Journal of Pediatric Urology (2013) 9, 464—471

Journal of Pediatric urology

Radiation-free percutaneous nephrostomy performed on neonates, infants, and preschool-age children

Ahmet Ali Sancaktutar [a,*], Yaşar Bozkurt [a], Adnan Tüfek [b], Haluk Söylemez [a], Hakan Önder [c], Murat Atar [a], Necmettin Penbegül [a], Mehmet Nuri Bodakçı [a], Namık Kemal Hatipoğlu [a], Tayfun Oktar [d]

[a] *Department of Urology, Faculty of Medicine, Dicle University, Diyarbakır, Turkey*
[b] *Department of Anesthesia, Faculty of Medicine, Dicle University, Diyarbakır, Turkey*
[c] *Department of Radiology, Faculty of Medicine, Dicle University, Diyarbakır, Turkey*
[d] *Department of Urology, Faculty of Medicine, Istanbul University, Istanbul, Turkey*

Received 3 January 2012; accepted 8 June 2012
Available online 2 July 2012

KEYWORDS
Percutaneous nephrostomy;
Preschool-age children;
Ultrasonographic guide

Abstract *Aim:* The aim of this study was to evaluate the effectiveness and safety of high-frequency linear probe ultrasonographic (US) guidance percutaneous nephrostomy (PN) in terms of diagnostic and therapeutic approach in preschool-age children with urological problems.
Materials and methods: PN was performed on 40 kidneys in 33 patients (13 girls, 20 boys) aged 3 days — 7 years (mean 4.1 years). All procedures were performed with US guidance utilizing a Shimadzu SDU 2200 Xplus 5—10 mHz probe. Complete blood count, urinalysis, bladder urine culture, blood urea, and creatinine values were obtained before PN placement on the same day. Urine cultures were obtained by nephrostomy tube and compared to bladder urine culture.
Results: PN procedures were technically successful in 39 kidney units (97.5%). Two major complications were macroscopic hematuria requiring blood transfusions (1 case) and sepsis (1 case). Minor complications were displacement of the catheter (4), urinary tract infection (4), urine extravasation (1), early dislocation of the catheter (1). In three cases, the catheter was replaced. Analysis of bladder urine showed that 13 patients (39.4%) had positive cultures, but analysis of PN urine showed that 25 patients (78.1%) had positive cultures.
Conclusions: PN is an easy, safe and efficient diagnostic and therapeutic procedure with few complications even in preschool-age children. The antibiotic regimen should be revised in order to avoid sepsis and urinary tract infection.

* Corresponding author. Tel.: +90 536 5814053; fax: +90 412 2488523.
E-mail address: aasancaktutar@gmail.com (A.A. Sancaktutar).

1477-5131/$36
http://dx.doi.org/10.1016/j.jpurol.2012.06.001

Introduction

Obstructive uropathy during childhood and adulthood demonstrates some differences in its etiological and therapeutic aspects. Congenital urinary system anomalies are seen more frequently in pediatric patients, while urolithiasis and malignity conditions are frequent in the adult age groups [1].

Percutaneous nephrostomy (PN) is an interventional procedure used mainly to decompress the renal collecting system. Ever since Goodwin and his colleagues introduced this procedure back in 1955, it has been well used in urologic clinics for renal drainage [2]. The procedure comprises routine placement of a percutaneous nephrostomy tube in the kidney through the skin as the last step of an operation, and is crucial to drain the kidney effectively and completely in a wide range of clinical situations [3]. This procedure should be approached with caution, since children's abdominal wall and kidneys are more pliable, and there is less space within the collecting system to maneuver guide wires and drainage tubes [4]. Compared to adults, children's kidneys lie much closer to the skin's surface with less subcutaneous fat, and the degree of dilatation is often extreme, which makes it easier to identify a large calyx suitable for puncture [3,4]. Thus, there are certain differences in the procedures performed on children and adults. PN is usually performed under ultrasound and/or fluoroscopic guidance and rarely under CT- or MR-guided nephrostomy [5]. Use of an ultrasound-guided modality has certain advantages: lack of ionizing radiation, lower costs, portability, shorter procedure time, decreased number of punctures, and no requirement of radiologists and contrast agent administration [6,7]. The added utility of real-time visualization of vasculature flow with Doppler is another advantage of ultrasonography. The ultrasound-guided nephrostomy insertion is usually more straightforward in children than in adults, as visualization of the kidney is often easier; however, this procedure should be approached with caution. However, in the case of neonates, the kidney is particularly mobile, and tract dilatation over a small guide wire is sometimes complex [8]. In addition, accessing even a non-dilated system is often easier in a child than in an adult, as a child's kidney is nearer the skin's surface and is therefore better visualized with ultrasonography [4].

