

Percutaneous Management of Ureteral Injuries that are Diagnosed Late After Cesarean Section

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Objective: We wanted to present the results of percutaneous management of ureteral injuries that were diagnosed late after cesarean sections (CS).

Materials and Methods: Twenty-two cases with 24 ureteral injuries that were diagnosed late after CS underwent percutaneous nephrostomy (PN), antegrade double J (DJ) catheter placement and balloon dilatation or a combination of these. The time for making the diagnosis was 21 ± 50.1 days. The injury site was the distal ureter in all cases (the left ureter: 13, the right ureter: 7 and bilateral: 2). Fifteen complete ureteral obstructions were detected in 13 cases. Ureteral leakage due to partial ($n = 4$) or complete ($n = 3$) rupture was noted in seven cases. Two cases had ureterovaginal fistula. All the cases were initially confirmed with antegrade pyelography and afterwards they underwent percutaneous nephrostomy. Balloon dilatation was needed in three cases. Antegrade DJ stents were placed in 10 cases, including the three cases with balloon dilatation. Repetition of percutaneous nephrostomy with balloon dilatation and DJ stent placement was needed in one case with complete obstruction. All the cases were followed-up with US in their first week and then monthly thereafter for up to two years.

Results: Eighteen ureters (75%) were managed by percutaneous procedures alone. A total of six ureter injuries had to undergo surgery (25%).

Conclusion: Percutaneous management is a good alternative for the treatment of post-CS ureteral injuries that are diagnosed late after CS. Percutaneous management is at least preparatory for a quarter of the cases where surgery is unavoidable.

Most ureteral injuries are iatrogenic, and they arise as potential complications of urological, abdominal or pelvic operations; these injuries have an overall incidence of 0.5–1% (1–3). Ureteral injury caused by obstetric or gynecologic surgery is rare, though ureteral injury caused by just gynecologic surgery is much more common (1). Ureteral injury during performance of cesarean section (CS) is very rare, with an incidence of 0.10–0.27% (4–6). Although the surgical management of ureteral injuries is simple and successful once they are recognized during performing a CS, these injuries are generally missed in 67–89% of all cases (6, 7). A delayed diagnosis may complicate the injury and this can result in a poor outcome.

Interventional radiology can offer some options to improve this outcome. We would like to present our experience with percutaneously managing post-CS ureteral injuries.

MATERIALS AND METHODS

From February 1999 to April 2007, 22 consecutive patients (mean age, 33 years;

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age range, 19–42 years) with 24 ureteral injuries that were recognized late after the intraoperative period were included in this study and we excluded those cases that were recognized intraoperatively (Table 1). The Urology or the Obstetric/Gynecology departments referred 18 cases. Four out of these 18 cases had hydronephrosis plus free abdominal fluid observed on the ultrasound exam, three had flank pain plus free abdominal fluid seen on the ultrasound exam, nine had flank pain plus hydroureteronephrosis seen on ultrasound and two had urine that discharged from the vagina, which all suggested the diagnosis of urinary tract injury. The remaining four cases with obstruction were initially recognized and diagnosed by the Radiology Department, although they were referred to radiology for ultrasound exams by other departments for various reasons other than ureteral injury (2 for fever of an unknown origin, one for gallbladder dysfunction/cholecystitis and one for back pain).

Two cases displayed ureterovaginal fistula, and both of these cases were diagnosed by the urine that had been discharged from the vagina within 24 hours of CS (these are the cases with the earliest detection of ureteral injury). The case referred to us for gallbladder dysfunction was diagnosed eight months after CS (this is the case with the

most delayed recognition of post-CS ureteral injury). The average time to recognition for all the cases was 21 ± 50.1 days (range, 1 day – 8 months).

After obtaining written informed consent from all the patients, the ureteral injury was initially confirmed by antegrade pyelography. Following prophylactic antibiotic coverage, a Neff set (Cook, Bloomington, IN) or an Accustik set (Boston Scientific, Watertown, MA) was used for the initial puncture under the guidance of US and/or fluoroscopy, and using the micropuncture technique as detailed elsewhere (8).

