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KIDNEY DISEASES (G CIANCIO, SECTION EDITOR)

Orthotopic Renal Transplantation: Indication, Technique and Outcomes

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Abstract

Purpose of Review Nowadays many ESRD patients awaiting kidney transplantation have known unsuitable iliac vessels for vascular anastomosis, due to severe atheromatosis, occupied iliac fossa, or other uncommon vascular abnormalities. In these cases, orthotopic kidney transplantation (OKT) could be the solution.

Recent Findings Since the update on OKT published in 2010, no more large series have been reported. Some small series or case reports being described in the literature. The orthotopic position has shown good recipient and graft results with acceptable complication rate in selected patients. This technique permits the possibility of kidney transplantation, in patients unfit for heterotopic kidney transplantation (HKT), and consequently the avoidance of the dialysis treatment.

Summary In this paper, we review what is new in the literature, analyzing indications, technique, and results of this surgical approach.

Keywords Kidney transplantation · Orthotopic · Atheromatosis · Complex recipient

Introduction

Kidney transplantation is the treatment of choice for patients with end stage renal disease (ESRD) because of the proven better survival and quality of life [1].

Nowadays the frequency of high-risk kidney transplantation from both the medical and surgical point of view has increased considerably, because of the higher recipient age combined with the presence of multiple comorbidities. ESRD itself and dialysis treatment can produce vascular deterioration, with a high prevalence of severe aortoiliac calcifications. Pre-surgical donor and recipient evaluation is essential to plan the surgery and to obtain the best possible results. During recipient image work-up, we can find patients with important arteriosclerosis in the iliac arteries, multiple previous kidney transplantation, unsuitable pelvic veins for kidney drainage, and other vascular abnormalities that make them unsuitable for heterotopic kidney transplantation (HKT) in the right or left iliac fossa. In this scenario, the orthotopic position opens up the viability of kidney transplantation in selected patients.

Initially, orthotopic kidney transplantation (OKT) was developed as an evolution of a surgery described to treat renovascular hypertension [2]. The OKT patients performed at the beginning were mostly fit, young, and without atheromatosis, as at that moment the indication for OKT was elective [3••]. During this period, the surgeons gained experience and the technique was consolidated, this has permitted continuity over time. To date, scarce literature about this surgical approach has been published. The aim of this article is to review the information regarding OKT, as well as to describe the surgical technique from its origins in the 1970s till today. Also, we include a description of the results published for OKT.

Surgical Technique

In 1978, Gil-Vernet et al. developed an extra-peritoneal approach to treat renovascular hypertension. Via a retroperitoneal approach, the splenic artery was used for kidney revascularization bypassing the stenotic segment of the artery. With this technique, excellent results were obtained [2]. Later, pushed to improve initial kidney transplant surgeries and to

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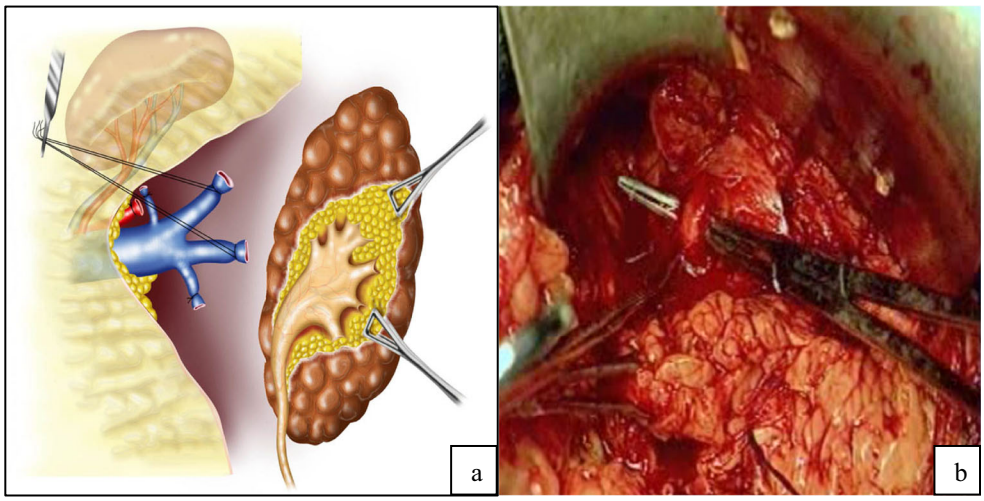

Fig. 1 **a** Native vein and urinary tract dissection. **b** Splenic artery through the parietal peritoneum

avoid the secondary effects of using the hypogastric artery, they adapted this technique to renal transplant surgery.

