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Challenges in the Management of Kidney Allograft Herniation With a Single-stage Pedicled Anterolateral Thigh Flap

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Wound complications are the most common surgical complication after kidney allograft transplantation. Total wound rupture exposing the entire kidney is a rare and not well-described event. We present a successful treatment of this complication in a patient admitted to our unit. A single-stage procedure was performed combining debridement and reconstruction with a pedicled anterolateral thigh flap and an iliotibial band transferring. A short literature review is performed comparing the different treatment strategies and results.

Since the first successful human kidney transplantation in 1954, allogeneic transplantation of kidney has been progressed significantly, not only achieving good success rate but also low complication profile. Early transplant failure has decreased primarily due to the progress in immunosuppressive therapy.¹ Nevertheless, several factors can jeopardize the new kidney transplant, which can be broadly divided into patient factors (eg, age, smoking, diabetes, obesity, and compliance), surgical factors (eg, surgical technique, bleeding, urine leak, and reoperation), and transplant-specific factors (eg, immunosuppression, rejection, graft loss, and delayed graft function).^{2,3}

Wound complications are considered the most common surgical complication in kidney transplantation.⁴ Perhaps,

due to its often minor nature, and thus, it rarely affecting the allograft function, the management of it is rarely reported in the literature.^{2,4,5} Total wound dehiscence exposing the entire kidney allograft is certainly a rarer entity in the spectrum of wound complications. When the authors reviewed the literature, there were only scant reports of its management, with the majority of the report proposing a somewhat outdated approach to the condition.⁶⁻⁹ In addition, it was not clear what the optimal timing of the soft-tissue coverage is. This case report presents the authors' experience in managing an exposed, herniated kidney allograft with aggressive debridement and immediate reconstruction of the abdominal fascia and soft-tissue defect with a pedicled anterolateral thigh (ALT) fasciocutaneous flap. A literature review was presented to summarize and contrast the management of this uncommon condition with previously published articles.

CASE REPORT

Formal informed consent was obtained from the patient for publication purpose.

Patient was first admitted at the age of 17 y to the Swedish Healthcare System, at that time he had body mass index (BMI) 15.8 kg/m² (159 cm, 40 kg) and was wheelchair-bound due to hip and knee fixation from childhood rickets. At presentation, he was diagnosed with end-stage renal failure (creatinine >600 μmol/L, urea 28) from a urethral valve. Despite valve ablation and catheterization, it failed to reverse the renal failure. Subsequently, bilateral nephroureterectomy was performed because of multiple infections. The procedure was complicated by postoperative bleeding (due to a previous unknown fibrin stabilizing factor deficiency) requiring hematoma evacuation. Screening for bleeding disorder revealed a factor XIII deficiency.

In January 2020, the patient was accepted on the waiting list to receive a kidney transplant from a deceased donor. One year later, at the age of 23 (BMI 20.6 kg/m²), renal

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transplantation was performed via an oblique incision in the left iliac fossa. The donor was 23 y old, had a height of 180 cm and a weight of 96 kg (BMI 29.6 kg/m²). Cold ischemia time was 13 h and 1 min. The kidney allograft had 2 separate arteries (main artery was 7 mm, lower pole artery was 3 mm) both with aortic patches, and 1 vein. The anastomoses were performed in an end-to-side fashion to the left iliac artery and vein, respectively. The patient received standard triple immunosuppression with tacrolimus, mycophenolate mofetil, and prednisolone and induction therapy with methylprednisolone and thymoglobulin. Factor XIII deficiency was managed with plasma transfusion before the transplant procedure. Despite this, the patient experienced several bleeding complications postoperatively requiring 3 reoperations, each time with wound debridement and attempted direct closure. In the final trip to theater, the rectal sheath was left with a 12-cm-wide fascial defect despite overlying abdominal soft-tissue closure. The patient was discharged 23 d after transplantation, during which he also developed posttransplant diabetes.

One week later, the patient was readmitted to the hospital with total wound dehiscence with herniation of the entire kidney (Figure 1A). The patient was stable but the wound looked infected and inflammatory markers were elevated. The creatinine level remained normal. A broad-spectrum antibiotic (meropenem) was initiated at recovery, and microbiologic specimens taken from the wound the day before operation as well as during the operation were subsequently identified as *Serratia marcescens* and *Klebsiella oxytoca*, which were both sensitive for meropenem.