Antegrade pyelography was diagnostic for all the cases. Accordingly, the injury site was found to be the distal ureter in all the cases (left ureter: 13, right ureter: 7, bilateral: 2). Complete ureteral obstructions were diagnosed in 15 ureters of 13 cases, including the two cases with bilateral ureteral occlusion. Ureteral leakage due to partial ($n = 4$) or complete ($n = 3$) rupture was seen in seven cases.

Percutaneous nephrostomy (PN) was performed following antegrade pyelography in all 22 cases. The control pyelography, which was done through the PN catheter, was obtained weekly for the complete ureteral occlusion cases to observe and wait for resolution of the sutures in

Table 1. List of Cases According to Characteristics of Injuries, Time to Recognize Injuries and Subsequent Management

Case No.	Age	Type of Injury	Site of Injury	Time to Diagnose (days)	Management
1	27	Obstruction	L	17	PN + DJ + Balloon
2	33	Obstruction	L	6	PN
3	24	Partial Rupture	R	49	PN + DJ
4	32	Obstruction	L	2	PN
5	32	Complete Rupture	R	3	Surgery
6	19	Partial Rupture	L	11	PN + DJ
7	34	Obstruction	L	17	PN + DJ
8	37	Complete Rupture	L	8	Surgery
9	38	Ureterovaginal Fistula	R	1	Surgery
10	36	Obstruction / Obstruction	R / L	2	PN / PN
11	29	Complete Rupture	L	7	Surgery
12	37	Obstruction	R	18	PN + DJ
13	41	Obstruction / Obstruction	R / L	3	Surgery / PN
14	32	Ureterovaginal Fistula	L	1	PN + DJ
15	27	Partial Rupture	L	12	PN + DJ
16	36	Partial Rupture	R	23	PN + DJ
17	42	Obstruction	L	26	(PN + DJ + Balloon) x 2
18	38	Obstruction	L	2	PN
19	35	Obstruction	R	9	PN + DJ + Balloon
20	37	Obstruction	L	~240	Surgery
21	33	Obstruction	R	2	PN
22	27	Obstruction	L	8	PN

Note.—R = Right ureter, L = Left ureter, R / L = Bilateral, PN = percutaneous nephrostomy, DJ = Double J catheter placement, Balloon = Balloon dilatation of ureter

anticipation of a reestablished ureteral flow. Ureteral patency was observed in eight cases, and there was no further intervention other than PN for these cases. Two cases had persistent occlusion where a guidewire could not be passed through to achieve balloon dilatation and/or insertion of a Double-J (DJ) stent; these cases were referred for surgery. The remaining five cases in this obstruction group required additional DJ stent placement

because of the irregular lumen that was seen on the control pyelograms, and these control pyelograms were done via PN. Three out of these five cases needed balloon dilatation as well.

Double-J catheter placement was initially attempted during the first session for all the cases with ruptures and fistulas where passage of the catheter through the injury point was feasible. DJ catheter placement was achieved in



Fig. 1. 32-year-old female with ureterovaginal fistula and who presented with vaginal urine leak on first day after cesarean section. **A.** Antegrade pyelography shows partial transection of lower right ureter with fistulization to genital tract. **B.** Guidewire passing through injured lower right ureter into bladder. **C.** Double J catheter is seen in bladder. **D.** Control antegrade pyelography of case three weeks later shows disappearance of leak.

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the first session for a total of five cases with partial rupture (n = 4) or fistula (n = 1) (Fig. 1). The guidewire could not be advanced through the distal part in three of the complete rupture cases and in one fistula case. These cases were referred for surgery.

Percutaneous nephrostomy catheters were used to check the ureteral patency before totally removing the DJ catheter. Once ureteral patency was established, all the DJ stents were eventually removed via the retrograde route by the urology team after an average of three to four weeks. Afterwards, PN catheters were left in place to check for possible leaks. If the healing was thought to be complete, then the PN was also removed, usually within a week after the removal of the DJ catheter.