The original surgical procedure described by Gil-Vernet et al. uses an extra-peritoneal approach to perform the nephrectomy and reach the splenic artery for renal vascularization. The kidney is released from its perirrenal fat, and a careful dissection of the vascular pedicle is carried out. The native renal vein must be gently liberated up to the bifurcation in the renal hilum. The dissection of the different branches of the vein will allow us to reduce the discordance in size between both veins, the graft and the native kidney, and to ensure adequate blood drainage.

The urinary system is also carefully dissected trying to preserve ureter vascularization. We have to reach the calyxes in order to get the maximum diameter for the anastomosis [3••] (Fig. 1).

Both vascular anastomosis are performed in an end to end fashion, while the ureter is anastomosed using uretero-uretal, uretero-pyelic, or pyelo-pyelic anastomosis. A double J stent and a Gil-Vernet nephrostomy are placed (Fig. 2).

Other approaches for renal vascularization have been described in the literature. One possibility is to use the native renal artery when possible. Usually, ESRD patients have atrophic kidneys because of the terminal condition, and this translates to a small diameter of the renal artery. These small vessels do not offer sufficient blood supply for a healthy kidney, which means that an alternative artery must be used (splenic artery). In some patients, for example patients in a pre-emptive situation or those with non-atrophic kidneys, the native renal arterial flow could be sufficient for revascularization.

In cases where the splenic artery does not offer enough blood supply, an end to side anastomosis to the aorta or even anastomosis to the inferior mesenteric artery has been described [4••, 5, 6]. One group from Canada recently described their experience and technique for OKT in three patients with inferior vena cava disease. In this series, two kidneys were revascularized with the common iliac artery using a graft interposition to gain length. During the postoperative period, the most important problem was wound infection, with good kidney function at 3 years [7•].

Indications

As mentioned before, this technique was first developed as an elective indication. In the Gil-Vernet series, 96% of patients were young without atheromatosis or other vascular abnormalities [3••]. In the update paper published 20 years later, this proportion changed, and 70.6% of cases were imperative OKT because of severe atheromatosis or bilateral retained

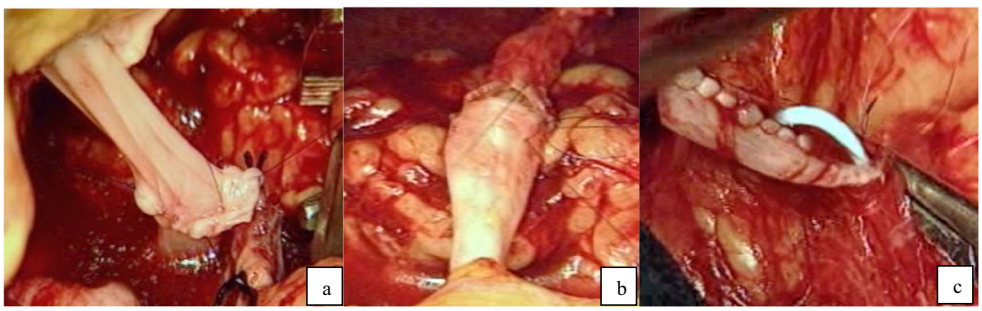

Fig. 2 **a** End-to-end vein anastomoses. **b** End-to-end arterial anastomoses. **c** Pyelo-pyelic anastomoses

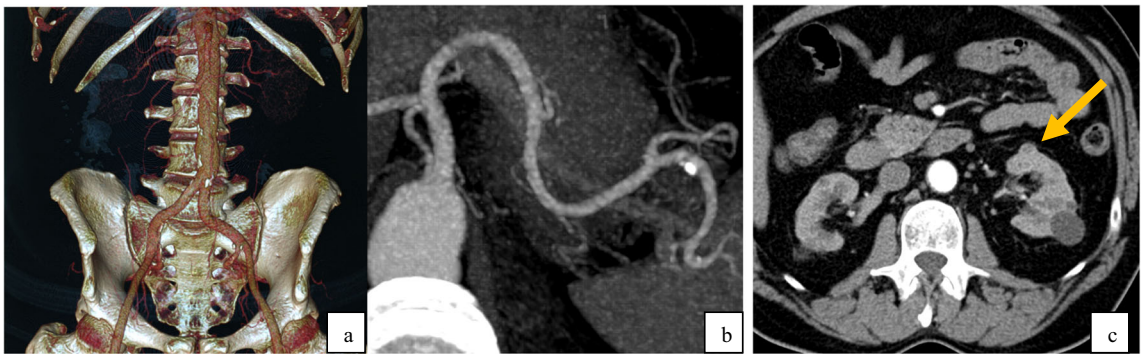

Fig. 3 AngioCT scan. **a** Aortoiliac territory. **b** Splenic artery. **c** RCC

iliac fossae [4••]. The indications for OKT in other published small series are mostly due to severe atheromatosis, occupied iliac fossae, inferior vena cava thrombosis, or urinary diversion [5, 6, 7•].