Plastic surgery service was consulted for wound management and reconstruction during the admission. After extensive discussion between the transplantation and the plastic surgery teams, it was decided that the wound would be managed with early aggressive surgical debridement and a single-stage

procedure for closure would be performed at the same session. The day after admission, the transplantation and plastic surgery teams collaboratively debrided all necrotic and compromised tissues of the abdominal wall. The allograft and the debrided wound were irrigated with a mixture of saline solution and hydrogen peroxide. An ALT flap with 2 skin perforators was raised in a standard fashion¹⁰ with the inclusion of the widest and longest iliotibial band as possible.^{11,12} The descending branch of the lateral femoral circumflex artery was dissected as proximally as possible such that the inset of the ALT flap would not create tension on the pedicle. The ALT flap was tunneled under the rectus femoris muscle to increase the arc of rotation and consequently to reach the wound without any tension in the pedicle. The procured iliotibial band was used to restore the continuity of the deep abdominal fascia (sutured with 2-0 Monocryl, Johnson & Johnson, New Brunswick, NJ), and the skin island filled in the soft-tissue defect with tensionless closure. Two active drains were placed over and under the kidney, an irrigation catheter system was created to flush the wound cavity once per day on the ward.

After the second postoperative week, pus leaked through the wound, 2 perirenal abscesses were diagnosed and drained by an interventional radiologist. They were located ventral and dorsal to the kidney graft measuring respectively 2 × 4 cm and 5 × 10 cm, respectively. No blood circulation disturbance was reported at this time. The creatinine level was elevated, and hydronephrosis was detected at the ultrasonographic examination. A percutaneous nephrostomy was inserted, and the creatinine level slowly normalized. Computed tomography during the third postoperative week showed a circular infarction in the lower lobe of the kidney and a ureteral stenosis probably caused by ceased circulation and/or thrombosis to the lower renal artery (Figure 2).

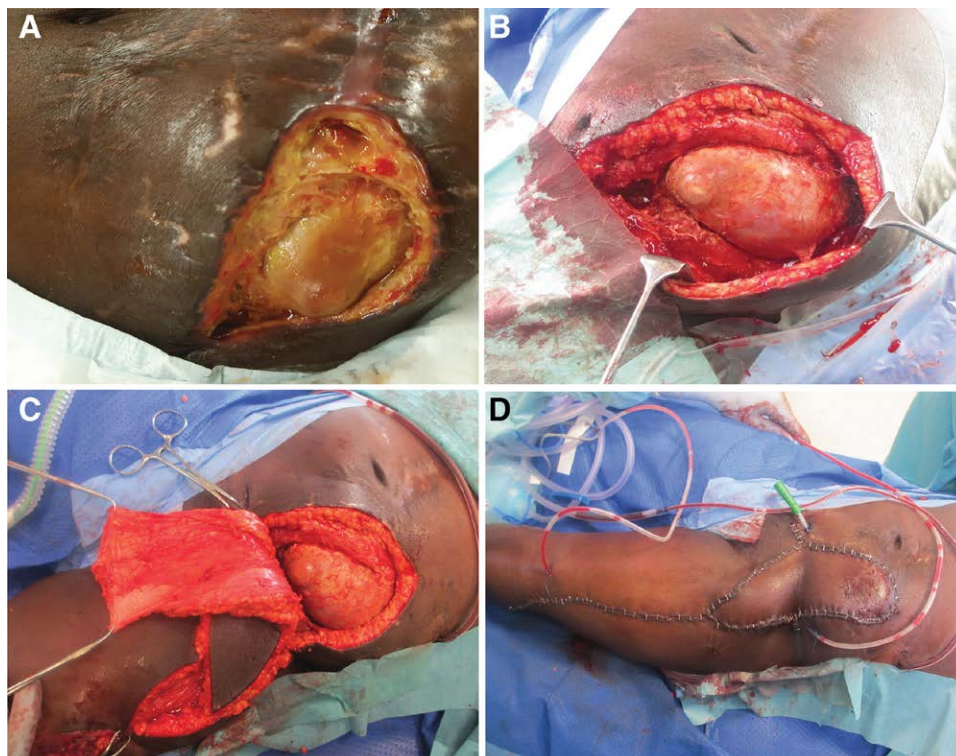


FIGURE 1. The abdominal wall of the patient with herniated kidney allograft. A, Preoperative. B, Perioperative after debridement. C, The ALT is raised, the forceps on the left extend of the iliotibial band. D, Postoperative. ALT, anterolateral thigh.

