



What do we know about Treatment of Post-Circumcision Penile Ischemia. Case report and Review of Literature

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Abstract

Circumcision for therapeutic and non-therapeutic purposes is one of the most frequently performed male procedures worldwide in all age groups. In order to decrease post-operative pain dorsal penile block (DPNB) with a long-acting (bupivacaine) or intermediate-acting (lidocaine or mepivacaine) agent is the most common anaesthesia technique. Although circumcision remains a quick and simple procedure, it is not without risk, with complications rate from 1 to 4%. Penile ischemia is a rare but severe complication of circumcision that can lead to irreversible necrosis of the glans. The causal mechanisms remain unclear although several hypotheses have been suggested including, such as the use of vasoconstricting agents in local anaesthesia, arterial vasospasm due to needle microtrauma during dorsal penile nerve block (DPNB), hematoma, blood vessel binding, excessive use of monopolar cautery, a tight suture line, and/or a tight bandage applied to the circumcised area. Various therapeutic options were proposed, but so far there are no treatment guidelines. We report the case of a 10-year-old boy with penile ischemia after circumcision that resolved spontaneously after one month and present a current review of 23 other published cases.

Keywords: Penile ischemia; dorsal penile nerve block; hematoma; blood vessel binding

Introduction

Circumcision for therapeutic and non-therapeutic purposes is one of the most frequently performed male procedures worldwide in all age groups [1]. In order to decrease post-operative pain dorsal penile block (DPNB) with a long-acting (bupivacaine) or intermediate-acting (lidocaine or mepivacaine) agent is the most common anaesthesia technique [2-4]. Although circumcision remains a quick and simple procedure, it is not without risk, with complications rate from 1 to 4% [5]. Penile ischemia is a rare but severe complication of circumcision that can lead to irreversible necrosis of the glans. The causal mechanisms remain unclear although several hypotheses have been suggested including, such as the use of vasoconstricting agents in local anaesthesia, arterial vasospasm due to needle microtrauma during dorsal penile nerve block (DPNB), hematoma, blood vessel binding, excessive use of monopolar cautery, a tight suture line, and/or a tight bandage applied to the circumcised area [6]. Various therapeutic options were proposed, but so far there are no treatment guidelines [7]. We report the case of a 10-year-old boy with penile ischemia after circumcision that resolved spontaneously after one month and present a current review of 23 other published cases.

Case Report

We present the case of a 10-year-old boy admitted for elective circumcision after recurrent balanitis and phimosis. The intervention was performed under general anaesthesia, including sevoflurane 4% O₂/N₂O 50/50 administered via mask. The technique of dorsal penile nerve block with bupivacaine 0.5% in 4 ml was used in order to decrease post-operative pain. The intervention lasted 16 minutes and was uneventful. The patient was sent home the same day. The day after parents called the surgeon to report the dark color of the glans. Physical examination showed a very dark necrotic appearance of the glans and light edema around the suture site (Figures 1A & 1B). No suggestive signs of infection were noted, and voiding function was normal. D-dimeres (1,23 microg/mL*; 0,5 microg/mL) and LDH (242 U/L; norm 135-225) levels were slightly elevated in a blood test. The color Doppler ultrasound examination showed normal permeability of the penile arteries and no abnormalities of vascularization. We thus decided to adopt a conservative attitude. Clear improvement was noticed after a few days with normalization of the color of the glans (Figures 2A & 2B) with the complete normalization one month after the intervention.



Figure 1A



Figure 1B

Figure 1: Physical examination showed a very dark necrotic appearance of the glans and light edema around the suture site.



Figure 2A



Figure 2B

Figure 2: Clear improvement was noticed after few days with normalization of the color of the glans with the complete normalization one month after the intervention.

