Guidelines

European Association of Urology Guidelines on Renal Transplantation: Update 2018

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Article info

Article history:
Accepted July 11, 2018

Associate Editor:
Christian Gratzke

Keywords:
EAU guidelines
Guidelines
Renal transplantation

Abstract

Context: The European Association of Urology (EAU) panel on renal transplantation (RT) has released an updated version of the RT guidelines.

Objective: To present the 2018 EAU guidelines on RT.

Evidence acquisition: A broad and comprehensive scoping exercise was performed, encompassing all areas of RT guidelines published between January 1, 2007, and May 31, 2016. Database covered by the search included Medline, Embase, and the Cochrane Libraries. Previous guidelines were updated, and levels of evidence and grades of recommendation were assigned.

Evidence synthesis: It is strongly recommended to offer pure or hand-assisted laparoscopic/retroperitoneoscopic surgery as the preferential technique for living donor nephrectomy. Decisions on the acceptance of a donor organ should not be based on histological findings alone since this might lead to an unnecessarily high rate of discarded grafts. For ureteroscalic anastomosis, a Lich-Gregor—like extravesical technique protected by a ureteral stent is the preferred technique for minimisation of urinary tract complications. It is also strongly recommended to perform initial rejection prophylaxis with a combination therapy comprising a calcineurin inhibitor (preferably tacrolimus), mycophenolate, steroids, and an induction agent (either basiliximab or antithymocyte globulin).

The long version of the guidelines is available at the EAU website (http://uroweb.org/guidelines).

Conclusions: These abridged EAU guidelines present updated information on the clinical and surgical management of RT for incorporation into clinical practice.

Patient summary: The European Association of Urology has released the renal transplantation guidelines. The implementation of minimally invasive surgery for organ retrieval and the latest evidence on transplant surgery as well as on immunosuppressive regimens are key factors for minimisation of rejection and achievement of long-term graft survival.

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https://doi.org/10.1016/j.euf.2018.07.014
2405-4569

1. Introduction

This article presents the updated European Association of Urology (EAU) guidelines for renal transplantation (RT) [1]. The main objective is to provide urologists and kidney transplant surgeons with practical guidance on the clinical management of renal transplantation, focusing on the medical and surgical management. Clinical guidelines represent a summary of the highest level of evidence available to the experts; however, following the guidelines will not automatically result in the best outcome. Clinical guidelines can never replace clinical and surgical expertise in the management of RT candidates, but they may help to focus decisions and to take personal values and individual circumstances of patients into account.

2. Evidence acquisition

A broad and comprehensive literature search covering all sections of published RT guidelines was performed. Databases searched included Medline, EMBASE, and the Cochrane Libraries, covering a time frame between January 1, 2007, and May 31, 2016. A total of 2601 unique records were identified, retrieved, and screened for relevance. For each recommendation within the guidelines, there is an accompanying online strength rating form which addresses a number of key elements, namely:

1. The overall quality of the evidence which exists for the recommendation—references used in this text are graded according to a classification system modified from the Oxford Centre for Evidence-Based Medicine Levels of Evidence [2].
2. The magnitude of the effect (individual or combined effects).
3. The certainty of the results (precision, consistency, heterogeneity, and other statistical or study-related factors).
4. The balance between desirable and undesirable outcomes.
5. The impact of patient values and preferences on the intervention.
6. The certainty of those patient values and preferences.

The strength of each recommendation is determined by the words “strong” or “weak” [3].

3. Organ retrieval and transplantation surgery

3.1. Living donor nephrectomy

There is strong evidence in support of laparoscopic living donor nephrectomy (LLDN), including several systematic reviews and meta-analyses which have compared LLDN with open surgery [4]. LLDN is associated with similar rates of graft function and rejection, urolological complications, and patient and graft survival. However, measures related to analgesic requirements, pain, hospital stay, and time to return to work are significantly better for laparoscopic procedures [5].

