Research Article / Araştırma Makalesi

Bleeding Control in Pediatric Hypospadias Surgery: Tourniquet and Adrenaline

Çocuklarda Hipospadis Cerrahisinde Kanama Kontrolü: Turnike ve Adrenalin

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Abstract

Background: Hypospadias is the most encountered congenital malformation of the newborn penis. Refashioning of the urethra, both physiologically and aesthetically requires a good surgical exposure to perform a scrupulous surgery. To obtain such standards tourniquet application and adrenaline injection have been performed in the past but there is still controversy for the best results.
Materials and Methods: The files of 78 patients, who were operated on for hypospadias repair in our pediatric surgery clinic between November 2017 and April 2022, were reviewed retrospectively. Operations were carried out by a single surgeon using tubularized incised plate urethroplasty (TIPU) technique. The hypospadias cases were grouped according to their meatal locations as to glanular, distal and proximal hypospadias. These patients were then compared in 2 groups by Tourniquet application (TA) and Adrenaline injection (AI) regarding their complications.
Results: In our study group 12 (15,4%) patients had glanular hypospadias, 58 (74,4%) patients had distal hypospadias and 8 (10,2%) patients had proximal hypospadias relating to meatal locations. 12 complications were encountered in total. The overall complication rate was 15,3%. There was statistical significance in complications between tourniquet application and adrenaline injection irrespective of meatal locations. We found no difference in-between glanular, distal or proximal hypospadias cases.
Conclusions: While adrenaline injection has been found with satisfying results in the past, our study showed that tourniquet application is a safe and reliable method obtaining hemostasis in hypospadias surgery. Nevertheless, further randomized studies with larger groups are required to determine the best option.

Key Words: Hypospadias, Hemostasis, Tourniquet, Adrenaline, Children

ÖZ.

Amaç: Hipospadias yenidoğan penisinde görülen en sık konjenital malformasyonudur. Üretranın hem fizyolojik hem de estetik olarak yeniden şekillendirilmesi, titiz bir ameliyat gerçekleştirmek için iyi bir cerrahi alan görünümü gerektirir. Bu standartları elde etmek için geçmişte turnike uygulaması ve adrenalin enjeksiyonu yapılmıştır ancak en iyi sonucun alınıp alınmadığı konusunda hala tartışmalar devam etmektedir.
Materyal ve Metod: Çocuk cerrahisi kliniğimizde Kasım 2017-Nisan 2022 tarihleri arasında hipospadias onarımı nedeniyle ameliyat edilen 78 hastanın dosyaları geriye dönük olarak incelendi. Ameliyatlar tek cerrah tarafından tübülarize insize plate üretroplasti (TIPU) tekniği kullanılarak gerçekleştirildi. Hipospadias olguları mea yerleşimlerine göre glanüler, distal ve proksimal hipospadias olarak gruplandırıldı. Bu hastalar daha sonra Turnike uygulaması (TA) ve Adrenalin enjeksiyonu (AI) ile komplikasyonları açısından 2 grupta karşılaştırıldı.
Bulgular: Çalışma grubumuzda mea yerleşimine bağlı 12 (%15,4) hastada glanüler hipospadias, 58 (%74,4) hastada distal hipospadias ve 8 (%10,2) hastada proksimal hipospadias vardı. Toplamda 12 komplikasyonla karşılaşıldı. Genel komplikasyon oranı %15,3 idi. Mea yerleşiminden bağımsız olarak turnike uygulaması ile adrenalin enjeksiyonu arasındaki komplikasyonlarda istatistiksel olarak anlamlı bulundu. Glanüler, distal ve proksimal hipospadias olguları arasında fark bulunamadı.
Sonuç: Geçmişte adrenalin enjeksiyonu tatmin edici sonuçlar vermesine rağmen, çalışmamız hipospadias cerrahisinde turnike uygulamasının hemostazı sağlayan güvenilir bir yöntem olduğunu göstermiştir. Bununla birlikte, en iyi seçeneği belirlemek için daha büyük gruplarla randomize çalışmalara ihtiyaç vardır.

Anahtar kelimeler: Hipospadias, Hemostaz, Turnike, Adrenalin, Çocuk

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Introduction

Hypospadias is the most common anomaly encountered in boys. Satisfactory results are achieved by providing a straight penis with slit-like meatus, thus aiming for smooth urination and subsequent normal sexual intercourse (1). Although more than 300 operations have been described for this surgery in the English literature, there is no uniform technique to date that guarantees successful results (2). Numerous and varied techniques have been developed for the treatment of these anomalies and are still in clinical practice (3). One of these techniques is tubularized incised plate urethroplasty (TIPU). This surgery was first described and developed by Snodgrass for the repair of distal hypospadias (4), and later the indication for this surgery included mid-penile and proximal penile hypospadias with no chordee or mild chordee (5). The most common problem in these cases is cutaneous fistula, while meatal stenosis is the second most common complication of hypospadias (6).