Discussion and review of literature

As penile ischemia can cause irreversible damage to the glans, the choice of the best treatment is of crucial importance. However, since no vascular anomaly had been demonstrated in our patient, we opted for a conservative attitude which was followed by a complete spontaneous resolution of the penile ischemia. In our case, we decided to choose conservative treatment as there was no vascular deficit that resulted in complete recovery of the glans. To the best of our knowledge, this is the fifth case described as being resolved spontaneously without any additional therapeutic methods. The cause of penile ischemia in our case remains unclear, as the color doppler ultrasound was normal, no adrenaline or other

irritative agent was used, the volume of local anaesthesia was adequate to the body mass of the patient, and no monopolar cautery was used. We could also exclude penile ischemia due to tightened sutures, as it resolved spontaneously without any re-intervention. The penile ischemia post circumcision is in the first hypothesis secondary to the local anaesthesia technique, type of product used, and/or volume of solution injected. The dorsal penile nerve block is the technique of choice for analgesia in circumcision as it is easy to perform and a safe procedure with a low complication rate of 0.18% [8]. Numerous authors cited the DPNB technique as a cause of penile ischemia due to endothelium damage caused by needle introduction and induction vasospasm of penile vessels [9].

Table 1A & 1B contain data concerning anaesthesia and surgical procedures. The most frequently used agents for DPNB are lidocaine, bupivacaine, and mepivacaine, whereas the use of ropivacaine is controversial as it possesses intrinsic vasoconstrictive action, especially at low doses [10,11]. The following solutions were used for local analgesia in the cases studied: lidocaine, bupivacaine, mepivacaine, xylocaine, ropivacaine, and carbocaine. According to Sara and Lowry, the volume of solution alone cannot be responsible for vessel compression and damage that may provoke penile ischemia [12]. However, the discussion about the molecule used for

local anaesthesia remains unanswered. Some considered that using a vasoconstrictor is contraindicated for anesthesia of extremities with terminal vascularization but remains a controversial issue. Only three of the 23 cases described in this review used a vasoconstrictor such as adrenaline for local analgesia [13,14]. Other potential causes of penile ischemia were tight sutures or too tight banding after intervention. Other hypotheses included concomitant use of an irritative substance such as thiopental or excessive use of monopolar cautery with an electrical current carried by the small diameter of the penis, which may lead to thermal injury [15].

Table 1A: Numerical values denote the overall incidence of this element in data collected from literature.

Anaesthesia and surgery details	Clinical Findings	Biology	Radiology findings
Technic	Color	Elevated D-dimeres: 2 (8,7%)	Color Doppler
DPNB only: 17 (74%)	Change: 21 (91,3%)	Elevated WBC: 1 (4,3%)	Abnormal: 2 (8,7%)
DPNB and general anaesthesia: 4 (13%)	No data: 2 (8,7%)	Normal biology: 6 (26,01%)	Normal: 8 (34,8%)
No data: 6 (13%)		No data: 14 (60,9%)	No data: 12 (52,2%)
Product	Edema		Radioisotope perfusion study: 1 (4,3%)
Lidocaine: 4 (17,4%)	Yes: 8 (34,8%)		Gray-scale US:
Bupivacaine: 4 (17,4%)	No: 2 (8,7%)		Normal*: 2 (8,7%)
Mepivacaine: 3 (13%)	No data: 13 (56,5%)		Abnormal**: 2 (8,7%)
Xylocaine: 2 (8,7%)	Voiding problem:		No data: 19 (82,6%)
Ropivacaine: 1 (4,3%)	Yes: 1 (4,3%)		
Carbocaine: 1 (4,3%)	No: 7 (30,5%)		
No data: 8 (34,9%)	No data: 15 (65,2%)		
Use of vasoconstrictor: 3 (13%)	Pain		
Surgery:	Yes: 5 (21,7%)		
Use of monopolar cautery: 2 (8,7%)	No: 1 (4,3%)		
No data: 21 (91,3%)	No data: 17 (74%)		

* Both associated with normal Color Doppler

** One associated with normal Color Doppler and one associated with abnormal Color Doppler.

Table 1B: Numerical values denote the overall incidence of this element in our case.

