Elongation of the right renal vein in 120 consecutive transplant patients: A comparative analysis

O. Arango*, J.A. Lorente, O. Bielsa, E. Rijo, A. Francés, L. Fumadó, A. Rodríguez

Servicio de Urología, Hospital del Mar, Parc de Salut Mar, Barcelona, Spain

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KEYWORDS
Kidney transplantation; Cadaveric donor; Right renal vein; Venous elongation; Surgical technique; Bench surgery

Abstract

Objectives: Shorter length of the right renal vein (RRV) may represent an additional difficulty for transplant. This paper has aimed to present our experience with RRV elongation in the kidney from a cadaveric donor and to compare the results with the rest of kidneys transplanted in the same period of time.

Materials and methods: We performed 377 kidneys transplants within the last 11 years. Of these, in 120, the RRV was elongated with the vena cava. The surgical technique is described and the results are compared with the remaining transplants of the series. Renal function, graft survival and complications were assessed at 1, 3 and 12 months. Data were obtained retrospectively from the database of the Urology Department and Hospital medical records.

Results: In the 377 transplants, there were 4 (1%) venous thrombosis, 2 (1.6%) of which concerned kidneys with elongation of the RRV and 2 (0.7%) in the rest of transplanted kidneys. There was no difference in postoperative bleeding, 11 (9.1%) occurred in kidneys with elongated RRV and 22 (8.5%) in the remaining kidney. In no case was the bleeding related to the elongated segment. Graft survival and renal function were similar for both groups.

Conclusions: Elongation of the RRV with the vena cava is a feasible, fast, and effective procedure that does not increase morbidity or affect renal function or graft viability. It facilitates vascular anastomosis and places the kidney in a less forced position, shortens the warm ischemia time and avoids the risk of kinking of the renal artery because it is equal to the length of the vein artery.

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* Corresponding author.
E-mail address: 85224@parcdesalutmar.cat (O. Arango).

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PALABRAS CLAVE
Traspante renal; Donante cadáver; Vena renal derecha; Alargamiento venoso; Técnica quirúrgica; cirugía de banco

Alargamiento de la vena renal derecha en 120 trasplantes consecutivos. Análisis comparativo

Resumen
Objetivos: La menor longitud de la vena renal derecha (VRD) puede representar una dificultad añadida para el trasplante. El objetivo de este trabajo es presentar nuestra experiencia con el alargamiento de la VRD en el riñón de donante cadáver y comparar los resultados con el resto de riñones transplantados en el mismo periodo de tiempo.

Material y método: en los últimos 11 años se realizaron 377 trasplantes renales y en 120 se alargó la VRD con la vena cava. Se describe la técnica quirúrgica y se comparan los resultados con el resto de trasplantes de la serie. Se valoró la función renal a 1, 3 y 12 meses, la supervivencia del injerto y las complicaciones. Los datos se obtuvieron de forma retrospectiva de la base de datos del Servicio de Urología y de la Historia Clínica del Hospital.

Resultados: En los 377 trasplantes ocurrieron 4 (1%) trombosis venosas, de ellas 2 (1,6%) eran riñones con alargamiento de la VRD y 2 (0,7%) en el resto de riñones transplantados. No hubo diferencia en el sangrado postoperatorio, 11 (9,1%) ocurrió en riñones con la VRD alargada y 22 (8,5%) en el resto de riñones. En ningún caso el sangrado estuvo relacionado con segmento alargado. La supervivencia del injerto y la función renal fue superponible en ambos grupos.

Conclusiones: El alargamiento de la VRD con la vena cava, es un procedimiento rápido, sencillo y efectivo, que no aumenta la morbilidad ni altera la función renal o la viabilidad del injerto. Facilita la realización de las anastomosis vasculares y sitúa el riñón en una posición menos forzada, acorta el tiempo de isquemia caliente y evita el riesgo de acodadura de la arteria renal ya que iguala su longitud a la de la vena.

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Introduction

The shorter length of the right renal vein (RRV) may represent an additional difficulty in right kidney transplant, especially when vascular anastomoses are performed with the external iliac vessels in obese patients, or when reusing the same fossa for a retransplant. In cadaveric kidney, elongation of the RRV on the workbench, with an adjacent segment of the vena cava solves this problem quickly, easily, and securely.

The aim of this paper is to present our experience in 120 kidneys transplanted with RRV elongation, the largest series published to date, and compare the incidence of complications and the long-term results to the rest of transplants performed in the same period.

Materials and methods

In the Renal Transplant Surgical Unit of our hospital, we usually perform lengthening of the RRV in cadaveric kidneys including a contiguous segment of the vena cava. The procedure is performed interchangeably by the 4 surgical teams that perform kidney transplants at our center.