3.2. Organ preservation

In the absence of a cost-utility analysis, the results of the meta-analysis of the randomised controlled trials (RCTs) comparing University of Wisconsin (UW) solution, Celsior solution, and Marshall’s hypertoncitrate solution in standard cadaver donors indicate that these cold storage solutions are equivalent [6]. For living donors, in whom immediate kidney transplantation is planned, perfusion with crystalloid solution is sufficient. Initial flushing with cold preservation solution followed by ice storage represents the standard method for kidney preservation. However, the limitations of static cold storage in preserving marginal organs such as expanded criteria donor kidneys has led to the increased use of dynamic methods [7].

3.3. Donor kidney biopsies

Donor kidney biopsies can serve different purposes, including histological assessment of organ quality prior to transplantation and histological analysis of focal lesions, especially if there is a suspicion of neoplasia. There is no consistent association between histological lesions observed in donor kidney biopsies and post-RT outcomes. Specifically, there is no agreement on prognostically relevant lesions and how they should be scored. Grading systems for donor kidney biopsies have not yet been developed and lesion scoring in pre-RT biopsies is mostly based on the Banff consensus for post-RT renal allograft pathology, which is supported by the 2007 Banff Conference report [8]. An adequate biopsy reaches beyond the immediate subcapsular area (≥5 mm) and contains ≥25 glomeruli and ≥one artery.

Needle biopsies, wedge biopsies, or specimens obtained with a skin punch biopsy device will result in equally adequate biopsies if sampling is properly performed. Because obtaining adequate biopsies with 18G needles is difficult and requires multiple cores, 14 or 16G needle biopsies are preferred. The evidence suggests that decisions on the acceptance of a donor organ should not be based on histological findings alone; histology has to be evaluated in context, taking into account donor and recipient clinical parameters, including perfusion parameters where available [9].

3.4. Living and deceased donor implantation surgery

Preoperative hyperkalaemia is the most common indication for pre-operative haemodialysis, although its routine use is not indicated owing to the potential to delay transplantation and increase cold ischemia time [10]. Based on low level of evidence studies, continuing anti-platelet therapy with aspirin, ticlopidine, or clopidogrel does not confer a significantly greater risk of peri- or postoperative complications [11]. None of the current major thrombosis prevention guidelines directly address thromboprophylaxis in the renal transplant perioperative period. A small RCT [12] showed no difference in early postoperative graft loss or thromboembolic complications with or without prophylactic anticoagulation.
Regarding antibiotic prophylaxis, a multicentre, prospective RCT showed no difference at 1 mo in surgical site, bacterial, fungal, or viral infection between those receiving a single-dose broad-spectrum antibiotic at induction of anaesthesia compared with those receiving antibiotic 12 hourly for 3–5 d [13].

Careful peri- and postoperative fluid balance is essential for optimal renal graft function. A small prospective RCT found the use of Ringer’s lactate solution to be associated with less hyperkalaemia and acidosis compared with normal saline in patients undergoing RT [14]. A small prospective RCT comparing constant infusion versus central venous pressure-based infusion (CVP) found that CVP produced a more stable haemodynamic profile, better diuresis, and enhanced early graft function [15].

### 3.5. Surgical approaches for first, second, third, and further transplants

Transplant (bench/back-table) assessment and preparation before commencement of immunosuppression and induction of anaesthesia is a crucial step in the transplantation process. Special attention has to be paid to the exclusion of exophytic tumours, the number, quality, and integrity of renal vessels and ureter(s) and preservation of the peri-pelvic and proximal peri-ureteral tissue (golden triangle). The sites of the vascular anastomosis should be chosen carefully according to the length of the renal artery and vein to avoid kinking of the vessels when the kidney is placed into its final location, usually in the iliac fossa. A small RCT (n = 38) comparing end-to-end anastomosis to the internal iliac artery versus end-to-side anastomosis to the external iliac artery found that both techniques showed similar results in the early postoperative period and at 3 yr of follow-up [16]. Lich-Gregorii-like extravesical ureterovesical anastomosis with a prophylactic ureteral stent is the election technique to minimise urinary tract complications in renal transplant recipients with normal urological anatomy (Table 1) [17]. In cases where an iliac artery prostatic replacement has previously been carried out because of severe symptomatic iliac atheroma, the renal artery should be implanted into the prosthesis. Administration of systemic heparin should be considered prior to clamping of a vascular prosthesis.