Anaesthesia and surgery details	Clinical findings	Biology	Radiology findings
General anaesthesia	Color change	LDH elevated	Color Doppler normal
DPNB with bupivacaine	Light edema	D-Dimeres elevated	
No monopolar cautery	No voiding problem		

Table 1A & 1B integrates the clinical data and procedures used. (Details of individual cases are shown in Supplemental Table 1). Median age is 7 years (range from 13 days to 33 years), with only four patients over the age of 18. In 14 cases, the first symptoms were noticed less than 24 hours after surgery, in 6 cases between 48 hours and one-week post-operation, in two cases there is no data about the time of apparition [16,17], and in one case estimation

was difficult because of the delay between observation of the symptoms and admission to the hospital. A clinical exam with signs of abnormal penile perfusion, such as dark color of the glans, acute pain, or flaccidity of the penis, is used to diagnose penile ischemia. However, not all of the patients were in pain or had penile edema; therefore, all of them presented pale or dark penile glans. No infection signs were detected, and voiding difficulty was described

only in one case [18]. The most frequently performed additional exams were blood tests (D-dimeres, clotting profile, white blood cells, protein S and C, fibrinogen), and color-doppler of penile arteries. In 8 cases, there is no information concerning additional exams. However, the blood tests were within the normal range in most of the cases. D-dimeres were elevated in two cases, WBC were elevated in one, and LDH and D-dimeres were elevated in our case.

The results of the color doppler were mostly normal, except for one case. Gray-scale ultrasound was conducted in four cases, and in two of them, it revealed unexpected thickening and echogenicity of the surface of the glans penis, indicating more than simple edema. As a consequence, in those two cases, a diagnosis of superficial ischemia was proposed. Although the first case of post-circumcision penile ischemia was described in 1981 by Sterenberg et al., nowadays there are still no guidelines for optimal treatment of this rare complication. Nevertheless, the main objective of the treatment is to restore sufficient blood flow and oxygen delivery to ischemic tissue in the glans [19]. Hyperbaric oxygen therapy (HBOT), topical 10% testosterone undecanoate, intravenous or oral pentoxifylline (PTX), low-molecular-weight heparin (enoxaparin), intracavernous glycerol trinitrate and bupivacaine, intravenous infusions of prostaglandin analogues, antiplatelets, corticosteroids, nitroglycerol, antibiotics, surgical review and caudal nerve block. In our case, as in four others, treatment remained conservative, and evolution was favourable and led to complete resolution. In those cases, a comparison of patient data was conducted. Results showed that the age range of patients varied from 10 days to 10 years. In this study, the type of anaesthesia administered varied among the

cases. In two cases, general anaesthesia with DPN with bupivacaine was used. In another case, lidocaine with epinephrine was administered, while information regarding the type of anaesthesia used in two other cases was not available. The precise time of the clinical apparition was not available in most cases.

After 24 hours, it was noticed in our case as well as another. In this review, it was observed that all patients were presented with a change in the color of their glans. Additionally, one patient exhibited a blister on the skin of their penile corpus. The lack of commonalities among those five cases makes it challenging to determine whether there was a specific reason for their spontaneous resolution. Pentoxifylline (PTX) is a non-selective PDE inhibitor used as a hemorheological agent that improves peripheral blood flow and decreases blood viscosity. PTX was chosen as a therapeutic option in 5 cases; in one case it was used alone [20], and in four other it was combined with other treatments such block or topical testosterone, nitroglycerin, HBOT and antibiotics, caudal block, topic treatment with nitroglycerin and antibiotics. In one case, administration of the combination of PTX and HBOT was preceded by an intracavernous injection of another phosphodiesterase inhibitor, papaverine, that showed immediate improvement of the glans condition and led to complete resolution of penile ischemia in 7 days [21]; Sildenafil is a selective inhibitor of 5-phosphodiesterase and was administered orally in one case in addition to intravenous L-arginine hydrochloride with unfractionated heparin following caudal epidural bloc, angiography with intraarterial injection of alprostadil and nitroglycerin [22] (Table 2).

Table 2: Treatment. Numeric values indicate the frequency of therapy administration in cases described in literature review.