One of the most common complications during hypospadias surgery is bleeding. Its control is one of the main concerns of every surgeon, and providing this task has several advantages such as better visualization of the operative field, smoother wound healing process, and a better postoperative cosmetic appearance (7,8). To attain this goal, the use of rubber bandages was first introduced by Esmarch according to a report by Klenerman in 1962 (9). Various types of tourniquets have been used in different surgical specialties to control bleeding during surgery. Redman first described the rubber band tourniquet application in hypospadias surgery in 1983 (10). In addition, various authors have suggested that improved results can be obtained with adrenaline injection during hypospadias surgery (4,11,12). Among the advantages of adrenaline injection are the limiting the use of tourniquet, which reduces the effects of reperfusion injury, and providing more effective pain control with an additive effect when intraoperative analgesic injection is required (11,12).

However, to date, there is no consensus among surgeons dealing with pediatric hypospadias on the most effective bleeding control technique. In this study, tourniquet application and adrenaline injection were compared for hemostasis during hypospadias surgery, and their effects on surgical and postoperative outcomes were evaluated.

Materials and Methods

78 patients who were operated by a single surgeon for hypospadias repair surgery in our clinic between November 2017 and April 2022 were included in this study. Patients were first divided into three groups based on meatal location, as described by Hadidi in 2004: glanular, distal, and proximal hypospadias (13). Patients were then randomly allocated into a tourniquet application (TA) group or an adrenaline injection (AI) group by simple randomization of subjects via computer-generated random numbers. Boys older than 1 year and hypospadias anomalies that can be corrected with a single surgery were included in the study. Exclusion criteria were determined as follows: recurrent hypospadias repair; prominent penile chordee; the presence of any disease requiring corticosteroid therapy and a history of hypersensitivity to adrenaline. In some patients, when adequate bleeding control could not be achieved with adrenaline, tourniquet application was added to the operation and the patient was excluded from the study. The ethics committee approved the study (Ethics committee decision number: HRÜ/22.09.31) and written informed consent for the hypospadias operation was obtained from all participants.

In the TA group, a rubber band cut out from a surgical glove was knotted at the base of the penis after degloving, and in the AI group, adrenaline of 1/100,000 solution was injected by the side of the incision lines. (Figure 1 and 2) Adrenaline was diluted by adding 0,1 cc of 1:1000 epinephrine to 10 cc of normal saline in a syringe, giving out 9 cc out of the syringe than taking another 10-cc saline into the syringe. Should the need arise, additional doses were given to the patient.

Figure 1. Tourniquet application at the base of penis

Procedures were carried out by a single pediatric surgeon. The operative technique was a two layer tubularized incised urethroplasty defined by Snodgrass. A single-layer flap of dartos was prepared and laid on the sutures, subsequent glansplasty was carried out with subepithelial 6-0 PDS sutures. In the TA group, the tourniquet was bound after the

skin dissection and released in every 10 minutes to minimize ischemia-reperfusion damage. In both groups, bipolar electrocautery was selected for hemostasis. Coban dressing (3M Critical & Chronic Care Solutions, USA) was wrapped around the penis, loosened the next day, and removed post-operatively 48 hours. As the choice of catheter, 8 Fr to 12 Fr Foley or Feeding tube was preferred depending on age and the penis size. It was removed after 3-7 days in glanular cases, 7 days in distal cases, and 14-21 days in proximal cases. In proximal cases, a suprapubic catheter was also inserted, and then was removed after the withdrawal of the urethral catheter.

Figure 2. Adrenaline injected by the side of the incision lines

Statistical analysis

All data were analyzed with SPSS 22 statistical program. Kolmogorov Smirnov test was used to evaluate the distribution of variables. Continuous variables were expressed as mean±standart deviation (SD), and categorical variables as percentages and numbers. Student's t test was used to compare continuous variables. The Chi-squared test was used for comparing the categorical data between the two studied groups. P value smaller than 0.05 was accepted as statistically significant. All analyses were performed with SPSS (version 22, SPSS Inc., Chicago, IL).

Results

78 patients were enrolled in the study. Mean age of the patients was 6,66 ±4,54. The follow up time was between 4 to 12 months. Of these 78 patients, 12 (15,4%) patients had glanular hypospadias, 58 (74,4%) patients had distal hypospadias, 8 (10,2%) patients had proximal hypospadias relating to meatal locations. 12 complications were encountered in overall groups. The overall complication rate was 15,3%. We had 2 UC fistula and 1 urethral diverticulum in in proximal hypospadias group (37%), 2 UC fistula and 1 glans dehiscence related to wound site infection in distal hypospadias group (5%) and 6 (50%) meatal stenosis in glanular hypospadias group. The characteristics and the complication rates are shown in Table 1.

Table 1. Characteristics depending upon meatus location

Variables	Tourniquet group	Adrenaline Injection group	P
Age, years	8.8±4.50	4.32±3.34	<0.001
Meatus location			
Glanular	6	6	
Distal	33	25	0.234
Proximal	2	6	

3 of the 4 fistulas developed throughout the 6 months period post-operatively and 1 fistula healed spontaneously. These 3 fistulas were operated 6 months later after several urethral dilations. In six meatal stenosis complications that were seen in glanular hypospadias, urethral dilations were done in office which resolved after several attempts. One diverticulum complication and one glans dehiscence were managed with re-do TIPU. Diverticulum patient needed a third operation and total re-operation rate was 7%.