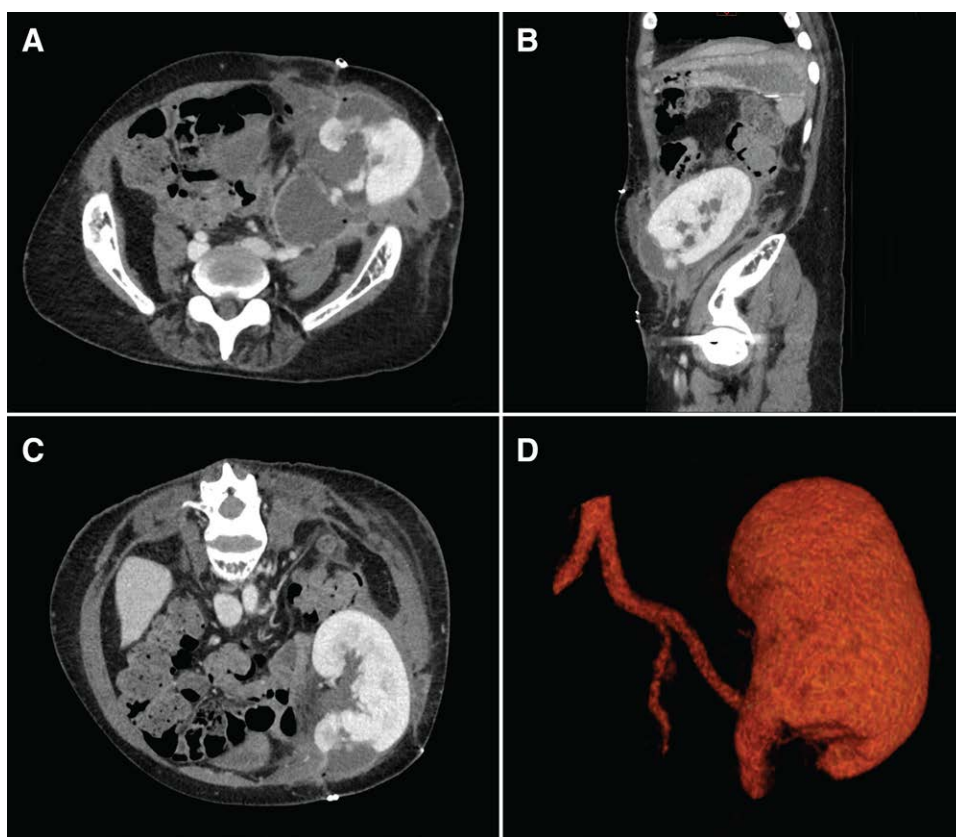


FIGURE 2. Postoperative computed tomography of the abdomen showing the infarction of the inferior lobe of the kidney allograft. Axial (A), sagittal (B), and parallel planes to the kidney (C). Three-dimensional reconstruction of the perfused areas in the kidney transplant (D).

The patient was discharged 2 mo after admission with a stable transplant function (creatinine 150 $\mu\text{mol/L}$), a healed flap, and a nephrostomy catheter.

During the most recent follow-up at 12-mo postreconstruction, the patient had resumed his usual life at home with a nephrostomy catheter and a stable creatinine around 110 $\mu\text{mol/L}$. No hernia was reported at clinical examination.

DISCUSSION

The treatment of small wound dehiscence after kidney transplantation is well known in the literature and commonly heals with conservative measures.⁵ However, when the wound is extensive with the allograft is exposed, the management can be challenging. Besides the already immunosuppressed patient with concurrent infection, the restoration of the abdominal anatomy and integrity while preserving allograft requires careful timing and considerations.

After a review of the literature, the authors identified 4 articles reporting on the management of exposed kidney allografts since 1980 (Table 1). The first article presented 4 patients treated with split-thickness skin graft (STSG) over the kidney at the same unit during the 80s.⁶ The second⁷ and the third⁸ articles presented 1 patient each treated with local flaps at different units during the last 14 y. The fourth article presented a patient treated with STSG over the kidney after several months of wound preparation with negative pressure wound therapy (NPWT).⁹ Although STSG is a safe and simple procedure, and it is, nonetheless, a weak option in this modern era of microsurgery. First, in order for an STSG to survive, the wound needs to be ready and showing signs of

granulation, prolonging the duration of allograft exposure. McKinnon et al⁹ introduced NPWT as a tool to reduce the duration of exposure, and it took 134 d before achieving the kidney allograft coverage. Second, restoring the defect by using a STSG neither restores the abdominal continuity nor provides an adequate soft tissue over the allograft.⁷ Not only does it produce poor aesthetic appearance with a herniated allograft, but its superficial position also subjects it to future infection and mechanical trauma. With the advancement of microsurgical techniques and the understanding of perforator flap anatomy,¹³ the surgeon should always consider locoregional flaps for definitive closure.

