

Preservation of Frenular Artery During Circumcision

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Abstract

Background: Circumcision is a widely performed surgical procedure. Though it is a simple operation, oftentimes a number of complications are encountered. Among them post-circumcision pain and bleeding are of paramount concern. These may cause apprehension in the parents as well as in patients. Surgical procedure of circumcision should, therefore, be pain-free and devoid of complication as much as possible.

Methods: In this prospective randomized double blind observational study, we had compared two commonly practiced technique of circumcision and evaluated the outcomes in regard to post circumcision pain and complications, and overall cosmesis. The study was carried out in 100 boys randomly allocated in two groups from July 2016 through June 2017.

Result: The results revealed that the modified sleeve method in which the frenular artery of penis was preserved was associated with significantly less post circumcision pain and fewer complications. In addition, boys who underwent modified sleeve method exhibited better overall cosmesis.

Conclusion: It could be reasonably inferred that preservation of frenular artery during circumcision reduces post circumcision pain and complications and provides better cosmesis.

Key words: Circumcision, Post-circumcision pain, complications, cosmesis, frenular artery.

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Introduction

Circumcision is a very common surgical procedure,¹⁻³ approximately one in three men are circumcised globally⁴. Although it is a simple procedure, several significant complications may be encountered following circumcision^{5,6}. Particularly, post-operative pain is a ubiquitous feature that accompanies circumcision and produces alarming apprehension and concern in the minds of the parents as well as the patients⁷. Freeman⁸ showed that parental perception and physicians' assessment differed considerably (9.3% vs. 2%) in regard to post-circumcision pain (PCP) & complication, and cosmetic outcome. PCP in infants and children may

have harmful effect on developing brain⁹ by increased free radical production and may cause immediate and subsequent psychological trauma¹⁰. It is, therefore, important that, in order to ameliorate PCP and also parental concern, the surgical procedure and post-surgical period must be smooth and uneventful. The surgical procedure thus should incorporate some ingenious technique as to obviate or eliminate PCP as much as possible^{11,12}. There are various methods of circumcision but none of these have been found to adequately eliminate PCP¹³. Belliene concluded that more research is required to find a better approach in order to make infantile circumcision a painless procedure without stress or discomfort¹³. In this study, the circumcision technique had been designed in such a fashion (preservation of the frenular artery) with an aim to minimize PCP and other complications effectively¹⁴. Recently, a study¹⁵ by Karakoyunlu, Polat et al. showed significantly less pain and less complication with the modified sleeve method. Here, we intend to validate the result of that study and establish a gold standard method of circumcision causing less pain and complication in boys undergoing circumcision majority

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of which undertake the procedure for religious and cultural reasons¹⁶.

Methods

This was a prospective randomized double-blind observational study carried out in the department of Pediatric Surgery in BIRDEM General Hospital, Dhaka from July 2016 to June 2017. Approval was obtained from the Ethical Review Committee of Diabetic Association of Bangladesh. The parents of the children involved were counselled in details and all of them signed an informed consent allowing their son to participate.

The objective of the study was to evaluate and compare the two commonly practiced circumcision techniques by observing if any one of these methods is superior in respect to PCP, overall cosmesis and post-operative complication. Specifically the following methods were espoused to measure outcome:

- a) Assessment of PCP at different points of time following surgery. In the first 12 hours, PCP was evaluated by Modified Objective Pain Score (MOPS) and during the ensuing 3 to 4 days pain was assessed by consumption of supplemental analgesics.
- b) Assessment of overall cosmesis during the two follow-ups following circumcision. The extent of wound healing, scar formation, presence of too much or too little foreskin, and preservation of normal anatomy of the frenulum were determined.
- c) Evaluation of complications was done in the context of bleeding, infection, edematous swelling of penis, scab formation on glans penis, glanular adhesion, skin bridges and meatal stenosis.

All the boys aged between 2 years to 12 years who attended pediatric surgery department for circumcision for religious ground or with medical indication were included in the study. The boys who had concomitant surgery (eg. herniotomy with circumcision) and boys with co-morbid medical conditions (Diabetes with polyneuropathy, coagulopathy or other bleeding disorders and chronic dermatological diseases) were excluded.