The lumen of even the narrowest of collecting systems can usually be identified using a high-frequency linear probe [9]. As the abdominal wall and kidneys are more pliable in children, a linear probe enables easy tracking of a nephrostomy catheter, avoiding potential vascular injury [4]. The highest frequency transducer that will penetrate the area being examined is optimal. In the case of an infant, this is usually a 7.5 MHz transducer, and for a child, a 5.0 MHz transducer. Especially in the case of newborns and in the infantile age group, during the stage when babies have a very low body weight with relatively thinner abdominal walls, superficial linear probes are preferable [10,11].

A variety of ultrasound equipment can be used here. In general, the highest ultrasound frequency permitting penetration to the depth of interest should be selected. For superficial vessels and organs such as the thyroid, breast, or testicle lying within 1—3 cm of the surface, imaging frequencies of from 7.5 to 10 MHz are usually used [12,13].

Our aim was to determine the efficacy and safety of a percutaneous nephrostomy procedure conducted on preschool-age children using a high-frequency linear probe (5—10 MHz transducer linear sector) under the guidance of ultrasound, without usage of fluoroscopy or general anesthesia.

Patients and methods

The study was approved by the Local Ethics Committee and conducted in accordance with the ethical principles described in the Declaration of Helsinki. The risk involved in the operation was explained to the parents of all the patients after which an informed consent was obtained.

A PN was attempted by our team on 40 kidneys in 33 patients (20 boys, 13 girls) during the period from March 2007 to December 2011. Medical records of these patients were retrospectively reviewed. The patients were evaluated through physical examination, complete blood count, erythrocyte sedimentation rate, urinalysis, bladder urine culture, blood urea, and creatinine values. Following PN, laboratory tests such as complete blood count, erythrocyte sedimentation rate, urinalysis, urine culture, blood urea, and creatinine analysis were repeated.

An hour before the intervention, all the patients received antibiotic prophylaxis with 25 mg/kg of intravenous ceftriaxone. All the procedures were performed under sedation and local anesthesia. Sedation was achieved either through oral chloral hydrate (50—100 mg/kg) or rectal midazolam hydrochloride (0.2 mg/kg). Local anesthesia was achieved through long-acting levobupivacaine 2.5 mg/ml [8]. All the patients were provided with oxygen through a nasal cannula and were monitored by continuous pulse oximetry and electrocardiography. A pediatric anesthetist was present to assist in all cases.

The ultrasonographic (US) guidance was performed with a Shimadzu SDU 2200 Xplus 5—10 MHz probe. All the PNs were performed by two urologists (AAS and NP), while the procedures were performed with US guidance using the Seldinger technique [14]. The patients were positioned prone and oblique, following which, an 18 G needle was placed into a posterior calyx of the lower pole under US guidance. A J tip guide wire (0.035 inch Cook®) was introduced via a needle lumen into the renal pelvis after which the needle was removed. Usually, after dilatation of the tract with the help of three dilators, a 6 or 8 F catheter nephrostomy catheter (NephrofixR, CertoR, Braun Melsungen, Germany) was introduced and the guide wire was removed. However, we used larger catheters (12 F) for drainage of pyonephrosis in older children. During the procedure, all the maneuvers were continuously monitored by US. The correct position of the catheter was determined by free urine drainage. A junior urologist and a pediatric urology nurse were present to assist in all cases. While all patients underwent an elective nephrostography to clarify the etiology of obstruction, we immediately performed nephrostography in cases of suspected placement of nephrostomy tube. As soon as we entered the pelvis, the inner stylet was removed and the syringe was filled with