Conservative*	PTX	HBOT	Analogues of prostacyclines	Testosterone	Low molecular heparine	Caudal nerve block	Others
Total: 4 (17,4%)	Total: 5 (21,7%)	Total: 5 (21,7%)	Total: 2 (8,7%)	Total: 4 (17,4%)	Total: 5 (21,7%)	Total: 6 (26%)	Nitroglycerine: 3 (13%)
	Alone: 1	Alone: 2	Alone: 0	Alone: 0	Alone: 2	Alone: 2	Antibiotics: 3 (13%)
	in association: 4	in association: 3	in association: 2	in association: 4	in association: 3	in association: 4	Aspirine: 2 (8,7%)
	Resolution: 5	Resolution: 3	Resolution: 2	Resolution: 4	Resolution: 5	Resolution: 6	Angiography: 1 (4,3%)
							Corticoides: 1 (4,3%)
							Sildenafil: 1 (4,3%)
							L-arginine:1 (4,3%)
							Hydrochloride: 1 (4,3%)

*Data concerning our case report is not included in Table 2.

Hyperbaric oxygen therapy raises the partial pressure of oxygen, improving oxygenation of ischemic tissues as well as increasing levels of growth factors, cytokines, and hormones via the intermediates of reactive oxygen and nitrogen, leading to neoangiogenesis and healing of post-ischemic tissues. HBOT was chosen as the sole treatment in two cases, but the outcome was

unsatisfactory due to the severe burn injury caused by monopolar electrocautery in one case, and plastic reconstruction was required in the other. However, in the case of this 13-day-old boy, first-line treatment was conservative, and de HBOT was administered only two days after the onset of penile necrosis [23]. In three cases HBOT was combined therapy with other therapeutic and was followed

by complete resolution. Iloprost and alprostadil are analogues, respectively, of prostacyclin PGI₂ and PGE₁, whose actions consist of inhibition of platelet aggregation and vascular smooth muscle relaxation [24]. This method was used twice in combination with other therapy and lead do complete resolution. Testosterone is known for its potential beneficial impact on endothelial cells and vascular endothelial growth factor expression that leads to improvement of the penile blood supply and revascularization of the glans. In four cases this method in combination with other methods led to complete resolution. Anticoagulant therapy with low-molecular-weight heparin alone or in combination was used successfully in 5 cases.

proposed LMWH as a first-line treatment, especially in cases of elevated D-dimeres, as enoxaparin is a safe anticoagulant in primary prophylaxis and the treatment of thromboembolism in pediatrics. The effectiveness of using the caudal bloc alone to decrease sympathetic tone and enhance arterial supply was demonstrated successfully by Kaplanian et al. and Berenes. In four other cases association with other therapy led to complete resolution of the ischemia of the glans. Additional therapeutic solutions were surgical revision, antibiotics, nitroglycerine, acetylic acid, and corticoids. In four cases, surgical revision was done with restoration of the sutures, and in one case, digital subtraction angiography was performed. Nitroglycerine was used as a spasmolytic agent during digital subtraction angiography, as a topic, and as an intracavernous injection in addition to other therapeutic methods. Although in all cases neither clinical nor biological signs of infection were detected and the use of antibiotics was not necessary in most of the cases, in three of them topical gentamicin, oral levofloxacin, or

amoxicillin with clavulanic acid were administered. Acetylic acid was used in addition to other therapeutic methods in two cases [25,26], and corticoids were used in one case. Out of 23 cases, 21 were managed successfully and led to complete resolution of penile ischemia, independent of the method that was chosen. In the two remaining cases treated ineffectively by HBOT, the possible causes of failure were delay of admission and severe thermal injury during circumcision.

Conclusions

In this review, we analyzed 23 heterogeneous cases in terms of age, circumcision technique, anaesthetic technique, delay of apparition, and delay of admission, therapeutic method. All details are contained in Table 3. As a consequence, it is difficult to make an association between therapeutic methods and their impact, as the outcome is probably multifactorial. Penile ischemia is an organ-threatening condition, and many practitioners did not take the risk to choose conservative treatment, it may be justified to limit therapeutic methods and avoid overtreatment. As mentioned, caudal block, PTX, and heparin infusion separately led to complete resolution in 5 cases, and in 3 other cases, recovery was obtained without any treatment. However, use of a vasoconstrictor in local anaesthesia is controversial and was mentioned as a potential explanation of penile ischemia; therefore, a vasoconstrictor agent was used only in three cases, so probably it is not the main cause of this condition.