In third or further transplants, the surgical approach must be planned pre-operatively so that appropriate arterial inflow and venous outflow exists with adequate space to implant the new kidney. Nephrectomy of an old transplant kidney may be required prior to transplantation or at the time of transplantation, as may mobilisation of the common or internal iliac artery, internal iliac vein, or inferior vena cava. In some cases, an intraperitoneal approach (via the iliac fossa or midline) may be required. Rarely orthotopic transplantation is needed.

Robot-assisted kidney transplant (RAKT) surgery is being evaluated in prospective non-randomised trials (using IDEAL consortium principles) [18]. Whilst potential advantages may exist (reductions in postoperative pain, length of hospital stay, incision length, and lymphoceles rate), evidence is too premature to recommend RAKT [19].

**Table 1 – Recommendations and summary of evidence for single kidney transplant.**

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>SR</th>
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</thead>
<tbody>
<tr>
<td>Use the external or common iliac arteries for an end-to-side arterial anastomosis to donor renal artery.</td>
<td>Weak</td>
</tr>
<tr>
<td>Use an end-to-end anastomosis to the internal iliac artery as an alternative to the external or common iliac arteries.</td>
<td>Weak</td>
</tr>
<tr>
<td>Check the intima of the donor and recipient arteries prior to commencing the arterial anastomosis to ensure that there is no intimal rupture/flip. If the latter is found, it must be repaired prior to/as part of the arterial anastomosis.</td>
<td>Strong</td>
</tr>
<tr>
<td>Preoperatively plan the surgical approach in third or further transplants to ensure that appropriate arterial inflow and venous outflow exists with adequate space to implant the new kidney.</td>
<td>Strong</td>
</tr>
</tbody>
</table>

**Summary of evidence:**

- A small RCT (n = 38) comparing end-to-end anastomosis to the internal iliac artery versus end-to-side anastomosis to the external iliac artery found that both techniques showed similar results in the postoperative period and at 3 yr of follow-up.
- Cohort studies have demonstrated that third or further transplants are a valid therapeutic option with reasonable short- and long-term patient and graft survival. **3**

**LE** = level of evidence; **RCT** = randomized controlled trial; **SR** = strength rating.

### 4. Donor complications

A systematic review and meta-analysis on complications in minimally invasive living donor nephrectomy (LDN) concluded that the techniques used for minimally invasive LDN are safe and associated with an overall complication rate of 16.8% [20]. Survival rates and risk of end-stage renal disease are similar to those in the general population whilst donors’ health-related quality of life remains on average better than that of the general population.

It is highly recommended to restrict LDN to specialised centres and to offer long-term follow-up to all living kidney donors.

### 5. Recipient complications

Arterial complications include thrombosis, stenosis, and arteriovenous fistula. The incidence of arterial thrombosis is low (0.5–3.5%), and it is usually a consequence of a technical error during the anastomosis. The diagnosis depends on colour Doppler ultrasound followed by surgical exploration to assess the status of the graft. Thrombectomy in the case of a viable graft and allograft nephrectomy in the case of a non-viable graft are the treatment options for renal artery thrombosis [21].

Arterial stenosis occurs in 1–25% of RT. It is suspected in the event of refractory arterial hypertension and/or increasing serum creatinine without hydrenephrosis or infections. It is important to determine whether the stenosis is haemodynamically significant or not prior to treatment. Interventional radiology is the first-line treatment option; however, in patients considered unsuitable for radiological angioplasty, surgical treatment may be considered [22].
RT vein thrombosis is an early complication (prevalence 0.5–4%) and one of the most important causes of graft loss during the first postoperative month. The aetiology includes technical errors and/or difficulties during surgery and the hypercoagulative state of the recipient. The diagnosis of renal vein thrombosis depends on colour flow Doppler ultrasonography followed by surgical exploration to assess the status of the graft.

Lymphocele occurs in 1–26% of RT. There is a significant aetiological association with diabetes, mammalian target of rapamycin (mTOR) inhibitor (eg, sirolimus) therapy, and acute rejection. Percutaneous drainage placement is the first treatment for large and symptomatic lymphocele [23]. Surgical fenestration is recommended when percutaneous treatments fail.

