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Original Article

Tourniquet and adrenaline use in hypospadias surgery: a survey on the current practice in Turkey

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ABSTRACT

Objective: Aim of the study is to determine the hemostatic techniques among pediatric urologists in Turkey.

Material and methods: Questionnaire forms were sent to 459 pediatric urologist by e-mail.

Results: Ninety eight of 459 participants answered the questionnaire forms. Eighty-one (84.4%) of the participants were using tourniquet. The participants who didn't use tourniquet stated their justifications as follows: lack of need (n=10: 66.7%), development of edema, ischemia, delay of wound-graft healing and fistula risk (n=5: 33.3%). The indications of tourniquet use were stated as follows: penile (91.4%: n=74), distal (72.8%: n=59), penoscrotal (55.6%: n=45) hypospadias; fistula repair (33.3%: n=27), cripple hypospadias (33.3%: n=27), repair with flaps (30.9%: n=25), repair with grafts (27.2%: n=22), and isolated penile curvature (21%: n=17). Most commonly used tourniquet material (49.9%) was latex glove. Erection test was applied by 43.8% of participants. Scalp vein set was the most commonly (54.8%) used injector during erection test. Only 9.4% of participants were using adrenaline. Adrenaline dosages used at 1/100.000 dilution by 55.6%, lidocaine with 1/100.000 adrenaline by 44.4% of participants.

Conclusion: Beside a few experimental ones there is a paucity of studies that can serve as a guideline for using these techniques in the literature. There is a necessity of realizing prospective, randomized studies with long-term follow up to evidence that postoperative complications could develop secondary to hemostatic techniques and also to facilitate safe use of these techniques.

Keywords: Adrenaline; hypospadias surgery; tourniquet.

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Introduction

Hypospadias is one of the most common congenital anomalies defined as malposition of the external meatus in a more proximal position than normal.[1] Penile chordee, preputial defect, penile torsion, disrupted development of corpus cavernosum and spongiosum are most commonly associated pathologies with hypospadias. Surgical correction of hypospadias is crucial to achieve normal penile function, penile length and cosmesis. Careful hemostasis has a significant impact in hypospadias repair. Inadequate hemostasis predisposes to hematoma formation and infection.[2] For better cosmetic impact and decreased breakdown of repair, it is crucial to obtain bloodless surgical field. There are various methods for achieving a bloodless field in hypospadias surgery such as tourniquet application, cauterization and vasoconstrictive agent injection.[3,4] Despite the wide use of tourniquet method in hemostasis for the last five decades, there is no general consensus among pediatric urologists about the optimal hemostatic technique. The aim of the present study is to determine the current management techniques to control bleeding in hypospadias surgery among pediatric urologists in Turkey.

Material and methods

The study was prepared, and conducted in accordance with the Helsinki Declaration. Multiple-choice questionnaire forms were e-mailed to 459 pediatric urologists from university and teaching and research hospitals inviting them to participate in a survey regarding the use of various hemostatic techniques and implementation path. No reminders were sent and 10-day

Table 1. Frequency of tourniquet applications among participants

Frequency of tourniquet applications in penile surgeries	Penile hypospadias 91.4% (n=74)	Distal hypospadias 72.8% (n=59)	Penoscrotal hypospadias 55.6% (n=45)	Cripple hypospadias 33.3% (n=27)	Fistula repair 33.3% (n=27)	Isolated penile chordee 21% (n=17)	Repair with grafts 27.2% (n=22)	Repair with flaps 30.9% (n=25)
Types of tourniquet	Latex gloves 49.9%	Penrose drain 33.3%	Vessel loop 28.4%	Nelaton catheter with clamp 4.9%	Penrose drain with knot 2.5%			
Tourniquet application period	Anastomosis phase 70.4% (n=57)	Chordee correction phase 6.2% (n=5)	Degloving phase 21% (n=17)	Grafting phase 17.3% (n=5)	Whole operation 25.9% (n=21)			
Tourniquet duration of application	0-5 min 2.5 %	5-10 min 16%	10-20 min 48.1%	20-30 min 23.5%	Whole surgery 9.9%			
Releasing period of tourniquet	One min 27.9% (n=17)	Two min 39.3% (n=24)	Five min 32.8% (n=20)					
Application area	Over Penile skin 67.9% (n=55)	Over corpus cavernosa 32.1% (n=26)						

period was given prior to the closing of the study and beginning of data analyses.