There was statistical significance regarding the age of the patients between TA and AI groups. The complications rates were higher in AI group and the difference was statistically significant. Patients were divided into 3 subgroups related to meatal locations and were compared accordingly. There was no statistical significance between hypospadias types. The general characteristics and complications are shown in Table 2.

Table 2. Complications compared in Tourniquet versus Adrenaline injection group

Variables	Tourniquet group	Adrenaline Injection group	P
Meatal stenosis	1	5	0.007
UC Fistula	1	3	
Glans dehiscence	-	1	
Urethral diverticulum	-	1	

Discussion

A meticulous bleeding control is a prominent factor in averting complications such as hematoma, wound dehiscence, or infection. A blood-free area can be attained by bipolar electrocautery, a vasoconstricting agent or a tourniquet assembly (14-16).

Taking a glance at the history of hypospadias surgery, several types of tourniquets have been used. When the English literature is reviewed, one can recognize that there is no consensus on the length of the tourniquet period or the dose of adrenaline to be used. Looking at the previous publications, there are authors who keep the tourniquet time between 9 minutes to 50 minutes in a wide range. In fact, some authors applied tourniquets throughout the operation, while others recommended loosening it every 10 minutes (17,18).

To find the answer to the question of how long a tourniquet can be safely kept, Çakmak et al conducted a series of studies in rabbits in 2002. A tourniquet with a circular rubber band was applied to the bases of the penis of animals that were divided into six subgroups for 10 to 60 minutes, and tourniquet intervals of 10 minutes were reported to have the least damage to the penile skin (19). Burul et al published a similar survey-style study that a time limit of up to 20 minutes is more appropriate than a longer blockade. Almost half of the participants stated that they employed the tourniquet around 20 minutes, while only 10% kept it in place throughout the entire operation. When asked at which stages of the operation the tourniquet was applied, it was reported that tourniquet was used most frequently during anastomosis (20). Accordingly, some authors such as Rabinovitch reported penile edema in 4.17% of cases after tourniquet release (21). It has also been published that nerve and muscle damage begins after the tourniquet pressure exceeds 500 mmHg (22). Kajbafzadeh et al. reported the effects of various hemostatic techniques used in hypospadias repair on the urethral wall in a study with rabbits (23). While light microscopy did not show any significant findings in histopathological parameters between tourniquet and control groups, electron microscopy showed that ultrastructural damage to the urothelial epithelium occurred after half an hour of continuous or intermittent tourniquet period (23).

Various authors have reported results with concentrations ranging from 1:100,000 to 1:800,000 for the optimal dose of Adrenaline (19, 22, 24). It is known that drugs containing adrenaline should not be used in tissues supplied by end arteries such as fingers and toes, but in some publications, opinions against this information have also been defended (22). In another study, Alizadeh et al compared the results of tourniquet application and adrenaline injection on bleeding control during hypospadias surgery and reported that adrenaline can be an effective method for bleeding control and surgical exposure (25). On the contrary, Çakmak et al. in their survey study reported that the

use of adrenaline may impair wound healing (19). In this study, only 9.4% of the participants stated that they used adrenaline. More than half of the surgeons were using adrenaline at the dose of 1/100. 000 while the remaining participants were employing the adrenaline at the same dose, but this time combined with lidocaine. The reasons for not preferring adrenaline reported by the participants were listed as not needing it (71.3%), post-operative complications (23%), systemic side effects (3.4%) and drug ineffectiveness (2.3%) (19). Similarly, we also found that adrenaline injection resulted in more complications in our study.

Limitations of our study included some factors such as insufficient number of patients and short follow-up time since some complications may emerge years after surgery. The other factor is the difference between tourniquet and adrenalin group in terms of age. It could well be speculated that younger age and smaller penile size may have caused afore mentioned complications. While the choice, tourniquet against adrenaline, it is easier to employ tourniquet in larger genitalia and prefer adrenaline in a relatively small penis in younger age. Last but not least, there are many factors that may affect hypospadias complications such as use of optical magnification, suturing materials and techniques, urinary diversion, urethral catheterization, or post-operative dressings as well as anatomical and environmental factors. To stabilize these determinants and avoid bias, the operations were carried on by a single surgeon and afore mentioned variables were applied mostly the same other than hemostasis variable.

In conclusion, tourniquet application is a safe and effective method in controlling operative bleeding for hypospadias surgery. It should also be kept in mind that no technique is bereft from harm in terms of ischemia reperfusion and adrenaline injection has its own disadvantages such as impaired wound healing. Even though both techniques are used universally there is still a need for randomized controlled studies with larger groups.

Ethical Approval: *The ethics committee approved the study (Ethics committee decision number: HRÜ/22.09.31*

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