The most important urinary complications are leak and stenosis. Urinary leakage occurs in 0–9.3% of RT and is associated with failure and/or suture necrosis. Non-technical risk factors include recipient age, number of renal arteries, site of arterial anastomosis, occurrence of acute rejection episodes, bladder problems, and immunosuppressive regimen. Urinary leakage should be suspected based on the urine output and the creatinine level in the drain fluid. For early and low-volume urine leaks, conservative management (JJ stent and bladder catheter and/or percutaneous nephrostomy) may be considered. When conservative management fails or massive urine leak occurs, surgical repair should be undertaken [24].

The incidence of ureteral stenosis is 0.6–10.5%. Early stenosis (within 3 mo of surgery) is usually caused by surgical technique or compromised ureteral blood supply during surgery. Late stenosis (after 6 mo) is provoked by infection, fibrosis, progressive vascular disease, and/or rejection. Clinically significant ureteral stricture should be considered when persistent hydronephrosis occurs in association with impaired renal function. The first approach is the placement of a percutaneous nephrostomy tube with an antegrade pyelogram. STRICTURES <3 cm in length may be treated endoscopically. In case of strictures >3 cm in length or those which have recurred following a primary endourological approach, surgical reconstruction should be performed [25].

Kidney stones occur in 0.2–1.7% of RT [26]. Recommendations include a complete evaluation of the causes of urolithiasis in the recipient and management of ureteral obstruction due to a stone with a percutaneous nephrostomy tube or JJ stent placement. Treatment includes shockwave lithotripsy or antegrade/retrograde ureteroscopy for stones measuring <15 mm and percutaneous nephrolithotomy for stones measuring >20 mm (Table 2) [27].

Other complications include haemorrhage, haematuria, reflux, acute pyelonephritis, wound infection, and incisional hernia [1].

### 6. Matching of donors and recipients

Human leucocyte antigen (HLA) matching is very important in RT outcome and correlates with the number of HLA mismatches. All patients registered for RT must have their serum screened for anti-HLA antibodies, which are particularly common after pregnancy, previous transplant, transplant rejection, and blood transfusions. Matching should concentrate on HLA antigens, which impact outcome [28]. HLA-A, B, C, and DR must be determined in all potential recipients and donors according to current guidelines and national allocation rules. Additionally, it is recommended to determine HLA-DQ antigens of donor and recipient. Furthermore, HLA-DP antigen characterisation may be performed, especially for sensitised recipients. In accordance with national and international recommendations, adequate (eg, CDC, virtual) cross-match tests must be performed prior to each kidney and combined kidney/pancreas transplantation to avoid hyperacute rejection. Even the barrier of a positive cross-match due to preformed HLA antibodies is under discussion, with newer “desensitisation” techniques available in cases with available living donors [29,30]. Based on the current evidence, analysis of the ABO blood group and the HLA-A, B, C, and DR phenotypes is recommended for all candidates awaiting RT. HLA-DP testing may be performed in sensitised patients.