Technical success of the percutaneous management was defined as uneventful passage of the DJ catheter through the injury site, when this was attempted. For the other cases, technical success was defined as uneventful PN placement.

All the cases were followed-up by US examination a week after the intervention procedures and then monthly for up to two years.

The clinical success of percutaneous management was defined as avoidance of surgery with restoration of ureteral patency at the end of the follow-up period.

RESULTS

The management of the post-CS ureteral injuries for each case is given in Table 1 and the outcomes, in accordance with the management, are given in Table 2.

Eighteen ureters (75%) were managed with only percutaneous procedures. Three cases with complete rupture and one case with a ureterovaginal fistula underwent surgery without waiting. One case in the total occlusion group that was diagnosed eight months after CS

had her surgery two weeks later, following confirmation of persistent total occlusion according to the control antegrade pyelography, and this was done through a PN. One of the cases with bilateral ureteral occlusion underwent surgery for the left side. A total of six cases of ureter injuries had to undergo ureteral reimplantation surgery, and this surgery went without complications (25%).

Our clinical success rate (effective percutaneous management alone without surgery for restoring the ureteral patency) was 87% (13/15) for obstruction and 56% (5/9) for rupture (including partial and complete ruptures and fistulas).

No complication related with percutaneous management was observed and our technical success rate for PN was 100%, while it was 63% (10 successful attempts out of 16) for DJ catheter placement.

For the short term results, the average resolution time after PN was two weeks (range: 1–5 weeks) for the obstruction group. DJ catheters were left in place for an average of three weeks in the partial rupture group. For the cases where balloon dilatation was needed, DJ catheters were left in place for an average of four weeks.

For the long-term results, all the cases were followed-up with monthly US examinations for a median of 11 months (range: 2–24 months). Only one case required a repeat PN, DJ and balloon dilation in the thirteenth month of follow-up. This case had no further problems for 14 more months, and then she was lost to follow-up.

DISCUSSION

The majority of ureteral injuries during CS are of the obstructive type as a consequence of the hemostatic sutures that are placed for controlling bleeding (and these occur mainly after extension of the uterine incision into the

Table 2. Management of Ureters as Grouped in Relation to Type of Injury and Outcomes

	Obstruction	Partial Rupture		Complete Rupture
		Rupture only	Fistula	
PN (n = 8)	8	–	–	–
PN + DJ (n = 7)	2	4	1	–
PN + DJ + Balloon (n = 3)	3	–	–	–
Surgery (n = 6)	2	–	1	3
Success Rate	87% (13/15)	100% (4/4)	50% (1/2)	0% (0/3)
		83% (5/6)		
		56% (5/8)		

Note.—PN = percutaneous nephrostomy, DJ = Double J catheter placement, Balloon = Balloon dilatation of ureter, Success rate = Percentage of ureters for which percutaneous management was effective and open surgery was eventually avoided.

broad ligament or vagina) (4, 5). Hemostatic sutures placed for bleeding control can cause ligation or kinking of the ureter. Less frequently, ureters may be directly injured due to extending a uterine incision, with resultant partial or complete transection of the ureter (5). Complete obstruction that was possibly due to hemostatic sutures was seen in 13 of our cases (59%). Partial or complete transection of the ureter was seen in nine out of 22 cases, including the two cases with ureterovaginal fistula (41%). While most of the ureter transections were seen in the earlier years of this study (6 out of 9 cases from 2000 to 2002), no partial or complete ureter rupture was seen in the last two years of our series. This observation is consistent with the current literature, which reports a shift from transection to obstructive injuries of the ureters during the recent years (5). This is likely related with the improved technique of worldwide surgical teams and the experience they have gathered.

