner diameter when the abdominal pressure is increased, or showed obvious blood reflux after the Valsalva movement.

Inclusion criteria

(1) CDFI indexing: a clinical type varicocele grade II or III. A grade II case meets the following conditions: clinical palpation is positive; ultrasound under quiet respiration suggests the inner diameter of a spermatic vein of 2.8–3.1 mm; there is a reflux during Valsalva movement, and the reflux duration is 4–6 s. A grade III case has the following: the clinical palpation is positive; ultrasound under quiet respiration suggests the inner diameter of a spermatic vein of at least 3.1 mm; there is a reflux during Valsalva movement, and the reflux duration is ≥ 6 s.
(2) A case is accompanied by scrotal pain, as well as scrotal varicose veins visible to the naked eye.

Exclusion criteria

(1) A patient who refused to enter the group.
(2) A patient with secondary varicocele.
(3) A patient with co-existing acute or chronic prostatitis, or other diseases that can cause scrotal discomfort.
(4) A patient with clear history of tumor or autoimmune diseases.
(5) A patient with other serious diseases or mental disorders.

Group criteria

A total of 100 patients were divided at random into two groups. The experimental group underwent the MSV with OMPEB operation, while the control group underwent surgery with the routine procedure.

The OMPEB-MSV operation

Main instruments

A ZEISS OPMI Vario/S88 surgical microscope; micromanipulation instruments; 4-0 non-absorbable sutures.

Surgical procedures

The specific procedures of the OMPEB method are as follows. (1) A 4-0 non-absorbable suture is used to ligate an internal spermatic vein at the distal end from the testicle. (2) At the proximal testicular side of the ligation, micro-scissors are used at a direction perpendicular to the vessel to cut the blood vessel. (3) Using gauze, the scrotum is squeezed to drain the blood from the spermatic vein. (4) A 4-0 non-absorbable suture is used to ligate the blood vessel at the proximal incision end from the testicle. (5) Micro-scissors are used to cut and remove redundant blood vessels (Fig. 1).

Research content and method

Research content

Grouping

A total of 100 patients were randomly divided into an experimental group ($n = 50$) and a control group ($n = 50$). All of the patients underwent the MSV, and patients in the experimental group were treated with an additional OMPEB procedure during the surgery.

Evaluation index

Emotion evaluation scales

The psychological evaluation of the patients was performed using the HAMD and HAMA scales. Patients were tested by a professional using the HAMD and HAMA scales before the surgeries, and the results were recorded. When the patients awoke after the surgeries, the patients were asked to observe their scrotal skin (Fig. 2). Then, the patients were tested again with the HAMD and HAMA scales, and the scores were recorded.

VAS

The VAS was used to evaluate the patients' scores for scrotal pain and discomfort pre-operatively and on postoperative days 1–7, and the results were recorded.

Healing state of surgical incision

The healing states of the surgical incisions were evaluated on day 10 after surgeries, and the results were divided into healing and non-healing.