<table>
<thead>
<tr>
<th>Table 2 – Recommendations and summary of evidence regarding complications after renal transplantation.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recommendation</strong></td>
</tr>
<tr>
<td>Perform colour Doppler ultrasound in cases of suspected graft arterial or venous thrombosis.</td>
</tr>
<tr>
<td>Perform colour Doppler ultrasound to diagnose an arterial stenosis; in the event of indeterminate results on ultrasound, consider a magnetic resonance or computed tomography angiogram.</td>
</tr>
<tr>
<td>Perform percutaneous drainage placement as the first treatment for large and symptomatic lymphocele.</td>
</tr>
<tr>
<td>Manage urine leak by JJ stent and bladder catheter and/or percutaneous nephrostomy tube. Perform surgical repair in cases of failure of conservative management.</td>
</tr>
<tr>
<td>Manage ureteral strictures &lt;3 cm in length either with surgical reconstruction or endoscopically (percutaneous balloon dilation or antegrade flexible ureteroscopy and holmium laser incision). Treat late stricture recurrence and/or strictures &gt;3 cm in length with surgical reconstruction in appropriate recipients.</td>
</tr>
<tr>
<td>Perform shockwave lithotripsy or antegrade/retrograde ureteroscopy for stones measuring &lt;15 mm.</td>
</tr>
<tr>
<td>Perform percutaneous nephrolithotomy for stones measuring &gt;20 mm.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Summary of evidence</strong></th>
<th><strong>LE</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Thrombectomy in the case of a viable graft and allograft nephrectomy in the case of a non-viable graft are the treatment options for renal artery thrombosis.</td>
<td>2b</td>
</tr>
<tr>
<td>Interventional radiology is the first-line treatment option for transplant renal artery stenosis; however, in patients considered unsuitable for radiological angioplasty, surgical treatment may be considered.</td>
<td>3</td>
</tr>
<tr>
<td>Surgical repair should be undertaken when conservative management fails or massive urine leak occurs.</td>
<td>2b</td>
</tr>
<tr>
<td>For strictures &gt;3 cm in length those who have recurred following a primary endourological approach, surgical reconstruction should be performed. Extracorporeal shockwave lithotripsy should be considered as the first-line treatment option for stones &lt;15 mm.</td>
<td>2b</td>
</tr>
</tbody>
</table>

LE = level of evidence; SR = strength rating.
7. Immunosuppression after kidney transplantation

Increased understanding of immune rejection has led to the development of safe modern immunosuppressive agents, which suppress sensitised lymphocyte activity against a transplant. Immunosuppression is particularly important during the initial post-transplant period when there is a high incidence of early post-transplant rejection. Nonspecific side effects of immunosuppression include a higher risk of malignancy and infection, particularly opportunistic infections [31]. A multidrug regimen constitutes the current standard of care for the majority of transplant recipients worldwide. It is strongly recommended to perform initial rejection prophylaxis with combination therapy comprising a calcineurin inhibitor (CNI), preferably tacrolimus, mycophenolate, steroids, and an induction agent (either basiliximab or anti-thymocyte globulin) [32].

CNIs (cyclosporine and tacrolimus) are nephrotoxic and their long-term use is an important cause of chronic allograft dysfunction, eventually leading to graft loss or severe chronic kidney disease in recipients of non-renal organs. A meta-analysis of tacrolimus and cyclosporine has demonstrated similar outcomes with respect to overall patient and graft survival [33]. Tacrolimus provided better rejection prophylaxis and was associated with better graft survival, when censored for death, in some analyses. Owing to its higher efficacy, tacrolimus is recommended by current guidelines as the first-line treatment [34].

Mycophenolates (MMF or enteric-coated mycophenolate sodium [EC-MPS]) are based on mycophenolic acid, which inhibits inosine monophosphate dehydrogenase. The co-administration of mycophenolate with prednisolone and CNI has resulted in a profound reduction of biopsy-proven rejections [35]. Mycophenolic acid is not nephotoxic; however, it inhibits bone marrow function and may cause cytomegalovirus (CMV) infections and gastrointestinal side effects [35]. There is also a higher incidence of polymya nephropathy, especially when mycophenolate is combined with tacrolimus [36].

Both the mycophenylate formulations, MMF and EC-MPS, are equally effective, with an almost identical safety profile. Due to a higher incidence of CMV disease with mycophenolate, either CMV prophylaxis or a pre-emptive strategy with regular screening for CMV viraemia should be instituted [36].

Azathioprine may be used in a low-risk population as an immunosuppressive drug, especially for those intolerant to mycophenolate formulations [37].

Steroids have a large number of side effects, especially with long-term use. Most practitioners still consider steroids (either prednisolone or methylprednisolone) to be a fundamental adjunct to primary immunosuppression. Initial steroid therapy should be part of immunosuppression in the perioperative and early post-transplant period. Moreover, steroid withdrawal may be considered in standard immunological risk patients on combination therapy with CNI and mycophenolic acid after the early post-transplant period [38].