The authors identified 2 important goals in the management of such patient: (1) a clean wound, which includes removal of nonviable tissues and appropriate infection control with targeted antibiotics, and (2) optimized coverage of the kidney with restoration of the abdominal fascial and soft-tissue continuity without tension at the earliest possible chance.

Once the decision is made to reconstruct the defect with a locoregional flap, the following question would be: When is the earliest possible opportunity? Should the wound be debrided conservatively in stages with multiple trips to the operating theater or in an aggressive debridement in a single-stage and obtain immediate coverage is a better option? The authors believe that prolonged exposure of the allograft with multiple trips to theater for debridement risks mechanical trauma to the allograft, compression or twisting of the vascular and ureteral anastomosis, predisposing it to acute allograft failure. With the use of a flap, not only does it provide soft-tissue coverage and a fascia component that can restore the deep fascia of the abdominal wall but it also provides

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TABLE 1.
Published cases of treated kidney transplant herniation

Reference	No. cases	Age Sex	Early treatment	Early outcome	Definitive closure	Late outcome	Time between KT exposure and definitive closure	Follow-up
Paley et al ⁶	4	55 M	Debridement, DC	Wound granulation	STSG	Successful coverage	12 wk	22 mo
		25 M	Debridement, DC	Wound granulation	STSG	Successful coverage	Unknown	38 mo
		22 W	Drainage, debridement, whirlpool treatment, DC	Wound granulation	STSG	Successful coverage	6 wk	8 mo
		53 M	Drainage, DC	Wound granulation	STSG	Successful coverage	24 wk	2 mo
Jeon et al ⁷	1	66 M	Pedicle rectus femoris flap covered with STSG	Partial flap necrosis, partial KT exposure	Debridement, V-Y flap	Successful coverage	2-3 wk	24 mo
Faizal et al ⁸	1	20 M	DC before pedicle ALT flap with vastus lateralis	Hematoma, dehiscence ureteral anastomosis	Surgical drainage, Boari Flap	Successful coverage	Unknown	24 mo
McKinnon et al ⁹	1	70 W	Debridement, NPWT	Wound granulation	STSG	Successful coverage	19 wk	Unknown
Our case	1	22 M	—	—	Debridement, pedicle ALT flap with iliotibial band	Successful coverage	0	12 mo

ALT, anterolateral thigh; DC, dressing change; F, female; KT, kidney transplant; M, male; NPWT, negative pressure wound treatment; STSG, split-thickness skin graft.

blood supply for the delivery of antibiotics to the local tissue to facilitate the resolution of local infection.^{7,8} The authors, after deliberations, thus, decided to proceed with the single-stage (debride and reconstruct) procedure. The aggressive debridement aimed at removing any colonized tissues with no blood supply with a low suspicion threshold, this strategy proved to be a success.

Pedicle ALT flap is a known, reliable workhorse for the reconstruction of lower abdominal deformities, as it has a favorable anatomical location with a discrete donor site morbidity.^{11,12,14} Furthermore, the iliotibial band provides a generous fascial component for deep abdominal fascia restoration with low risk for postoperative hernia.^{11,15} The alternatives to ALT would be the rectus abdominis flap,⁷ which could further compromise the abdominal wall integrity,¹⁶ or a local soft-tissue flap with a biological or synthetic mesh for fascial closure.¹⁷ Although there has been an advancement in the materials used for fascial replacement, vascularized autologous tissue remains as the first choice in infected fields.^{17,18} Biological meshes could be appropriate in an infected field, but their indication is still debated.¹⁸ Moreover, the surgeons decided it was not appropriate in this case because the big loss of soft tissue still needed a flap coverage to achieve a tensionless closure.

The postoperative period was relatively uneventful with only minor wound problems. We speculate that the lower pole artery thrombosis was due to the kidney herniation.

Upon reflection, a multitude of factors culminated to the total wound rupture in the reported patient. Several reoperations requiring debridement, superimposed infection, closure under tension, and the consequent fascia discontinuity were a vicious cycle. Liaising with a reconstructive plastic surgeon at the earliest possible opportunity, to obtain closure using a vascularized tissue would have addressed all these problems. An ideal alternative, when the reconstructive surgeon was not immediately available, would be the utilization of NPWT to temporize the wound. The literature reviewed suggests it is still a safe option.

In summary, this article presents a safe and successful management in a patient with kidney allograft herniation and exposure. The single-stage procedure, combining aggressive debridement and immediate coverage with pedicle ALT fasciocutaneous flap is a feasible option, regardless of patient's infection status.

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