Table 3: 23 heterogeneous cases in terms of age, circumcision technique, anaesthetic technique, delay of apparition, and delay of admission, therapeutic method.

Age of patient	Characteristics of anaesthesia	Delay of apparition and type of first symptoms	Blood test results	Additional tests	Treatment	Evolution	Hypothesis
20 years	1% Mepivacaine hydrochloride DPNB	24 hours; brownish color and edema, necrotic appearance, no voiding problem	Blood count, chemistry, bleeding-clotting profile normal	Color Doppler US normal	Levofloxacin 550mg for 15 days, aspirine 330mg for one month, prednisone 25mg for 15 days, hyperbaric therapy for 15 days	Normal color and trophism after 15 days of treatment	None
10 years	DPNB	2 hours after surgery	No data	Color Doppler US: weak flow of the penile artery, progressive worsening	Pentoxifylline for 6 days, topical testosterone and a caudal blocking (for 48 hours)	Favourable evolution within a few hours and complete resolution in 6 days.	DPNB seems to be the most frequent cause
33 years	DPNB with 7 mL of the anaesthetic agent containing 2% lidocaine	24 hours; deep purple color of glans	No data	No data	Intracavernous injection of papaverine (30mg) pentoxifylline and hyperbaric oxygenation (2,5 atm) for 5 days	Complete resolution after 7 days	Surgical trauma, pressure upon the vessels by the anaesthetic solution or local hematoma and prolonged vasospasm can be possible causes.

9 years	DPNB 3ml 0.5% bupivacaine, general anaesthesia, bipolar diathermy	4 hours; flaccid penis with a significantly ischaemic, poorly perfused, almost black, glans	No data	Color Doppler US: good blood flow in both penile arteries distal to the block site.	Caudal block 15ml plain bupivacaine 0.25%	1-2 minutes; improvement in the color and perfusion of the glans 10 minutes; further improvement over the next 10 min	The cause is likely to have been localised veno/vasospasm at the glans secondary to the surgery or the dorsal penile nerve block.
Case 1: 13 months Case 2: 3 years	Both cases: general anaesthesia (thiopentone with nitrous oxide, oxygen and halothane supplement), DPNB with bupivacaine 0.50 without adrenaline Case 1: metal bell clamp and Case 2: a classical circumcision Case 1 two injections either side of the dorsal vein of 0.5 ml Case 2 one injection in the midline of 1.5 ml In both cases: a 25-gauge needle and a two-millilitre syringe was used.	Case 1: 1 st postoperative day skin of the glans 'deep' red and in part 'black'. Case 2: 3 rd day, the penis was 'very dark'.	Coagulation tests within normal range	Case 2: radioisotope perfusion study	Case 1: Conservative treatment Case 2: infusion of normal saline with heparin at a rate of 25 units/kg/hr 4 days	Case 1: 2 weeks: small loss of dorsal coronal skin with scarring Case 2: several days the color of the glans lightens	Arteria damage
6 months	DPNB 2% lidocaine without adrenaline	Several hours; cyanotic glans with a moderate edema of the dorsal penile skin, no voiding difficulty	Plasma level of D-dimer: 8.57 mg/L (normal level 0-0.5 mg/L).	Color Doppler US: normal	subcutaneous injection of enoxaparin as a single daily dose of 1.25 mg/kg, topical 2.5% DHT twice daily.	2nd day: improvement 5th day almost normal	ischemia might be due to the tight bandage on the base of glans with a consequent venous obstruction.
24 years	DPNB with 10 ml of 2% mepivacaine. monopolar electro-cauterization	24 hours: black color	No data	Color Doppler US: cavernosal and dorsal artery flow normal echogenicity of the corpora cavernosa and spongiosa normal	Intracavernosal 2.5 µg PGE1 injection, pentoxifylline 100 mg in 500 ml normal saline solution at 100 ml/h than increasing dose every day, after 4 days per os, Hyperbaric therapy 2.5 atm 4 h per day for 7 days., <i>Amoxicillina 875 mg + clavulanic acid 125 mg per os for 8 days.</i>	8 days: complete resolution	