Recently, a new possible indication for OKT has appeared. The diagnosis of small renal cell carcinoma (RCC) in the native kidney in ESRD patients is quite frequent. A risk factor for RCC is the existence of acquired renal cystic disease (ARCD) that is directly related to the ESRD situation and duration of dialysis [8]. Consequently, the ESRD population, especially patients on dialysis treatment, has a higher risk of developing renal cell carcinoma compared with the general population. The estimated prevalence of RCC in ESRD patients on dialysis is 3–4% which corresponds to a rate 100 times more frequent than in the general population, and this risk is maintained after kidney transplant [9].

These tumors are usually low grade and stage tumors that permit immediate kidney transplantation [10]. In this scenario, it is feasible to plan a simultaneous native nephrectomy and OKT. After our published update paper, we performed a left living donor OKT due to the detection of an incidental left renal tumor during a living donor kidney transplantation work-up. The patient was a 47-year-old male in a preemptive situation, and the CT scan described a small renal tumor (Fig. 3). To avoid dialysis, we decided to perform simultaneous nephrectomy and OKT. The pathology report showed a low-grade papillary renal cell carcinoma and ARCD. The surgery proceeded without complications, and after 5 years, the patient still has excellent kidney function and no tumor recurrence (Fig. 4). This same situation has been published recently by the group of Novotny et al. in their case; a young woman with a diagnosis of bilateral incidental RCC in the native kidneys underwent a bilateral nephrectomy simultaneously with OKT. The surgery was done through a midline laparotomy incision, and the vascular sutures were performed in a termino-terminal fashion to the left native renal vessels [11].

Another described indication for OKT refers to those patients with a previous bladder tumor that required cystectomy and urinary diversion such as ileal conduit or neobladder, with or without unsuitable pelvic vessels for transplantation. The rationale to use OKT is to avoid the dissection of the iliac vessels, which can be very challenging after lymphadenectomy for oncological reasons.

OKT is still a possibility, but some variation of the urinary anastomosis must be observed. The issue in these cases is that the native ureter's vascularization can be impaired due to the lack of perfusion from below. The nephrectomy can result in an ischemic native ureter, so an anastomosis between the grafted ureter and the native urinary pathway can develop stenosis. In this situation, we recommend direct anastomoses to the ileal conduit or neobladder using the donor's ureter, although the graft ureter is longer than usual, an ischaemic events can also occur.

In our series, we faced this situation in two patients with previous neobladder and unsuitable iliac vessels for HKT. Both cases were dealt with similarly. One of the cases was a 63-year-old man with a previous cystectomy and neobladder

