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Combined CT- and fluoroscopy-guided nephrostomy in patients with non-obstructive uropathy due to urine leaks in cases of failed ultrasound-guided procedures

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ABSTRACT

Aim: To report our experience of combined CT- and fluoroscopy-guided nephrostomy in patients with non-obstructive uropathy due to urine leaks in cases of failed ultrasound-guided procedures.
Patients and methods: Eighteen patients (23 kidneys) with non-obstructive uropathy due to urine leaks underwent combined CT- and fluoroscopy-guided nephrostomy. All procedures were indicated as second-line interventions after failed ultrasound-guided nephrostomy. Thirteen males and five females with an age of 62.3 ± 8.7 (40–84) years were treated. Urine leaks developed in majority after open surgery, e.g. postoperative insufficiency of ureteroneocystostomy (5 kidneys). The main reasons for failed ultrasound-guided nephrostomy included anatomic obstacles in the puncture tract (7 kidneys), and inability to identify pelvic structures (7 kidneys). CT-guided guidewire placement into the collecting system was followed by fluoroscopy-guided nephrostomy tube positioning. Procedural success rate, major and minor complication rates, CT-views and needle passes, duration of the procedure and radiation dose were analyzed.
Results: Procedural success was 91%. Major and minor complication rates were 9% (one septic shock and one perirenal abscess) and 9% (one perirenal haematoma and one urinoma), respectively. 30-day mortality rate was 6%. Number of CT-views and needle passes were 9.3 ± 6.1 and 3.6 ± 2.6, respectively. Duration of the complete procedure was 87 ± 32 min. Dose-length product and dose-area product were 1.8 ± 1.4 Gy cm and 3.9 ± 4.3 Gy cm^2, respectively.
Conclusions: Combined CT- and fluoroscopy-guided nephrostomy in patients with non-obstructive uropathy due to urine leaks in cases of failed ultrasound-guided procedures was feasible with high technical success and a tolerable complication rate.

1. Introduction

Percutaneous nephrostomy was first described more than 50 years ago as a blind puncture of the renal pelvis in hydronephrosis [1]. Since that time, the percutaneous approach has been performed routinely as a relief for obstructive uropathy with fluoroscopy, ultrasound, CT and MRI as guidance modalities [2–6]. It is used as direct urinary drainage for a variety of disorders. The most frequent are renal or ureteral calculi causing obstructive uropathy, trauma of bladder or ureter, urinary tract leaks due to infiltrating malignancies or after surgical complications [7–9]. In obstructive uropathy, blockage of the urinary drainage system can lead to severe functional defects of the kidney [10]. Non-obstructive uropathy associated with leaks bears the risk of localized and systemic infection such as infected urinoma, retroperitoneal abscess, pyelonephritis, peritonitis and urosepsis [11]. All these conditions can be treated effectively with percutaneous urinary drainage [12,13]. Under fluoroscopy- and ultrasound-guidance, percutaneous nephrostomy is technically feasible in up to 98% of cases with dilated systems [14]. In non-obstructive uropathy, fluoroscopy- and ultrasound-guided nephrostomy fail in 15% [15,16]. CT-guided per-

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cutaneous nephrostomy is an alternative approach when routine procedures are difficult or infeasible. Especially in patients with complex anatomic situations as ectopic kidneys or retrorenal colon, obesity and postoperative patients with extensive laparotomy wounds, CT-guidance can be advantageous. For proper positioning of guidewire and catheter, fluoroscopy is mandatory after successful CT-guided access to the renal collecting system [17]. The purpose of the current study was to report our experience with combined CT- and fluoroscopy-guided nephrostomy in patients with non-obstructive uropathy due to urine leaks in cases of failed ultrasound-guided procedures.

2. Materials and methods

This study was a retrospective analysis of existing clinical data. All procedures were indicated by a senior interventional radiologist and the referring clinician and carried out as emergency care. The institutional review board did not require its approval for this study. Written informed consent was obtained.