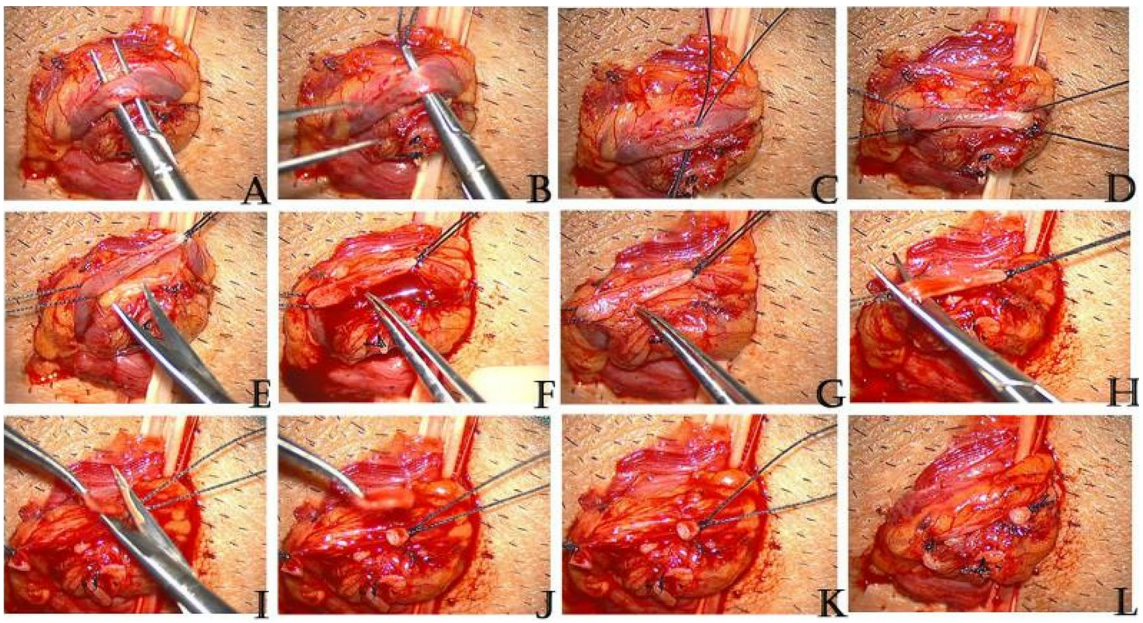

Fig. 1 The procedure of the surgery

Fig. 2 Typical pictures of the local skin of the scrotum before and after the surgeries. Preoperative and postoperative photos of the control group are shown in **a** and **b,** respectively. Preoperative and postoperative photos of the experimental group are shown in **c** and **d,** respectively

Average postoperative hospitalization duration

The postoperative hospital stays were counted in the two groups, and the average postoperative hospital stay was calculated for each group.

Scrotal edema

Scrotal swelling was measured in the two groups. The results were divided into edema and no edema.

Statistical analysis

SPSS 17.0 Statistical Software was used for data processing. For enumerated data, the Chi-square test was used for intergroup comparison. For the measurement data, a normality test was first performed; if the data fit a normal distribution, the mean ± standard deviation ($\bar{x} \pm S$) was used for statistical description. If the data were not normally distributed, the median and interquartile range (M (Q25, Q75)) were used for statistical description. If the measurement data exhibited the normal distribution and had equal variance, *t* test was used for inter-group comparison; if not, the Wilcoxon rank sum test was used. A *P* value of 0.05 or less was considered to indicate statistical significance.

Results

Comparison of the general features between the experimental group and the control group

The study finally included 100 patients, 50 cases each in the experimental group and the control group. There was no significant difference in age or diagnosis between the two groups ($P > 0.05$) (Table 1).

Comparison of the evaluation indexes between the experimental group and the control group

Comparison of the evaluation indexes between the experimental group and the control group indicated that the HAMD scores after viewing the scrotum immediately after the surgeries, the HAMA scores after viewing the scrotum immediately after the surgeries and the average VAS scores on days 1–3 after the surgeries were significantly different between the two groups ($P < 0.05$), while the other evaluation indexes showed no statistically significant differences ($P > 0.05$) (Table 2).

Analysis of the evaluation indexes related to symptom duration

Among the evaluation indexes, the preoperative HAMA score, the preoperative HAMD score, the preoperative VAS score, the HAMA score after viewing the scrotum immediately after the surgery, the HAMD score after viewing the scrotum immediately after the surgery, the scrotal edema, the average VAS score on days 1–3 after the surgery, and average VAS score on days 4–7 after the surgery were related to the duration of pain ($P < 0.05$), while the state of the incision

Table 1 Comparison of the general features

General features	Experimental group ($n = 50$)	Control group ($n = 50$)	Gross	$t/Z/\chi^2$	*P*
Age (years)	30.2 ± 9.3	30.2 ± 9.1	30.2 ± 9.1	0.022	0.983
Diagnosis					
Unilateral varicocele	36	38	74	0.208	0.648
Bilateral varicocele	14	12	26		