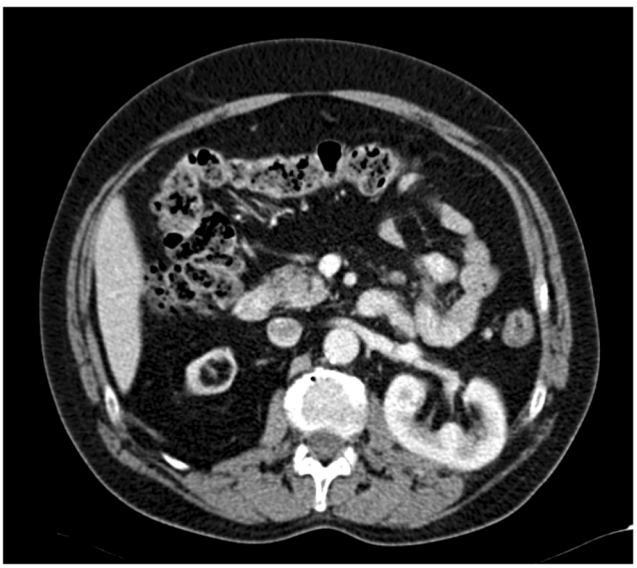

Fig. 4 AngioCT scan 5 years after OKT

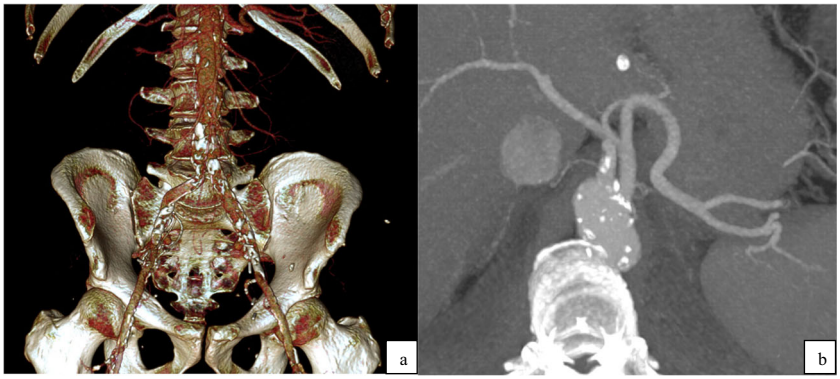

Fig. 5 AngioCT scan. **a** Aortoiliac territory. **b** Splenic artery

10 years ago. The OKT was indicated due to severe aortoiliac atheromatosis and bilateral iliac arterial stenosis (around 50%) (Fig. 5). In this case, the arterial anastomosis was performed using the native left renal artery because an excellent flow was seen intraoperatively. For the ureteroneocystostomy, a direct anastomosis to the neobladder was made through an elongation of the lumbotomy incision. After 5 years, the patient remains alive, with excellent quality of life and a creatinine of 1.6. Figure 6 shows the CT scan 4 years later. Hevia et al. have reported OKT because of previous urinary diversion. In their series, three of nine OKTs were carried out because of a previous ileal conduit without vascular abnormality, obtaining good results [5]. Performing an OKT in a patient with good iliac vessels could be considered controversial, mainly due to the increased technical difficulty and the higher risk of complications, while HKT into an ileal conduit or continent urinary diversion has been described previously with excellent results [12–14].

As a curiosity, in our series, we faced a case of a double ureter for an OKT patient that was detected intraoperatively. In this case, a direct anastomosis to the bladder was performed. The patient presented with a postoperative delayed graft function (DGF) with a good final result, without developing any ureteral complication.

Results

Available data on OKT is very scarce, and we currently do not have adequate comparative studies between OKT and HKT that could provide evidence on when to use either of them. Despite that, it seems reasonable to maintain the indication of OKT for those patients where HKT is not feasible. All published data confirm the feasibility of the technique with an acceptable complication rate [4••, 5–7, 15, 16].

As we mentioned before, the largest series of OKT was first published in 1989 by Gil-Vernet et al. counting 139 patients [3••], with a final total of 223 OKT in the update review 2010 [4••]. The two-era comparison showed no difference in graft survival, but a higher mortality rate during the second period due to the older age of the population, with higher associated comorbidities. In the update paper, they did not find significant differences between OKT and HKT in terms of overall graft and patient survival. The different published series (see Table 1) agree that OKT has a significant incidence of postoperative complications, with a higher reintervention rate. The most frequent complication was urinary fistula or stenosis, but with a similar percentage as reported in HKT [17, 18]. One of the small published series described a higher incidence of wound infection [7•]. Probably the higher incidence of

Fig. 6 AngioCT scan. OKT well perfused and renal vein anastomoses

Table 1 Number of OKT and indications by center

Author	N	Indication
Gil-Vernet	139	Elective
Musquera	84	Atheromatosis
Hevia	9	Vascular/urinary diversion
Paduch	5	Atheromatosis
Rodrigues	4	Vascular/urinary diversion
Chan	3	Inferior vena cava disease
Novotny	1	RCC in the native kidney
Sasaki	1	Ateromatosis

postoperative complications is related to the recipient's condition whereby HKT was discarded. Graft survival is acceptable in all published data avoiding dialysis in unfit HKT patients.

Conclusions

OKT is a good option in selected patients unfit for HKT. Postoperative complications are higher than in HKT. Functional results are comparable with HKT.