Two techniques of circumcision namely the dorsal slit method (DS, Group-1) and the modified sleeve method

(MS, Group-2) were used. Randomization was achieved by allocating the technique alternately amongst the consecutively registered boys in BIRDEM General Hospital. The conventional sleeve technique was partially modified to preserve the frenular artery of the penis.

Two different pediatric surgeons carried out circumcision with loupe magnification using bipolar diathermy. The surgeon adept in a particular technique performed circumcision in that technique only. The surgical procedure was performed after induction of general anesthesia with intravenous propofol (2mg/kg) and fentanyl (1mcg/kg) followed by insertion of laryngeal mask airway, and complemented by caudal block (Inj 0.25% Bupivacaine 0.5 – 1.0 ml/kg) in every patient. Anesthesia was maintained using halothane in a 50/50 oxygen-nitrous oxide mixture. During surgery, the boys were monitored for mean arterial pressure (MAP), heart rate (HR) and peripheral oxygen saturation (SPO₂). The efficacy of intraoperative analgesia was assessed by changes in HR and MAP. Increase of >20% of the pre-incision values in HR and MAP were indicative of inadequate intraoperative analgesia. In such circumstances, additional 1mcg/kg of fentanyl was administered. After completion of the surgery, the boy was shifted to the recovery room where he was monitored closely and assessed for PCP by an anesthetic doctor.

Assessment of pain

1. In this study the primary outcome parameter -PCP- was assessed by MOPS during first 12 hours and during next 3 to 4 days by post-operative consumption of supplemental analgesics. Immediately following surgery, anesthetic doctors blinded to the technique assessed the boy in the recovery room at different point of time such as 0, 3, 6, and 12 hour. This was based on objective variables (viz, crying, movements, behavior, verbal or body expression). These variables were staggered in three grades (such as 0 = none; 1 = moderate; 2 = severe). This resulted in a cumulative score of 0-10. For children with a MOPS score equal to or greater than 4 (=or>4) analgesic was prescribed.
2. Pain assessment after discharge of the patients was done by the parents who perceived discomfort

experienced by the child. At home for the next 3 to 4 days, pain was graded by the number of oral analgesic intake or by frequency of per rectal application of analgesics (analgesic demand).

Assessment of complications and cosmesis: These were done independently by clinicians who were blinded to the technique. This was carried out during the post-operative period (2 weeks) and the ensuing follow-up period (12 weeks). The outcome measures of complications included post-operative bleeding, edematous swelling, infection, formation of glanular scab, glanular adhesion, skin bridges and meatal stenosis. The overall cosmesis was evaluated on the basis of wound healing, scar formation, residual foreskin, and preservation of normal anatomy of the frenulum.

Statistical method

The sample size was calculated by accepting 90% reduction of the primary end-point of the study (10% margin of error). Data were expressed as means +/- standard deviation (SD). ANOVA test was used to determine significant differences for mean values between the groups (MOPS scores). Chi-square test was

done for testing the need for supplemental analgesic consumption. Z-test was done to compare percentage or proportion between the groups. All tests were two-sided and statistical significance was considered with P-value less than 0.05.

Results

There were 100 boys with age ranging between 2 years and 12 years. Fifty boys were allocated alternatively in each group. The circumcision technique in Group-1 was dorsal slit (DS) and that in Group-2 was modified sleeve (MS). Table I shows the ages and weights of the boys between the groups were similar.

The MOPS were significantly lower in Group-2 than in Group-1 at the first assessment (0-hour) in the recovery room, at 3-hour and 6-hour (P = 0.01, 0.025 and 0.037 respectively) as depicted in Table II.

The time of first analgesic need (i.e. the pain-free period after end of procedure) was significantly prolonged in group-2 (P=0.005) (Table III). Significantly larger number of patients did not require any supplemental analgesics upto 12 hours from end of surgery in Group-2 than in Group-1 (42% vs 20%; P=0.015). Similarly,

Table I. Ages and weights of the boys (n=100) in the study

	Group-1 (n=50)	Group-2 (n=50)	P-value
Age (year)	5.8 +/- 1.9	6.3 +/- 2.0	0.332
Weight (kg)	22.1 +/- 5.6	22.8 +/- 7.7	0.673

Table II. Objective Pain Score (MOPS) at different point of time post-operatively