Results

Ninety-eight pediatric urologists reached by e-mail answered the questionnaire. Two out of 98 respondents were excluded from the study because they were not performing penile surgery. Length of time in pediatric surgery practice varied from 0 to 5 years for 26, 6 to 10 years for 20, 11 to 15 years for 18 and more than 16 years for 34 participants. Length of time in practice with hypospadias surgery varied from 5 to 20 years for the majority (96 of 98) of respondents. When the average operation time of the hypospadias surgery was examined, 54.3% of the participants had an operation time between 1-2 hours, 42% had between 30-60 minutes, 2.5% had more than two hours and 1.2% had 0-30 minutes. Eighty-one of 96 participants (84.4%) were using tourniquet during penile surgery. Ten of 15 participants (66.7%) who were not using a tourniquet, stated that they didn't need it and the rest of five participants (33.3%) gave up using tourniquets due to complications. Edema, ischemia, delay of wound healing, disruption of graft healing and increase of fistula formation rate were the complications for giving up. When the participants asked about their use of prophylactic antibiotics; 50 of 96 participants (52.2%) responded that they were using prophylactic antibiotics 30 minutes before the surgery, 23 participants (24%) during anesthesia induction and two participants after tourniquet application. Twenty-one participants were not administering antibiotics (Table 1).

Fifty-five participants (67.9%) were applying tourniquet around the penile skin, while the remaining 26 participants (32.1%) were applying tourniquet around the corpora cavernosa after degloving. Fourty-five participants (55.6%) (n=45) were questionning the existence of additional diseases before the operation (diabetes mellitus, sickle cell anemia, hypertension, obesity, vasculitis, etc.).

Fourty-two of 96 participants (43.8%) stated that they were performing routine erection test during penile surgery. When the participants were questionned about the type of operations, in which they performed erection tests, the indicated percentages of respondents stated that they were applying these tests in all cases (59.5%: n=55), in proximal hypospadias (42.9%: n=18), in penile curvature (40.5%: n=17) and in distal hypospadias (7.1%: n=3) surgeries. When the application method of erection test were inquired the participants stated that they were applying these tests with saline solution and using tourniquet (36/42: 85.7%), with saline solution without using tourniquet (n=5; 11.9%) and with medical agents (papaverine) without using tourniquet (n=1; 2.4%). The scalp vein set was the most commonly used injector type during the erection test (54.8%), followed by insulin injector needle (33.3%), branule needle (14.3%) and injector needle (2.4%).

Only nine of 96 respondents (9.4%) stated that they were using adrenaline during penile surgery. Eighty-seven participants (90.6%) were not using adrenaline. Their justifications were as follows; lack of need (71.3%: n=62), development of systemic side effects (3.4%: n=3), ineffectivity (2.3%: n=2), and for in-

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Table 2. Adrenaline use among participants			
Adrenaline dose	1/100.000 55.6% (n=5)	1/100.000 with lidocaine 44.4% (n=4)	
Application period	Incision phase 55,6% (n=5)	Degloving phase 33.3% (n=3)	Anastomosis phase 11.1% (n=1)
Application area	Whole surgical site 66.7% (n=6)	Incision line 33.3% (n=3)	
Application frequency	More than z 55.6% (n=5)	Only once 44.4% (n=4)	

creased complications (23%: n=20). The indicated complications were especially skin necrosis (75%), disruption of graft healing (55%), delay in wound healing (50%), and wound dehiscence (25%). Details of adrenalin use among participants are shown in Table 2.

