SECTION 29

Kidney Transplantation and Critical Care

CHAPTER 211

Patient Selection and Pretransplantation Care for Kidney Transplant Recipients

Maria P. Martinez Cantarin, Pooja Singh, and Jerry McCauley

OBJECTIVES

This chapter will:

1. Outline an overall approach to evaluating renal transplant recipients.
2. Identify risk factors for graft loss and death after transplantation.
3. Identify renal diseases known to recur after transplantation.
4. Identify the basic cardiac evaluation for transplant recipients.
5. Identify appropriate waiting periods for patients with malignancies before transplantation.

Innovations in transplantation have led to progressive improvement in patient and graft survival after renal transplantation. In most transplant centers, the criteria for the referral and acceptance of patients with end-stage renal disease (ESRD) have broadened. Guidelines have now been advanced by the American Society of Transplantation (AST), the Canadian Society of Transplantation (CST), and the European Association of Urology.[1–3] The AST and the CST used a system developed by the Canadian Task Force on Preventive Health Care to grade their recommendations as follows[4]:

A. There is good evidence to support the recommendation that the condition be considered in the evaluation process.
B. There is fair evidence to support the recommendation that the condition be considered in the evaluation process.
C. There is poor evidence regarding the inclusion of the condition in the evaluation process, but recommendations may be made on other grounds.
D. There is fair evidence to support the recommendation that the condition be excluded from consideration in the evaluation process.
E. There is good evidence to support the recommendation that the condition be excluded from consideration in the evaluation process.

Although this is a qualitative scheme that may leave room for clinical judgment, it does set common ground for patient evaluation. We therefore use the AST grading in discussing the evaluation of renal transplant recipients in this chapter.

REFERRING PATIENTS FOR KIDNEY TRANSPLANTATION

Preparation for renal transplantation should begin once the nephrology specialist suspects the patients will need renal replacement therapy in the following 6 to 12 months or once the estimated glomerular filtration rate (GFR) is less than 20 mL/min (evidence support C). The process of evaluation for transplantation begins when patients are referred to the transplant center. Preemptive transplantation may generate superior graft and patient survival in renal transplant recipients.[5] The CST and the AST recommend preemptive transplantation after maximal utilization of the patient's renal function (evidence support C).

The importance of early transplantation was illustrated in a study comparing patients undergoing early (<6 months on dialysis) versus late (>24 months on dialysis) kidney transplantation; at 60 months, graft survival was 78% versus 58% in the two groups, respectively.[6] A further study by Ojo et al. demonstrated that the long-term risk of death can be reduced by renal transplantation compared with remaining on dialysis.[7] Given these studies and others, there is little justification for delaying referral of patients for transplantation.

RECIPIENT EVALUATION PROCESS

Evaluation of patients is costly, is time consuming for patients, and expends limited healthcare resources. For these reasons, the process should attempt to eliminate contraindications to transplantation early in the process.