In the last 11 years, 377 kidney transplants, 305 first transplants, and 72 retransplants were performed, of which 146 (38.8%) were women and 231 (61.2%) men, with a mean age of 52.8 years (19–78). In 333 (88.5%) transplants, the grafts came from cadaveric donor in brain death, 17 (4.5%) were asystolic donors, and 27 (7%) living donors, removal having been laparoscopic in the last 15 cases. Of the 186 (49.5%) right kidneys, the RRV was elongated in 120 (64.5%) cases, 108 were cadaveric donors in brain death, 12 asystolic donors and logically none from living donor. The functional results, graft survival, and vascular complications of these were compared to the total right kidneys, and to the 66 (17.5%) without elongation of the renal vein. They were also compared to 191 (50.5%) left kidneys of which 110 (58.5%) came from the same cadaveric donor. Furthermore, we compared the renal function of the kidney retransplants with elongated RRV versus the rest of retransplants.

From the database of the Urology Department and the medical history of the transplanted patients, we extracted the data on the characteristics of the patient, the transplanted kidney, the surgical technique used, and the intraoperative and postoperative complications until discharge from the hospital, as well as the data on kidney function after 1, 3, and 12 months after the transplant and long-term graft survival.

Surgical technique

In order to elongate the RRV on the workbench, and with the kidney in hypothermia, we used three different techniques. The first one, considered as the standard technique, was carried out in 105 (87.5%) kidneys, and it consists in lengthening the vein reshaping the adjacent vena cava to the RRV using two transverse incisions directed toward the ostium of the left renal vein, which are joined with continuous sutures of non-absorbable material. Not only this technique was the most used in our series, for being the most simple and easy to perform, but also because it is the one that provides an elongated segment more like the renal vein itself (Fig. 1).
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The second technique was performed in 12 (10%) kidneys and it consists in elongating the RRV through an oblique section of the cava that runs from the upper edge of the RRV ostium to the lower edge of the left renal vein, forming a kind of 'pipe'. As a disadvantage of this technique, we find that the distal part of the elongated segment is too broad and the reno-iliac anastomosis is too long (Fig. 2).

The third and final elongation technique was used only in 5 cases (4.1%), when the right kidney brought only half of the vena cava, as this had been cut longitudinally during extraction of the organs and each hemicava was with the corresponding kidney. It consists in joining both vena cava flaps along the longitudinal axis of the RRV (Fig. 3).

In all cases, the suture material used for the venous elongation was 6/0 non-absorbable monofilament, in some cases of expanded polytetrafluoroethylene (Goretex®), and in others of polypropylene (Prolene®), according to the preference of the surgeon performing the transplant.

Results

In our experience, the elongation of the RRV, taking advantage of the contiguous segment of the vena cava, made it possible to increase its length about 3 cm, which is more than twice the initial length of the RRV (Fig. 4).
In the 377 transplants, there were 4 (1%) venous thromboses and they were always presented in the first postoperative week. Among the right kidneys with 1/120 (0.8%) elongation, it came from brain death donors, and 1/12 (8.3%) from asystole.

Of the other two without elongation, 1/66 (1.5%) was a right kidney and 1/191 (0.5%) was a left kidney. All the thromboses occurred in kidneys with the elongated RRV were with the first technique described, which was the most frequently used.

As for other complications, no difference was observed in intra- or postoperative bleeding between the kidneys with RRV elongation and the other transplanted kidneys. In the group of kidneys with venous elongation, there were 11 (9.1%) cases of postoperative bleeding, of which 8 (6.6%) were solved with conservative treatment, and 3 (2.5%) had to be reoperated, but in no case was the bleeding related to the elongated segment. In the rest of transplanted kidneys, there were 22 (8.5%) cases of bleeding, of which 11 (4.2%) were resolved with conservative treatment, and 11 (4.2%) had to be reoperated.

There was no statistically significant difference in terms of graft survival, or concerning the renal function at 1, 3, and 12 months, when we compared the right kidneys to the RRV elongation compared to the other transplanted kidneys (Table 1 and Fig. 5). We did not observe differences in renal function either when it was a right kidney retransplant with elongation of the RRV versus the other retransplanted kidneys with the conventional technique, creatinine after 1 month having been 2.2 mg/dl vs. 1.7 mg/dl, at 3 months 1.6 mg/dl vs. 1.6 mg/dl, and 1.4 mg/dl vs. 1.5 mg/dl at 1 year (NS, Mann–Whitney U test).