Table 2 Comparison of the evaluation indexes

Evaluation indexes	Experimental group ($n=50$)	Control group ($n=50$)	Gross	$t/Z/\chi^2$	P
The preoperative HAMA score	15 (8,17)	15 (8,17.25)	15 (8,17)	0.729	0.466
The preoperative HAMD score	4 (3, 5)	4 (3, 9)	4 (3, 5)	0.688	0.491
The preoperative VAS score	3 (2, 4)	3 (2, 4)	3 (2, 4)	0.086	0.932
The HAMA score after viewing the scrotum immediately after the surgery	6 (5, 6)	13 (9, 17)	7.5 (5, 15)	5.865	< 0.001
The HAMD score after viewing the scrotum immediately after the surgery	3 (3, 4)	4 (3, 4.5)	3 (3, 4)	2.709	0.0067
Scrotal edema					
Yes	10	15	25	1.333	0.248
No	40	35	75		
The incision state on day 10 after the operation					
Healing	49	48	97	0.344	0.558
Non- healing	1	2	3		
The average VAS score on day 1 to day 3 after the surgery	0 (0, 0)	0 (0, 2)	0 (0, 0)	3.132	0.002
The average VAS score on day 4 to day 7 after the surgery	0 (2, 3)	0 (2, 3)	0 (2, 3)	0.272	0.786
Symptom duration (months)	6.9 ± 4.1	5.6 ± 3.0	6.3 ± 3.6	1.688	0.095
The postoperative hospital stay	3.1 ± 0.6	3.3 ± 0.9	3.2 ± 0.8	1.16	0.247

Table 3 Analysis on the evaluation indexes related to symptom duration

Evaluation indexes	R	P
The preoperative HAMA score	0.7421	< 0.001
The preoperative HAMD score	0.3755	0.001
The preoperative VAS score	0.4319	< 0.001
The HAMA score after viewing the scrotum immediately after the surgery	0.3092	0.0017
The HAMD score after viewing the scrotum immediately after the surgery	0.3729	0.0001
Scrotal edema	0.5386	< 0.001
The incision state on day 10 after the operation	− 0.0394	0.6974
The average VAS score on day 1 to day3 after the surgery	0.2328	0.0197
The average VAS score on day 4 to day 7 after the surgery	0.4505	< 0.0001
The postoperative hospital stay	− 0.0246	0.8084

on day 10 after the operation and the postoperative hospital stay were unrelated to the duration of pain ($P > 0.05$) (Table 3).

Discussion

The use of microscopic spermatic vein ligation has increased over time, as microscopic technology improves. Microsurgical spermatic vein ligation produces a more thorough ligation of a spermatic vein and smaller risks in misalignment of the artery and lymphatic vessel in a spermatic cord than other techniques, and is the therapy with the best clinical outcomes for varicocele [6, 7]. At present, microscopic spermatic vein ligation is the preferred surgical treatment for varicocele.

MSV is a microscopic spermatic vein ligation method. A groin external ring incision is usually used to open the cremaster muscle and the external and internal spermatic cord fascia, the testicular artery is identified and protected with traction, a non-absorbable suture is used for double ligation, and all of the internal spermatic vein branches are cut. According to the results of this study, the integration of the OMPEB procedure improves the outcomes of MSV.

In clinical practice, many patients question why their "bag of worms" still exists after their operation. Their inquiry is often accompanied by strong feelings of anxiety and fear. Pain arises not just from an organic lesion, but involves cognition, emotion, behavior, environment, and other psychosocial factors [8]. Therefore, it appears that negative emotions such as anxiety, depression, and fear may aggravate scrotal pain in PVC patients, resulting in poor psychological conditions and compromising their postoperative recovery and confidence about overcoming the disease. Surgeons should make efforts to help patients to alleviate negative emotions and regain a favorable postoperative mental state. The easiest

way to achieve this end is to "squash" the "bag of worms," allowing a patient to observe immediate reduction of the "bag of worms" after surgery, reducing the visual stimuli and the consequent negative emotions, and enhancing the patient's confidence about recovery. Experience shows that the internal spermatic vein segment close to a scrotum can refill if the OMPEB was integrated into the surgery, but the degree of refilling is significantly lower than that without the OMPEB. The immediate reduction of the "bag of worms" can significantly improve a patient's levels of anxiety and depression and produce a favorable psychological state in the patient.