The immunosuppressants sirolimus and everolimus inhibit mTOR and suppress lymphocyte proliferation and differentiation. mTOR inhibitors exhibit dose-dependent bone marrow toxicity [39]. Other potential side effects include hyperlipidaemia, oedema, development of lymphocele, wound healing problems, pneumonitis, proteinuria, and impaired fertility [40]. Combination therapy with CNIs aggravates CNI-induced nephrotoxicity. When CNIs are used in conjunction with mTOR inhibitors, the CNI dosage should be substantially reduced owing to the highly synergistic potential of this combination therapy; such a reduction in CNI dosage seems to have no impact on efficacy. Several studies have suggested that mTOR inhibitors cannot replace CNIs in the initial phase after transplantation owing to lower efficacy and a less favourable side-effect profile, particularly wound healing problems and lymphoceles [39]. When combined with CNIs, antimicrobial prophylaxis for Pneumocystis jiroveci pneumonia should be administered for 1 yr following transplantation [41]. Conversion from CNIs is not advisable in patients with proteinuria exceeding 800 mg/d, and a cautious and individual approach should be followed in patients with a glomerular filtration rate of less than 30 ml/min [39].

Due to an anti-proliferative effect and a lower incidence of malignancy in mTOR inhibitor-treated patients, conversion from CNIs to mTOR inhibitors may be beneficial for patients who develop malignancy after transplantation or who are at a high risk for the development of post-transplant malignancy or skin cancer [42].

Basiliximab, a high-affinity anti-interleukin-2 (IL-2) receptor monoclonal antibody, is approved for rejection prophylaxis following organ transplantation. The drug is safe, and IL-2 receptor antibodies have been shown in RCTs to reduce the prevalence of acute cellular rejection by approximately 40%. Meta-analyses have confirmed the efficacy, although no positive effect on patient or graft survival could be demonstrated [43].

T-cell-depleting antibodies may be used for induction therapy in immunologically high-risk patients [44]. Some centres use these agents to provide effective rejection prophylaxis while initiating CNIs after recovery of the graft from ischaemic injury, although evidence supporting this approach is lacking. Belatacept (fusion protein, which effectively blocks the CD28 co-stimulatory pathway and thereby prevents T-cell activation) may be used for immunosuppressive therapy in immunologically low-risk patients who have a positive Epstein-Barr virus serology [45].

8. Immunological complications

Immunological rejection is a common cause of early and late transplant dysfunction. There is great variation in the timing and severity of rejection episodes and how they respond to treatment. Today, two main types of immunological reaction are distinguished, T-cell-mediated rejections and antibody-mediated rejections [46]. The ultimate standard for the diagnosis of rejection is transplant biopsy.
because it is impossible to differentiate acute rejection from other causes of renal dysfunction (eg, acute tubular necrosis, infection, disease recurrence, or CNI nephrotoxicity) solely on the basis of clinical indicators. Therefore, all rejections should be verified by renal biopsy and biopsies should be classified according to the most recent Banff criteria [47]. There must be routine access to ultrasound-guided biopsy of the transplant and sufficient expertise in the hospital pathology department to allow a rapid and clear-cut diagnosis of rejection or other type of allograft dysfunction. Moreover, steroid treatment for rejection may start before the renal biopsy is performed.

It is strongly recommended that steroid bolus therapy is used as the first-line treatment for T-cell-mediated rejection in addition to ensuring adequate baseline immunosuppression. In severe or steroid-resistant rejection, intensified immunosuppression, high-dose steroid treatment, and eventually, T-cell-depleting agents should be used.

### Table 3 – Recommendations and summary of evidence for follow-up after renal transplant.

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide lifelong regular post-transplant follow-up by an experienced and trained RT specialist at least every 6–12 mo.</td>
<td>Strong</td>
</tr>
<tr>
<td>Advise patients on appropriate lifestyle changes, potential complications and the importance of adherence to their immunosuppressive regimen.</td>
<td>Strong</td>
</tr>
<tr>
<td>Regularly monitor (approximately every 4–8 wk) serum creatinine, estimated glomerular filtration rate, blood pressure, urinary protein excretion, immunosuppression, and complications after RT. Changes in these parameters over time should trigger further diagnostic work-up, including renal biopsy, a search for infectious causes and anti-HLA antibodies.</td>
<td>Strong</td>
</tr>
<tr>
<td>Perform an ultrasound of the graft in cases of graft dysfunction in order to rule out obstruction and renal artery stenosis.</td>
<td>Strong</td>
</tr>
<tr>
<td>Initiate appropriate medical treatment, (eg, tight control of hypertension, diabetes, proteinuria, cardiac risk factors, infections, and other complications, according to current guidelines).</td>
<td>Strong</td>
</tr>
</tbody>
</table>