Discussion

Cadaveric anatomical studies have quantified the body length of the RRV versus the left one, being 13.7% shorter (right vein: 31.5 ± 7.8 mm vs. 37.4 ± 10.0 mm of the left vein). The limitations imposed by the shortness of the RRV
Table 1  Function of the kidney vein in 120 consecutive transplant patients: A comparative analysis.

<table>
<thead>
<tr>
<th>Renal function</th>
<th>Total right kidneys</th>
<th>Right kidneys with lengthened RRV</th>
<th>Right kidneys without lengthened RRV</th>
<th>Total left kidneys</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>186 cases</td>
<td>120 cases</td>
<td>66 cases</td>
<td>191 cases</td>
<td></td>
</tr>
<tr>
<td>Cr. 1 month</td>
<td>1.90 mg/dl</td>
<td>1.91 mg/dl</td>
<td>1.85 mg/dl</td>
<td>1.71 mg/dl</td>
<td>NS</td>
</tr>
<tr>
<td>Cr. 3 months</td>
<td>1.63 mg/dl</td>
<td>1.65 mg/dl</td>
<td>1.58 mg/dl</td>
<td>1.61 mg/dl</td>
<td>NS</td>
</tr>
<tr>
<td>Cr.12 months</td>
<td>1.61 mg/dl</td>
<td>1.54 mg/dl</td>
<td>1.72 mg/dl</td>
<td>1.57 mg/dl</td>
<td>NS</td>
</tr>
</tbody>
</table>

* Kruskal–Wallis test.

Figure 5  Kaplan–Meier curve in which it is seen that there are no statistically significant differences in the graft survival between kidneys with and without lengthened RRV (RK without lengthening and LK), log-rank (Mantel–Cox 2.266, p = 0.132).

are evident when the kidney that is going to be transplanted comes from a living donor, and despite the various maneuvers that have been proposed to minimize the loss of length of the vein during laparoscopic extraction, about 90% of living donor transplants are performed with the left kidney.5-7

However, when the kidney comes from a cadaveric donor, this difference in length is easily solved by means of a venous enlargement plasty on the workbench, according to the various techniques described from the initial work by Barry and Fuchs.6

Of the three techniques used by us in this work in order to elongate the RRV (Figs. 1–3), the first is considered the standard technique, as it is the easiest to perform and which provides a more anatomical elongated segment and closer to the renal vein itself.5-8 Therefore, it is important that during the extraction of the organs, the full cava segment is always left with the right kidney.

Although not recommended, some urologists continue sectioning the cava longitudinally during the removal of the kidneys and they leave each half with the corresponding kidney. When receiving a kidney with these features, the RRV can be extended with the ‘clam’ plasty also described by Barry et al.9 (Fig. 3). On other occasions, during the multi-organ extraction, the surgeons who remove the liver injure the RRV and the vena cava by including a piece of this with the liver, making the transplant difficult and threatening the viability of the organ. Although with this type of injury we cannot perform a conventional elongation of the RRV, we can use the rest of the adjacent vena cava to be repaired.10,11

Besides the three surgical techniques used by us to elongate the RRV, other techniques have been described using the inferior vena cava and the external iliac vein of the corpse. The living donor gonadal vein, and the saphenous vein, or the superficial femoral vein of the recipient7,12-15 have also been used for elongation. In the laparoscopic living donor removal, the gonadal vein of the donor can be used to elongate the RRV, according to the technique proposed by Nghiem in 1989. This technique consists in making with the gonadal vein open longitudinally a spiral-shaped tube, which is then anastomosed in termino-terminal to the RRV, so we manage to elongate it about 2 cm.16,17

We have also used different homologous and synthetic materials to lengthen the RRV; among which worth mentioning are cryopreserved cadaveric vein grafts and synthetic Dacron® or Goretex® prostheses, but it is generally accepted that this type of grafts increase the risk of venous thrombosis.15,18-20 For the reconstruction of the elongated venous segment, some authors propose using mechanical sutures through specific endostaplers for vascular structures21-23 However, we consider that the elongation of the RRV can be done quickly and at a lower cost using 6/0 Prolene or 6/0 Goretex monofilament continuous sutures.

Several authors have analyzed the advantages of elongating the RRV in renal transplant surgery and have laid the anatomical and physiological foundation for the procedure.1,6,8,14,24 Renal transplant with a right kidney, to which the renal vein has been strengthened with a segment of the vena cava, makes it possible to place the graft in the iliolumbar fossa on the psoas muscle, this one adopting a less forced position than when it is placed within the pelvic excavation due to the shortness of the renal vein.4,25 The elongation of the RRV reduces the warm ischemia time, as it not only shortens the time of the anastomoses, but also makes it possible to perform them with the kidney placed between two pads of crushed ice to keep the hypothermia of the organ throughout the surgery.