The pain caused by PVC occurs mainly in the scrotum and groin areas [9]. The specific pathogenesis of the pain is still unclear, but has been reported to be related to the oppression of the traction of varicosed veins on the sensory branches of the ilioinguinal nerve and the genitocrural nerve, or possibly related to the temperature increase and tissue ischemia caused by blood stasis in the spermatic vein. These factors stimulate terminal pain receptors to produce nervous impulses, which are transmitted to the spinal dorsal horn by the spinal nerve pathway, and then transmitted through the spinothalamic tract to the brain, where algesia is produced [10, 11]. According to Traditional Chinese Medicine, PVC belongs to the category of "nodular varicosity," "swelling with bearing-down pain of one testis," and "fascial hernia." It is believed in Traditional Chinese Medicine that, in PVC cases, blood clogs in the internal spermatic vein, and the backflow of vital energy and blood is poor, causing pain. The "method of pain relieving with stasis removal" is a commonly used treatment for the pain and discomfort caused by poor circulation of vital energy and blood stasis. From the perspective of Traditional Chinese Medicine, the degree of blood stagnation in the lumen, as well as the pain, is maximized within a short period of time after internal spermatic vein ligation. The OMPEB procedure eliminates stagnant blood, reduces the poor circulation of vital energy and blood, and, therefore, relieves the pain. According to Western medical research, the initiator of the pain is venous blood stagnation in the spermatic veins; in the conventional MSV operation, the blood in the spermatic vein segment close to the scrotum continues to stagnate in the blood vessel after the internal spermatic vein is ligated, possibly causing local temperature rise and tissue hypoxia within a short period of time, as well as persistent pain. If the blood is not discharged after internal spermatic vein ligation, it may cause a short-term pressure peak in the lumen, which will maximize the diameter of the lumen, pull, and stimulate the sensory branches of the peripheral nerves, and result in short-term postoperative pain. The ligated internal spermatic vein segment close to the scrotum may continue to thicken because of increased internal pressure in the segment due to the continued transmission of venous blood from the testicles in the short term. If the stagnant venous blood in the internal spermatic vein is drained at the segment close to testis, the filling of the scrotal veins will be reduced. This phenomenon needs further research. Our findings confirm the hypothesis that integration of the OMPEB procedure lowers patients' mean postoperative VAS scores on days 1–3. Short-term pain relief after the surgery is improved. Combined with the pathogenesis of the pain in chronic scrotal conditions [12], it is possible that a long history of varicocele may cause dysfunction of the venous wall, causing the exudation of testicular metabolic waste in the lumen and adrenal backflow hormones; this exudation stimulates the sensory branches of the peripheral nerves, and results in neurogenic inflammation and neuronal hypersensitivity, which in turn causes pain. This fact also explains the finding that the integration of OMPEB does not reduce the mean postoperative VAS score on days 4–7. The integration does not reduce longer term pain after the operation. This is only speculation and requires future verification. The timely elimination of stagnant blood around the testicles may reduce the effects of the intra-blood metabolic waste, hormones, high temperature, and high pressure on testicular function, and protect the patients' testicular function.

There were no statistically significant differences between the two groups in the average postoperative hospital stay, scrotal edema, or postoperative day 10 incision conditions. Scrotal edema is a common complication after MSV. It is currently considered that edema is associated with intraoperative lymphatic injury, and there appears to be no correlation between OMPEB and the occurrence of scrotal edema.

The scores related to pain, mood, and scrotal edema were positively correlated with the duration of pain, consistent with the current research theories. The positive correlation of scrotal edema with the duration of pain in the patients may be associated with inflammatory adhesion of the internal spermatic content caused by a long-disease history, increasing the difficulty of the operation and causing erroneous ligation of a lymphatic vessel. We observed that many patients with long history of varicocele suffered from more severe adhesion of the internal spermatic content, and it was more difficult to separate the internal spermatic veins during surgery; for cases with a shorter history, most of the spermatic contents showed no adhesion, and the operations were relatively simple.

It appears that blood remaining in the blood vessels has an adverse effect on testicular function and scrotal pain, but this effect might be negligible when externalized as a relevant evaluation index. OMPEB can be completed in just a few minutes, and appears to have a positive effect on the outcome of surgery. With the current rapid development of medical technologies, refinement of surgical procedures and the maximization of patient benefits are important, and even a small impact may be advantageous.

Conclusions

Compared with the conventional MSV, adding the OMPEB procedure has several advantages. It can significantly improve the postoperative anxiety and depression of patients, improving their psychological state, and increasing their speed of recovery and confidence in the outcome; it can reduce the patients' pain in the short term after surgery; and it can also maximize the benefits of MSV. Overall, the addition of OMPEB to conventional MSV is quick, easy to implement, and has positive implications for patient outcomes.

Funding No funding was received.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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