Compliance with Ethical Standards

Conflict of Interest Mireia Musquera, Lluis Peri, Ricardo Álvarez-Vijande, Tarek Ajami, and Antonio Alcaraz declare no potential conflicts of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

References

Papers of particular interest, published recently, have been highlighted as:
- • Of importance
- •• Of major importance

1. Levin A, Hemmelgarn B, Culleton B, Tobe S, McFarlane P, Ruzicka M, et al. Canadian Society of Nephrology. Guidelines for the management of chronic kidney disease. CMAJ. 2008;179(11):1154–62.
2. Gil-Vernet JM, Caralps A, Ruano D. New approach to the splenic vessels. J Urol. 1978;119:313–5.
3.•• Gil-Vernet JM, Gil-Vernet A, Caralps A, Carretero P, Talbot-Wright R, Andreu J, et al. Orthotopic renal transplant and results in 139 consecutive cases. J Urol. 1989;142(2 Pt 1):248–52 **First largest series on OKT.**
4.•• Musquera M, Peri LL, Alvarez-Vijande R, Oppenheimer F, Gil-Vernet JM, Alcaraz A. Orthotopic kidney transplantation: an alternative surgical technique in selected patients. Eur Urol. 2010;58(6):927–33. https://doi.org/10.1016/j.eururo.2010.09.023 **Update of the largest series, with a comparison between different periods and indications. A comparison with HKT in terms of graft survival.**
5. Hevia V, Gómez V, Álvarez S, Díez-Nicolás V, Fernández A, Burgos FJ. Orthotopic kidney transplant: a valid surgical alternative for complex patients. Curr Urol Rep. 2015;16(1):470.
6. Sasaki H, Nakazawa R, Iwata T, Usuba W, Yoshie H, Fujimoto E, et al. Orthotopic kidney transplantation in an elderly patient with various severe comorbid conditions: a case report. Transplant Proc. 2017;49(10):2388–91. https://doi.org/10.1016/j.transproceed.2017.09.008.
7.• Chan E, Sener A, McAlister VC, Luke PP. Techniques - orthotopic kidney transplantation in patients with diseased inferior vena cavas. Can Urol Assoc J. 2019;13(5):E154–6. https://doi.org/10.5489/cuaj.5515 **interesting small series on different surgical strategies for OKT in inferior vena cava disease.**
8. Dunnill MS, Millard PR, Oliver D. Acquired cystic disease of the kidneys: a hazard of long-term intermittent maintenance haemodialysis. J Clin Pathol. 1977;30:868–77.
9. Farivar-Mohseni H, Perlmutter AE, Wilson S, Shingleton WB, Bigler SA, Fowler JE Jr. Renal cell carcinoma and end stage renal disease. J Urol. 2006;175:2018–21.
10. Denton MD, Magee CC, Ovuworie C, Mauiyyedi S, Pascual M, Colvin RB, et al. Prevalence of renal cell carcinoma in patients with ESRD pre-transplantation: a pathologic analysis. Kidney Int. 2002;61(6):2201–9.
11. Novotny R, Marada T, Chlupac J, Viklicky O, Fronek J. Simultaneous living donor orthotopic renal transplantation and bilateral nephrectomy for recurrent renal cell carcinoma and renal failure: case report and review of literature. Res Rep Urol. 2018;10:69–73. https://doi.org/10.2147/RRU.S167507 eCollection 2018.
12. Fournier R, Codas-Duarte R, Daily T, Martin X, Badet L, Fassi-Fehri H. Long-term kidney transplant survival in patients with continent urinary diversion. Int J Urol. 2017;24(11):787–92. https://doi.org/10.1111/iju.13434.
13. Surange RS, Johnson RW, Tavakoli A, Parrott NR, Riad HN, Campbell BA, et al. Kidney transplantation into an ileal conduit: a single center experience of 59 cases. J Urol. 2003;170(5):1727–30.
14. Eltemamy M, Crane A, Goldfarb DA. Urinary diversion in renal transplantation. Urol Clin North Am. 2018;45(1):113–21. https://doi.org/10.1016/j.ucl.2017.09.012.
15. Paduch DA, Barry JM, Arsanjani A, Lemmers MJ. Indication, surgical technique and outcome of orthotopic renal transplantation. J Urol. 2001;166:1647–50.
16. Rodrigues P, D' Imperio M, Campagnari M, Azevedo LA, Campagnari JC, van Bellen B. Alternative grafting technique for patients unsuited to heterotopic transplantation due to diseased pelvic conditions. Urol Int. 2004;73:316–9.
17. Mäkisalo H, Eklund B, Salmela K, Isoniemi H, Kyllönen L, Höckerstedt K, Halme L, Ahonen J. Urological complications after 2084 consecutive kidney transplantations.Transplant Proc. 1997;29(1-2):152-3.
18. Butterworth PC, Horsburgh T, Veitch PS, Bell PR, Nicholson ML. Urological complications in renal transplantation: impact of a change of technique. Br J Urol. 1997;79(4):499-502.