	Group-1 (n=50)	Group-2 (n=50)	P-value
MOPS : 0-hour Median (min—max)	3 (1—7)	2 (0—4)	0.010
MOPS : 3-hours Median (min—max)	2 (0—5)	1 (0—3)	0.025
MOPS : 6-hours Median (min—max)	2 (1—5)	1 (0—4)	0.037
MOPS : 12-hours Median (min—max)	1 (0—4)	1 (0—3)	0.287

Table III. Doses of analgesics required postoperatively between groups

	Group-1 (n=50)	Group-2 (n=50)	P-value
Time of first analgesic use (Mean +/- SD)	1.4 +/- 1.6	4.4 +/- 3.2	0.005
No. of boys requiring no analgesics for 12 hr	10 (20%)	21 (42%)	0.015
No. of boys requiring bid analgesic till 3 rd POD	26 (52%)	12 (24%)	0.027
No. of boys requiring od analgesic till 3 rd POD	24 (48%)	09 (18%)	0.019
No. of boys requiring analgesic after 3 rd POD	08 (16%)	03 (6%)	0.003
Acetaminophen consumption/day (Mean+/-SD)	650 mg	315 mg	0.022

Table IV. Complications observed during 1st follow-up* and 2nd follow-up**

	Group-1 (n=50)	Group-2 (n=50)	P-value
Reactionary/Secondary bleeding. Nos. (%)	06 (12%)	01 (2%)	0.045
Edematous swelling of penis. Nos. (%)	11 (22%)	02 (4%)	0.005
Glanular scab. Nos. (%)	07 (14%)	01 (2%)	0.023
Glanular adhesion. Nos. (%)	05 (10%)	04 (8%)	0.726
Skin bridges. Nos. (%)	01 (2%)	01 (2%)	1.000
Infection. Nos. (%)	02 (4%)	01 (2%)	0.496
Wound/Stitch scarring. Nos. (%)	07 (14%)	01 (2%)	0.023
Excess foreskin. Nos. (%)	02 (4%)	03 (6%)	0.652
Too little foreskin. Nos. (%)	01 (2%)	01 (2%)	1.000
Altered frenular contour. Nos. (%)	17 (34%)	01 (2%)	0.0001
Meatal stenosis	04 (8%)	00 (0%)	0.036

*First follow-up was done during 7 POD through 14 POD

**Second follow-up took place about 12 weeks after circumcision

acetaminophen consumption per day was also significantly less in boys in Group-2 (P=0.022) than in Group-1.

Table IV showed complications of circumcision and post-surgical cosmesis. Post-circumcision bleeding, edematous swelling, glanular scabbing and scarring were significantly lower in Group-2 than in Group-1. There was no difference between the groups in regard to infection, glanular adhesion, skin bridges, and residual foreskin. The majority ((98%) of boys in Group-2 exhibited normal anatomical contour of the frenulum (P=0.0001). The number of boys developing meatal stenosis in Group-1 was significantly greater than in Group-2 (8% vs 0%; P=0.036).

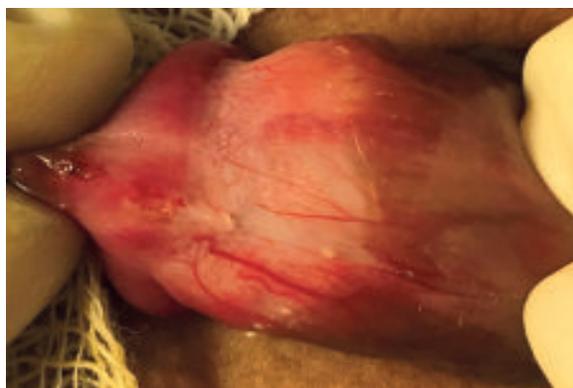


Figure 1. Frenular artery—coarse and distribution

Discussion

Historically, infants undergoing circumcision have not been given analgesia on the erroneous presumption that they do not feel, localize or remember pain. In reality, they have all the anatomical and physiological components for nociception¹⁷. During circumcision boys get agitated, cry intensely, and have fear and fright in facial expression. Their heart rate & blood pressure increase, and oxygenation decreases. Their serum cortisol, beta-endorphin, and catecholamine rise. Clearly, circumcision is painful and, surely, it should be performed with appropriate analgesia by topical analgesia, systemic nonsteroidal anti-inflammatory drugs, opioids analgesics or use of regional anesthetic techniques¹⁸. In this study, caudal block was used as regional anesthesia. Other techniques include dorsal penile nerve block (DPNB), pudental block and topical lidocain-prilocain gel. Belliene et al. systematically reviewed 14 studies and found that no method completely eliminated pain¹³. Presently, attention is focused to reduce circumcision related pain and other complications on refinements in the circumcision technique.