33 years	DPNB lidocaine 2% and carbocaine	24 hours; painless black colored cold skin	No data	Post-circumcision Reoperation: Intraoperative color-Doppler was performed, atesting a good vascularization of the penis and glans	Reoperation, the glans heated up in warm saline 30min, the suture was renewed with a less tightening purpose Enoxaparin 2000 IU subcutaneously with 100 mg of acetylic acid per os for 20days	Improvement after 24 hours and complete resolution after 5 days	
13 days	No data	72 hours; necrotic glans-penis without signs of inflammation, infection nor demarcation line.	No data	No data	7 days of hyperbaric therapy	Necrotic part fell off spontaneously. In this case the glans-penis could not be rescued. Plastic reconstruction was done.	
16 years	DPNB 15 mL of 0.25% bupivacaine each side.	24 hours; pain, black discoloration, and swelling of the glans.	blood count, lactate, D-dimer, and clotting profile within normal limits.	Color Doppler US: normal Angiography under sedation, internal pudendal artery explored selectively via microcatheter; no vasospasm or thrombus was detected.	Caudal epidural block, Intra-arterial Angiography with spasmolysis with a bolus of 5 µg alprostadil and 150 µg nitroglycerine. Sildenafil (1 mg/kg orally once a day), L-arginine-hydrochlorid (0.1 mg/kg/hour), and unfractionated heparin (15 units/kg/hour, up to 20 units/kg/hour depending on partial thromboplastin time)	Improvement after 2 days.	Excessive dose 15 mL of bupivacaine on each side may have led to a transient vasospasm.
8 years	DPNB with lidocaine hydrochloride 20 mg/mL and epinephrine 12.5 mcg/mL per 2 mL	1 hour; swelling, pain sensation, glans was paler, incarcerating crust, blister, swelling improved.	No data	No data	Conservative treatment. Saline compress and crust cleansing	3rd day, yellowish-necrotic tissue on the lateral side of the glans. One week after the circumcision, the wound at the glans and corpus was improved.	Probably caused by incarcerating crust/scab, which could also have happened in the other circumcision cases.
Case 1: 3 years Case 2: 4 years	No data	Case 1: 7 days, black discoloration of glans penis and voiding difficulty, edema, necrosis Case 2: 3 rd day, pain, brownish discoloration and edema of the distal half of the glans, a flaccid penis, poor perfusion and an almost black glans, no voiding difficulty.	No data	1. Color Doppler US normal 2. Color Doppler US normal	Opening the skin sutures, irrigating the wound, and urethral catheterization. 10 % testosterone undecanoate cream twice a day to the penis for 1 month	Improvement after 7 days. Complete resolution.	