### Summary of recommendations

Regular long-term follow-up by experienced transplant physicians is essential in order to detect complications or graft dysfunction early and ensure adherence to the immunosuppressive regimen.

Annual screening should include a dermatological examination, cardiovascular history and exam, tumour screening (including a nodal examination, faecal occult screening, chest X-ray, gynaecological and urological examination) and abdominal ultrasound, including ultrasound of the native and transplanted kidney. If appropriate, further diagnostic tests should be prompted to treat or slow the progression of any identified complication.

In patients diagnosed early with interstitial fibrosis and tubular atrophy, particularly if there is evidence for CNI toxicity, disease progression may be slowed by conversion to a CNI-free regimen. If the risk of rejection seems too high, another option is substantial reduction of CNI under the protection of mycophenolate. Supportive measures should aim to adequately treat the consequences of chronic kidney disease (eg, anaemia, acidosis, bone disease).

**Treatment of antibody-mediated rejection should include antibody elimination** [48].

### 9. Follow-up after transplantation

Regular long-term follow-up by an experienced transplant physician is essential to detect complications or graft dysfunction early and ensure adherence to the immunosuppressive regimen [31]. Annual screening should include a dermatological examination, cardiovascular history and exam, tumour screening (including a nodal examination, faecal occult screening, chest X-ray, and gynaecological and urological examination), and an abdominal ultrasound, including of the native and transplanted kidney. If appropriate, further diagnostic tests should be prompted to treat or slow the progression of any identified complication [49]. In patients diagnosed early with interstitial fibrosis and tubular atrophy, particularly if there is evidence for CNI toxicity, disease progression may be slowed by conversion to a CNI-free regimen. If the risk of rejection seems too high, another option is substantial reduction of CNI under the protection of mycophenolate. Supportive measures should aim to adequately treat the consequences of chronic kidney disease (eg, anaemia, acidosis, bone disease; Table 3) [50].

## 10. Conclusions

These abridged EAU guidelines present updated information on the clinical and surgical management of RT for incorporation into clinical practice. Current evidence recommends pure or hand-assisted laparoscopic/retroperitoneoscopic surgery as the preferential technique for LDN.

For organ preservation and cold storage, use of either UW solution or histidine-tryptophan-ketoglutarate preservation solution is recommended. Do not base decisions regarding acceptance of a donor organ on histological findings alone and do optimise pre-, peri-, and postoperative hydration to improve renal graft function.

Perform a Lich-Gregoir-like extravesical ureterovesical anastomosis technique to minimise urinary tract complications in RT recipients with normal urological anatomy. It is also strongly recommended to restrict LDN to specialised centres and to offer long-term follow-up to all living kidney donors.

Initial rejection prophylaxis comprises a combination therapy of a calcineurin inhibitor (preferably tacrolimus), mycophenolate, steroids, and an induction agent (either basiliximab or anti-thymocyte globulin).

**Author contributions:** Oscar Rodríguez Faba had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.  

Study concept and design: Faba, Breda.  
Acquisition of data: All authors.  
Analysis and interpretation of data: All authors.  
Drafting of the manuscript: Faba, Breda.  
Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: None.
Obtaining funding: None.
Administrative, technical, or material support: Faba.
Supervision: Breda.
Other (specify): None.

Financial disclosures: Oscar Rodríguez Faba certifies that all conflicts of interest, including specific financial interests and relationships and affiliations relevant to the subject matter or materials discussed in the manuscript (e.g., employment/affiliation, grants or funding, consultancies, honoraria, stock ownership or options, expert testimony, royalties, or patents filed, received, or pending), are the following: None.

Funding/Support and role of the sponsor: None.

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