2.1. Patients

From May 2003 until April 2010, 18 patients (23 kidneys) with non-obstructive uropathy due to urine leaks underwent combined CT- and fluoroscopy-guided nephrostomy (Table 1). All procedures were indicated as second-line interventions after failed previous attempts of ultrasound-guided nephrostomy. A collecting system was defined as non-dilated when no calyceal dilatation was observed at ultrasound [15,17]. Urine leaks developed in majority after open surgery, e.g. postoperative insufficiency of ureteroneocystostomy (5 kidneys) or ureteroureterostomy (4 kidneys) as well as iatrogenic ureter injury (4 kidneys) or urinary bladder injury (4 kidneys). The main reasons for failed ultrasound-guided nephrostomy included anatomic obstacles in the puncture tract (7 kidneys), inability to identify pelvic structures (7 kidneys) and impossibility of adequate patient positioning due to wound healing disorders after laparotomy with severe risk of dehiscence (5 kidneys). Thirteen males and five females with a mean age of 62.3 ± 8.7 (40–84) years and a mean body mass index of 29.1 ± 5.2 (22.9–42.1) kg/m^2 were treated. Eleven patients had overweight (body mass index beyond 25 kg/m^2 and below 40 kg/m^2) and three patients morbid obesity (body mass index beyond 40 kg/m^2). As a high-volume center for complex surgical procedures including transplantation and tumor resection, percutaneous nephrostomy is a routinely performed intervention. During the 7-year study period, 1089 ultrasound-guided percutaneous nephrostomies were performed in our institution, among those 152 (14%) in non-obstructed kidneys. Thereby, 23 (2% of all ultrasound-guided nephrostomies and 15% of nephrostomies in non-obstructed kidneys, respectively) ultrasound-guided procedures failed in patients with non-obstructive uropathy due to urine leaks. All these cases were included in the study described herein. CT-guided guidewire placement into the renal collecting system as first step was followed by fluoroscopy-guided nephrostomy tube positioning as second step. In case of bilateral percutaneous nephrostomy, the interventions were performed at the same day or at consecutive days.

2.2. CT-guided guidewire placement

All patients underwent the procedure with updated CT-diagnostics performed the day before or at the day of the intervention. Prothrombin time, partial thromboplastin time and thrombocyte count were normal or had been corrected sufficiently prior to the procedure. According to our standard operating procedure protocol, all patients were premedicated with 1 g of cefotaxime (Sanofi-Aventis, Frankfurt, Germany) and 120 mg gentamicin (Hexal, Holzkirchen, Germany) unless the patient was already covered with antibiotics [14,15]. Pulse rate, blood pressure, electrocardiogram and peripheral oxygen tension were monitored. If the patient was not intubated, analgosedation was initiated with an intravenous injection of 2.5 mg midazolam (Roche Pharma, Grenzach-Wyhlen, Germany), 25 mg pethidine (Sanofi-Aventis, Frankfurt, Germany) and 1 g metamizole (Hexal, Holzkirchen, Germany) 15 min prior to the initial puncture. Further pain or restlessness during the intervention was controlled with another bolus injections of pethidine in portions of 25 mg up to a maximum dose of 75 mg and/or additional bolus injections of piritramide (Janssen-Cilag, Neuss, Germany) in portions of 7.5 mg up to a maximum dose of 22.5 mg For the CT-guided guidewire placement, the patients were positioned head first either in supine or supine oblique position in the scanner (Siemens Volume-Zoom or Siemens Somatom Definition DS; Siemens, Forchheim, Germany). The main scanning parameters included a tube voltage of 120 kVp, a tube current of 240 mA s, a detector collimation of either 4 × 1.25 mm or 14 × 1.2 mm and a pitch of 0.5. All images were reconstructed in axial and coronal planes with a slice thickness of 3 mm and an increment of 2 mm. The first CT-scan was acquired 10 min after injection of 60 ml of iodinated contrast material (iomeprol, Imeron

Table 1
Demographics.

Patients	18
Sex (male:female)	13:5
Age (years)	62.3 ± 8.7 (40–84)
Body weight	
Body mass index (kg/m^2)	29.1 ± 5.2 (22.9–42.1)
Overweight/morbid obesity[a]	11/3
Malignancies	13
Urinary bladder cancer	3
Rectosigmoid cancer	3
Prostate cancer	3
Pancreatic carcinoma	2
Sacroma	2
Within the 30-day interval after	11
Pelvic exenteration with ileal conduit	3
Cystectomy with ileal conduit	3
Radical prostatectomy	2
Pancreas resection	1
Rectosigmoid resection	1
Transurethral bladder resection	1
Intubated	5
Kidneys	23
Side (right:left)	10:13
Reasons for urine leaks	23
Postoperative insufficiency of ureteroneocystostomy	5
Iatrogenic ureter injury	4
Postoperative insufficiency of ureteroureterostomy	4
Tumor-associated urine fistula	4
Ureteral necrosis	3
Iatrogenic urinary bladder injury	3
Reasons for failed previous attemps of ultrasound-guided nephrostomy	23
Anatomic obstacles in the potential puncture tract	7
Inability to identify the renal collecting system	7
Impossibility of adequate patient positioning due to wound healing disorders after laparotomy with severe risk of dehiscence	5
Failed guidewire or nephrostomy tube insertions[b]	4

[a] Patients with a body mass index beyond 25 kg/m^2 and below 40 kg/m^2 had overweight and beyond 40 kg/m^2 morbid obesity.
[b] Due to improper punctured calyces or unfavourable entrance angle to the renal collecting system.