In this study, post-operative outcome was evaluated by comparing results from Dorsal Slit (DS) and Modified Sleeve (MS) methods. Conventionally, in circumcision, the frenular artery is cut as incision is made in the inner

preputial layer. In this study, the Sleeve method is partially modified to preserve the frenular artery. This artery is formed by union of two un-named arteries (arising from the dorsal artery of penis) that traverse across onto the ventral aspect and run underneath the frenulum (Figure-1). Two branches from the frenular artery on each side pass distally at the level of corona sulcus¹⁹. In order to save the frenular artery in Modified Sleeve (MS) method, the circumferential incision is made in the inner preputial layer far proximally (0.5 – 0.8 cm from the frenulum).

The areas supplied by the frenular artery include the most distal part of glanular urethra and the superficial layer of glans penis. When the artery is cut, as in DS method, these areas become relatively ischemic which potentially may result in exaggerated PCP, excess scabbing of glans and in long term meatal stenosis¹⁴. On the other hand, In MS method, as frenular artery is preserved, there is minimum bleeding and no partial ischemia. This will consequently result in reduced PCP and less complications.

To obviate bias for PCP, the anesthetic technique was standardized for both the groups and same drugs in similar dosage were used so as not to influence the outcome between the groups. In the study, intra-operative pain was monitored by heart rate and mean arterial pressure and kept within permissible threshold level. This had provided a similar milieu of post-anesthetic analgesia for the patients irrespective of the groups.

In the present study, it had been demonstrated that boys circumcised by the MS method had significantly longer pain-free period (P-value=0.005) immediately after surgery, and greater number of boys needed no analgesics during the first 12 hours (P-value=0.015). These are substantial evidence of less PCP in MS technique attributable to preservation of frenular artery. Besides, the MOPS at 0-hour, 3-hour and 6-hour were significantly lower in MS than in DS method though no significant difference was found in MOPS at 12-hour. The patients' analgesic demand per day during the post-operative days was also significantly low (0.022) in MS method. Similar results were also seen in the study by Karakoyunlu et al¹⁵.

To measure PCP, we espoused MOPS for non-verbal children during first 12 hours after surgery; then as the

patients were discharged, the degree of pain was assessed by analgesic requirement. This period was divided as 1st post-operative day (POD) for 24 hours and 2nd POD for next 24 hours and so on. During this period parents perceived pain based on how much discomfort they believe their child felt, and used oral or per rectal analgesics. These data were collected by telephonic communication and during first follow-up visit. Early and late post-operative complications were assessed respectively during the 2nd week and 3rd month follow-up. Similar means for assessing PCP and similar follow-up schedules were followed in other studies²⁰⁻²².

Regarding complications, it was found that boys in MS group had significantly less bleeding, edema of penis and glanular scabbing than the boys in DS group. These were attributable to preservation of frenular artery. Evidently, there was less primary bleeding, so less cauterization was needed precluding edema and less reactionary or secondary hemorrhage; also, as there was no ischemia, handling injury to glans epithelium leading to scabbing was less.

The overall cosmetic appearance of penis after circumcision in MS Group was better because of good wound healing, insignificant scarring and maintenance of anatomical contour of frenulum. These were achieved because there was no partial ischemia consequent to preservation of frenular artery and the frenulum as well. None of the boys undergoing MS technique developed meatal stenosis during 3 months follow-up. This was a rewarding consequence of preservation of frenular artery during circumcision^{14,15}.

Conclusion

Preservation of frenular artery during circumcision results in less post-circumcision pain (PCP). This also reduces a number of complications commonly encountered following circumcision. The overall cosmesis is also improved when frenular artery is preserved.

Conflict of interest: Nothing to declare.

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