Discussion

Present survey highlights the diversity in hemostatic techniques and especially types of tourniquet, techniques used, application times, and sites, tourniquet release intervals, antibiotic usage with tourniquet application and adrenaline usage. This study shows that tourniquet application and adrenaline usage in penile surgery is an unresolved issue among pediatric urologists in Turkey.

Careful hemostasis is a very important factor for preventing complications like hematoma, infection, wound dehiscence in hypospadias surgery. Different techniques are available for hemostasis during hypospadias surgery including application of tourniquet, injection of vasoconstructive agents and bipolar electrocautery.[5-10]

Different tourniquet techniques have been used in different specialities for the bleeding control. Tourniquet was first described by Jean Luis Petit for limb surgery in 1718 and John Redman was the first who used the penile tourniquet with a rubber band in 1983.[5] Several different techniques and materials have been used to obtain bloodless field like soft latex catheter, clipped penrose drain, rubber catheter and bands, rolled rubber glove or silicone vascular band.[11] Devendra Kumar Gupta designed a tourniquet by using two tubectomy rings, silicone strip and straight artery forceps. They argue that this type of tourniquet is safe and simple, it provides a clear surgical field of enhanced visibility since it is made of flat, silicone strip of appropriate width that reduces sharp pressure on soft tissue, vessels and nerves.[11] Kaya et al.[12] evaluated the effects of tourniquet on growth factors in rat penile tissue. As a conclusion of their research they argued that penile tourniquet may result in altered growth factors in penile tissue and may reduce the success rate of repair. Despite a number of popular techniques used in penile surgery there are no clear guidelines for the safe usage of tourniquets. In this study 84.4% of the participants stated that they were using tourniquet during penile surgery. Fifteen participants (66.7%) who did not use a tourniquet, stated that they didn't need it. Latex glove was the most frequently used (49.9%) material by respondents, followed with penrose drain with clamp, vessel loop, Nelaton catheter and penrose drain with knot.

Safe tourniquet application time in penile surgery is still controversial and there are few studies to guide surgical practice. The tolerance of tissue to ischemia and reperfusion demonstrates a great variation in different organs.[13-16] Reperfusion injury may develop after tourniquet removal as blood flow is restored to the ischemic area. This leads to the generation of free oxygen radicals, which can trigger a cascade of events with potentially deleterious consequences.[17,18] Some of the pediatric urologists keep tourniquet during whole operation, while others advice intermittent release.[19,20] Kajbafzadeh et al.[8] evaluated histopathological changes of urethral wall in rabbit model after application of different hemostatic techniques. These hemostatic techniques are described as tourniquet application for different time periods, adrenaline injection and normal saline injection. Electron microscopic studies demonstrated ultrastructural urothelium damage in all hemostasis groups compared to controls. However, the changes were most prominent in adrenaline injected animals than in the continuous or intermittent groups. Light microscopic studies revealed no significant differences in the histopathological parameters between tourniquet and control groups. In 2002 Cakmak et al.[21] tried to determine safe tourniquet time in rabbits. The researchers divided animals into six groups and applied standard circular rubber band to the base of the rabbit penis for a variable lenght of time which ranged from 10 to 60 min. As a conclusion they argued that tourniquet usage for the shortest period of 10 min had the least negative effect on the penile skin. They reported that operating under tourniquet control only during the flap dissection or glandular preparation phase without exceeding 10 min will preserve the viability of the tissue. Another study published in 2008 attempted to look for the consequences of prolonged tourniquet use.[22] The study revealed that if tourniquet is necessary in penile surgery the application time of up to 20 min is more appropriate instead of prolonged usage. In the present study majority of participants (48.1%) applied tourniquet for 1-20 min, followed by 20-30 min (23.5%), 5-10 min (16%), 0-5 min (2.5%) and during whole surgery (9.9%). When they were asked about the applying phases

answers alined as follows: during anastomosis phase 70.4%, the whole operation (25.9%), degloving phase (21%), grafting phase (17.3%), and only during chordee repair (6.2%).