The timely recognition of the ureteral injury is very important since the single controllable factor that adversely affects the outcome is a delayed diagnosis (6, 7). Delay in recognition of any complication is a medicolegal issue (9). Since the primary concern of the obstetric surgeon treating the baby rather than other surgical fields, the intraoperative recognition of ureteral injuries during CS is very low, and this was confirmed by the experience of the urology team at our center. The intraoperative recognition rate in the literature ranges from 11% to 33% (7, 10). The diagnosis of ureter injury requires a high index of suspicion and the making the diagnosis is generally difficult unless there is a leak (11). There may be a silent total occlusion until secondary urinary infection or pain develops. Two of this study's cases were diagnosed quite late and only by the signs of infection. One case that was sent from the Gastroenterology Department had undergone a US examination because of abdominal discomfort and another case displayed only lumbar pain. The time to diagnosis ranged from 2 to 382 days (median: 52 days) in the previous literature (12). The average time for making the diagnosis in our series was 21 ± 50.1 days (range: 1 day - 8 months). The cases in our hospital that had intraoperatively recognized ureteral injuries were discussed with Urology Department during the operation.

Ureteral injuries diagnosed during a CS operation can easily be handled using the retrograde, endoscopic approach since the treatment setting is already convenient. On the other hand, the antegrade approach requires non-attenuating surgical table for X-ray use and the patient must be placed in the prone position. However, the cases with ureteral injuries that were diagnosed late after CS were referred to our Radiology Department because late strictures are difficult to manage by the retrograde

approach since the ureteral orifice may not be visualized cystoscopically, and this precludes the retrograde approach (13). The procedure may be complicated by creation of submucosal flaps during attempts to pass a guidewire beyond the site of the stricture (14).

The left ureter is more vulnerable to injury than the right ureter since the dextrorotation of the gravid uterus displaces the left ureter anteriorly (5). In this study, there was a left ureter preponderance among the unilateral ureteral injury cases (65%; 13 left-sided injuries out of 20 unilateral injuries).

Most studies concerned with the management of post-CS ureteral injuries in the literature are from surgical groups, and mainly urology and obstetric/gynecology teams. The lack of published data in the current interventional radiology literature makes it impossible to compare the surgical and percutaneous management of ureteral injuries. The only study that has compared surgery and minimally invasive management was again from a Urology team, and they presented a review of 30 cases (1). Minimally invasive treatment was initially done in seventeen cases, while the remaining 13 cases directly underwent surgery. Surgical treatment was eventually required for 6 out of 17 cases (35%) where minimally invasive treatment was initially done. Eighteen out of 24 injured ureters (75%) in our series were managed percutaneously, while the remaining six (25%) required additional surgery following antegrade pyelography and nephrostomy placement. More specifically, our success rate for the total occlusion group was 87%. Urinary diversion with percutaneous nephrostomy can allow time for suture absorption, as reported by Harshman et al. (15). Lask reported an 80% success rate with performing percutaneous nephrostomy alone (12). Therefore, for the cases without rupture, nephrostomy placement \pm DJ ureteral stent placement with balloon dilatation insured a high cure rate in our present study.

Surgery is the preferred approach for the cases with complete rupture, though it can be safely deferred by creating a percutaneous urinary diversion until elective conditions are restored (16). The only technical problem with this group of patients is to gain access to a non-dilated renal collecting system. All the cases in this study had percutaneous nephrostomy safely done with the micropuncture technique under the guidance of high resolution imaging equipment.

Partial ruptures that allow an antegrade guidewire passage can be managed with the help of antegrade DJ catheters. Five out of six partial ruptures (including one of the two cases with ureterovaginal fistulas) in our series were managed with just percutaneous procedures (83%). The overall percutaneous success rate for the management

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of complete and partial ureteral ruptures was 56% in this study.

The main limitation of this study was the small number of cases; it was not enough for a detailed statistical analysis. However, the main reason for this limitation is related with the rarity of this complication, which did not let us make a comparison with surgical management.

To sum it up, the recognition of post-CS ureteral injuries remains a challenge. When these are recognized, interventional radiology with all its well known advantages may be part of the management. One should particularly consider the fact that the percutaneous approach for the management of ureteral injuries that are diagnosed late after CS may help patients avoid more open surgery. Based on our results, the success rate of percutaneous management in such cases may far exceed 50% depending on the type of injury. It's worthwhile to offer patients some minimally invasive approach before attempting surgical correction, and especially for the obstructive and partial rupture types of ureteral injuries.

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