3 years	DPNB: 2 sub-pubic symmetrical 2 mL injections of 1% mepivacaine without adrenalin	48 hours; pain, significantly ischemic, poorly perfused, almost black glans.	increase of white blood cells count > 25000/mm	No data	Liberation of the suture with a posterior therapeutic caudal block with bupivacaine 0.25% 1 mL/kg topic treatment with nitroglycerin and gentamicin and oral administration of pentoxifylline 60 mg/8 h	48 hours; improvement	
7 years	DPNB with 0.1% xylocaine containing ephedrine	After 24 hours a painful swelling, discoloration, black and necrotic appearance of the glans penis, edema on the dorsal penile skin. The urethra, corpus spongiosum, and both corpora cavernosa were flaccid. No voiding problem.	Blood test: normal but D-dimer: 2.57 mg/L (normal 0-0.5 mg/L).	Grayscale US: corpora spongiosa and cavernosa with normal tissue echogenicity. Thickening and echogenicity of the surface of the glans penis more pronounced than expected for simple edema. Color Doppler US examination: normal penile and glandular blood flow	On the first day subcutaneous enoxaparin 2000 anti-factor Xa IU. Next 4 days, enoxaparin anti-factor Xa 50 IU/kg subcutaneously as a single daily dose.	48 hours: the glans penis changed from black to a brownish color, and on the fifth day, the dark color had vanished fifth day, the D-dimer level was normal and enoxaparin treatment was stopped.	Diagnostic of superficial glans ischemia
7 years	No data	Less than 24 hours; cyanosis of glans penis.	No data	No data	Hyperbaric oxygen therapy was administered in the following days, the lesion worsened and resulted in significant tissue loss involving the whole glans and the distal parts of the penile shaft	No complete resolution.	The monopolar electrocautery caused a severe burn injury on the glans of the child.
11 years	DPNB with 0.1% xylocaine	24 hours; black color and swelling of the glans penis edema, no voiding problem	No data	No data	Pentoxifylline injections, 10 mg/kg divided into four equal doses daily for 5 days	48 hours improvement	
11 years	DPNB 3 mL of 0.25% bupivacaine solution.	Admission 3 days after but no information about delay of apparition of the symptoms. Edema and a necrotic appearance of the glans.	No data	No data	Glycerol trinitrate (3 mg/kg, 2 mL) was administered to the cavernous body, epidural nerve block with Bupivacaine 0.0625% for 5 days, Rheomacrodex infusion for 6 days	Improvement after 3 days.	Probably vasoconstrictor agent used for anaesthesia.

14 days	No data	No data; black discoloration of the glans penis, no voiding problems, no fever	Blood test: normal	Gray-scale US: normal echogenicity of the corpora cavernosa in contrast with the hypoechoic glans penis tissues, consistent with ischemic tissue Color Doppler US: normal flow within the cavernosal arteries but no vascularity in the superficial glans tissues, consistent with ischemia	Conservative treatment	Four months later, a follow-up color Doppler sonographic examination was performed. Small bright hyperechoic foci scattered at the periphery of the penis over the former ischemic region of the glans were observed	
10 years	No data	3 days after black necrotic, no voiding problem, no fever.	Normal blood test .	No data	Conservative treatment	17 days after necrotic glans fell off and showed healed distal portion of corpora.	Constrictif effect of dressing
18 years	Anaesthesia was induced with propofol (200 mg), fentanyl (50 µg), and a laryngeal mask, DPNB with a total of 8 mL of 0.75% ropivacain	Pale after surgery pallor of the tip of the glans. There was no edema	No data	No data	Following surgical review, the dressings were removed with only marginal improvement. Subcutaneous Fragmin (dalteparin sodium) 15,000 IU, iloprost infusion (0.5 to 2 µg/h)	43 hours; complete resolution	
2 years	DPNB 1.2-ml solution containing adrenaline 1 : 1000.	Vasoconstriction and ischemia of penile glans	No data	No data	Caudal block	Complete resolution	

However, color doppler showed anormal blood flow only in one case, blood tests showed increased D-dimer and WBC only in three cases, and greyscale US was performed only in two cases, revealing signs of superficial ischemia; therefore, in eight cases out of 23, there was no information about complementary tests. As a consequence, we suggest doing color doppler, greyscale US, and blood tests with D-dimers and WBC in all patients with clinical suspicion of post-circumcision penile ischemia, as we need more data in order to conclude the pathogenesis and elaborate the therapy protocol. For future cases, it is essential to determine the precise volume and type of solution used for anaesthesia, the delay of the apparition of the symptoms, and the delay between the beginning of the treatment and clinical improvement in order to establish the protocol to follow in post-circumcision penile ischemia. In order to minimize the risk, we recommend avoiding the use of vasoconstrictive agents

when performing a dorsal penile nerve block, preferring bipolar cautery during surgery, and not using a postoperative bandage.

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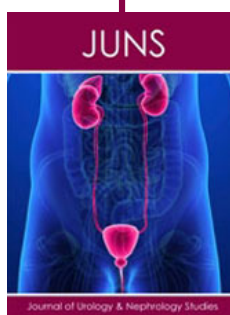
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