Different doses of adrenaline have been applied to penile skin solely or with local anesthetic agents to prepare bloodless field by some authors. Varying doses from1:100.000 to1:800.000 concentrations have been used.[21,23,24] Alomari et al.[25] evaluated safety and efficacy of topical adrenaline solution in hypospadias surgery. They showed that topical adrenaline usage eliminates the need of a tourniquet, decreases bleeding and wound hematoma, minimizes cauterization, reduces the operative time, and diminishes postoperative complications such as wound infections, hematomas and fistula. None of the respondents in this study were using topical adrenaline. Alizadeh et al evaluated the effect of tourniquet application and adrenaline injection for hemostasis during hypospadias surgery.[1] They argued that adrenaline could be safe and effective method for preparation of a bloodless field. Cakmak et al.[21] came to a conclusion that adrenaline injection to penile skin may have a deleterious effect on wound healing. In this study only 9.4% of participants stated that they were using adrenaline as a vasoconstrictor agent in penile surgery. Reasons for not using adrenaline indicated ny respondents were lack of need (71.3%), postoperative complications (23%), systemic side effects (3.4%), and ineffectiveness (2.3%). The 55.6% of the participants were using adrenaline at the dose of 1/100.000. The remaining 44.4% of the participants were using the adrenaline at a dose of 1/100.000 with lidocaine. Respondents were asked about the phase of adrenaline application, and the indicated percentages of the participants stated that they were using adrenaline at the incision (55.6%), degloving (33.3%) phases, and during anastomosis (11.1%). A 66.7%, of the participants were applying adrenaline to the whole surgical site while 33.3% of them only to the incision line.

Use of preoperative and postoperative antibiotics in hypospadias surgery is common among pediatric urologists.[26] Moreover antibiotics thought to reduce postoperative complications like meatal stenosis and fistula.[27] While applying tourniquet during penile surgery it is important to adjust antibiotic administration. For favorable tissue penetration it is important to allow sufficient time between antibiotic administration and tourniquet application.[28] There are several studies that are recommending at least 5 min between antibiotic administration and application of tourniquet.[29,30] In the present study 52.2% of the participants were applying antibiotics 30 minutes before the surgery, while 24% of them during anesthesia induction. Twenty one of them were not using antibiotics and only two were administering antibiotics after applying tourniquet.

One of the oversighted point is related to the patients who are at higher risk of complications following penile tourniquet use. Age of the patient, body mass, associated comorbidities like sickle-cell disease, obesity, diabetes mellitus, hypertension, arteriopathy should be questioned. Some of these patients may require higher tourniquet pressure for bloodless surgical field resulting in pressure-related injuries.[28] Especially tourniquet should be used with caution in sickle-cell disease patients. The circulatory stasis, hypoxia and acidosis have the potential to precipitate sickling crisis in these patients during tourniquet usage. So it is important to evaluate cautiously the benefits of tourniquet use for penile surgery. Hazards of tourniquet use and benefits of operating in bloodless field should be balanced.[30] Beside pre-operative questionning of concomitant pathologies, it is crucial to ask patients about existence of above- mentioned conditions. In the present study 55.6% of the participants reported that they were questioning the existence of additional diseases mentioned above.

Limitation of the study is low rate of return among pediatric urologists. Further survey trials with high rate of participant return is needed for certain determination of preference for hemostatic technique among pediatric urologists.

In the present study we tried to understand implemention of hemostatic techniques like tourniquet and adrenaline injection among pediatric urologists in Turkey. Despite the wide use of above mentioned techniques all over the world there is still paucity of data to guide. For safe use of these hemostatic techniques more randomized controlled trials with long-term follow up are needed.

Ethics Committee Approval: Authors declared that the research was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects", (amended in October 2013).

Informed Consent: Written informed consent was not obtained from patients because it was a survey study, based on pediatric urologist's preferences.

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