When the transplant is performed with the external iliac vessels of the receiver, given that the RRV is considerably shorter than the artery, this can be layered, endangering kidney perfusion.4,11,26 The RRV elongation with the adjacent vena cava equals the length of the vein to that of the renal artery, without having to sacrifice the patch of aorta.
to prevent kinking (Fig. 4). Also, with the elongated RRV, extensive vascular dissections are avoided at the receptor, since there is no need to mobilize the iliac vein due to transposition to the short renal vein, thereby reducing the risk of vascular lesions and the formation of lymphoceles. 11,27

Another advantage of elongating the RRV is that it allows the surgeon to work in a more comfortable and safe way, as the sutures are much more attainable and without tension. Moreover, when the kidney to be transplanted has multiple veins, a situation that is more common in the right kidney, it is possible to bring them together on a single stem by the elongation techniques with a segment of the adjacent vena cava.

As an additional advantage, it is worth mentioning that when the RRV is too short, it is not necessary to dissect it within the renal sinus to gain length, thus avoiding the risk of bleeding and venous ischemia of the ureter, which can lead to ureteral necrosis. 28 Likewise, the elongation of the RRV facilitates the mobilization of the kidney to check the hemostasis without risk of tearing the vascular sutures. Therefore, we believe that the short time spent on the workbench to perform elongation of the RRV-no more than 20 min— is compensated by the time gained being easier to implant the kidney.

Regarding the complications, various authors consider that the venous elongation lowers the risk of thrombosis, because it avoids tension and angulation on the anastomosis of the RRV to the iliac one, both factors have been associated to increased incidence of venous thrombosis and kidney loss. 23,24,26,29 Overall, the incidence of renal vein thrombosis in kidneys from cadaveric donors ranges between 0.5% and 3.4%, this being in one third responsible for early graft loss. 30 In our series of transplanted kidneys with RRV lengthening, vein thrombosis occurred in 2/120 (1.6%), and it was similar to that of the rest of transplanted kidneys with the conventional technique.

When separately analyzing the causes of venous thromboses in our series, we found that in only one of the two cases of the group with lengthening of the RRV, this could be related to the surgical technique used, as the lengthened segment was larger caliber than the ostium of the left renal vein that remained intact, giving rise to two fornices that may have caused a venous stasis and the subsequent thrombosis (Fig. 6). In the other case of thrombosis with elongated renal vein, the transplant was performed with end-to-end anastomosis from the renal artery to the hypogastric one, and, in the postoperative period, the kidney shifted in cephalic direction producing a clamping occluding the left renal vein between the external iliac artery and the hypogastric one. In both cases of thrombosis without lengthening of the RRV, one was a left kidney in which a series of transfixing sutures had to be performed in the renal sinus fat due to bleeding, which possibly impeded venous return. The remaining case was a right kidney of asystolic donor implanted in a patient with increased thrombotic risk factor, as it was homozygous for the variant G20210A of the prothrombin gene.

In this paper, we assessed for the first time the graft survival with long-term elongation of the RRV (5 and 10 years), as well as the renal graft function with elongation at 1, 3, and 12 months. From our results, it follows that both graft survival and renal function of kidneys with elongation of the RRV are comparable to the rest of transplanted kidneys in our series (Table 1 and Fig. 5).

Among the published series with greater number of transplanted kidneys with RRV elongation, we can emphasize that by Dalla Valle et al., 23 with 119 cases. These authors used the classical technique described by Barry, but in 41% of the cases, they used mechanical sutures. When comparing the results with 252 right kidneys transplanted without venous elongation, the authors found no difference in the incidence of thrombosis, graft loss, delayed receptor function, or morbidity of the receptor. However, the follow-up of the patients was only 14 months. 23

Likewise, Benoit et al. 24 and Baptista-Silva et al., 8 published their findings in 17 and 34 transplanted right kidneys with RRV elongation respectively. As elongation technique, both groups used the remodeled vena cava through an
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Conclusions

From our experience, we can conclude that the lengthening of the RRV with a segment of vena cava is a quick, simple, and effective procedure, which does not increase the morbidity or alter the function or viability of the long-term graft. By contrast, it greatly facilitates the performance of vascular anastomoses, especially when the renal vessels are short or the receptor obese. It places the kidney in a less forced position, shortens the warm ischemia time, and avoids the risk of kinking of the renal artery, as it equals its length to that of the RRV.

Conflict of interest

The authors declare that they have no conflict of interest.

References