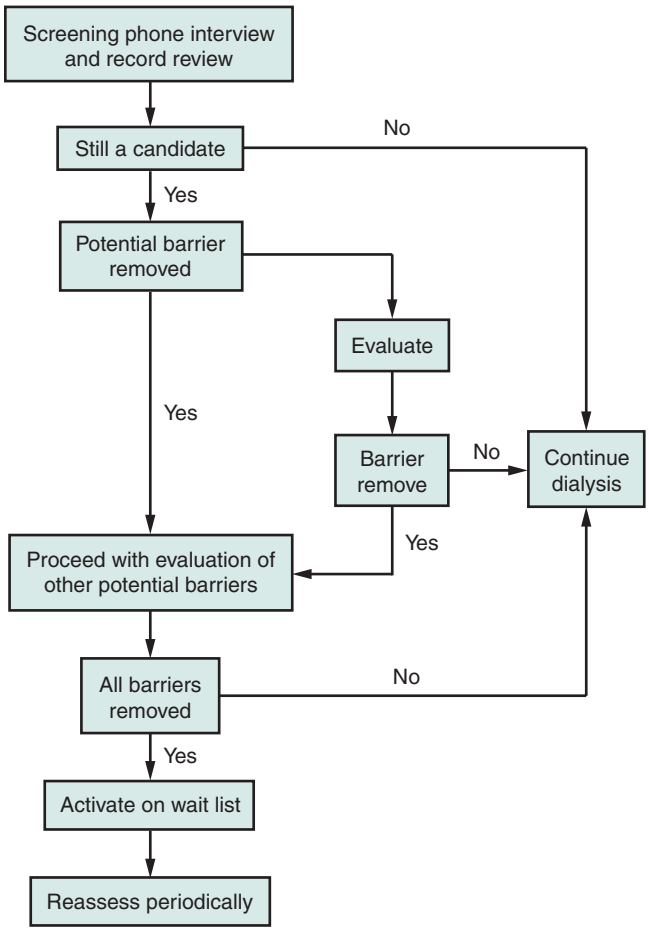

FIGURE 211.1 Transplant recipient evaluation process. (Modified from Kasiske BL, Cangro CB, Hariharan S, et al. The evaluation of renal transplant candidates: clinical practice guidelines. *Am J Transplant.* 2001;1[Suppl 2]:1–95.)

BOX 211.1

Contraindications to Transplantation

Noncompliance (nonadherence to therapy)
- Active infection
- Active or incurable malignancy
- Psychiatric illness preventing decision making or compliance
- Illicit drug abuse
- Primary oxalosis (without prior liver transplantation)
- Severe uncorrectable impairment of other organs (e.g., liver failure, cardiovascular disease, pulmonary disease)
- Severe obesity (body mass index >40)

Fig. 211.1 illustrates the flow of events in evaluating potential candidates. An initial screening history is taken before the patient is scheduled for a visit to the center. Special attention is given to problems that would contraindicate transplantation (Box 211.1). Patients with known contraindications should be eliminated at that point, and appropriate patients should be scheduled for a visit to the center. During the evaluation process, potential barriers to transplantation are reviewed and measures to remove them are performed if possible. If a prohibitive barrier cannot be removed, the patient should continue dialysis. The protocol

TABLE 211.1

Evaluation Protocol for Renal Transplantation

Professional evaluations	Social worker, nurse coordinator, financial coordinator, surgeon, nephrologist
General laboratory studies	BUN, creatinine, electrolytes, calcium, phosphorus, AST, ALT, GGTP, alkaline phosphatase, cholesterol, triglyceride, LDH, amylase, albumin, total protein, CBC, platelet count, PT, PTT, RPR
Viral infection screen	Cytomegalovirus (IgG and IgM), hepatitis B (HBsAb/Ag, HBcAb), hepatitis C, HIV, Epstein-Barr virus, varicella-zoster virus, herpes simplex RPR
Other routine studies	Chest radiograph, ECG, PPD/ Quantiferon gold, urine culture and sensitivity
Urologic studies	Ultrasound of both kidneys; PSA (men ≥40 years)
Screening studies for women	Mammogram (≥40 years); gynecology examination, PAP
Immunology studies	ABO type and screen, HLA and DR typing, PRA, circulating antibodies, cross-match
Gastrointestinal evaluation	Colonoscopy (≥50 years)

ALT, Alanine transaminase; *AST,* aspartate transaminase; *BUN,* blood urea nitrogen; *CBC,* complete blood count; *ECG,* electrocardiogram; *GGTP,* gamma-glutamyl transpeptidase; *HBsAb/Ag,* hepatitis B surface antibody/antigen; *HIV,* human immunodeficiency virus; *HLA,* human leukocyte antigen; *Ig,* immunoglobulin; *LDH,* lactate dehydrogenase; *PAP,* Papanicolaou smear; *PPD,* purified protein derivative; *PRA,* panel-reactive antibody; *PSA,* prostate-specific antigen; *PT,* prothrombin time; *PTT,* partial thromboplastin time; *RPR,* rapid plasma reagin test.

for recipient evaluation is outlined in Table 211.1. In many centers, the patients and their referring physicians are given a list of routine studies that could be performed before the visit. This may expedite transplantation, but expensive or potentially risky studies should be withheld until after the visit to the transplant center. Once the patients have been seen at the transplant center, a multidisciplinary professional approach is begun.

Detailed history and physical examinations are performed by the professional staff, looking for medical, surgical, or psychosocial problems. Patients who are unable to consistently take medications or appear for clinic visits are more likely to develop acute rejection and graft failure. Typically, compliance with therapy for 6 to 12 months is required before placement on the waiting list. Drug or alcohol abuse has been reported in 25% of patients being evaluated for renal transplantation and may indirectly jeopardize long-term graft survival.[8] Common practice and the ATC guidelines (evidence support C) require that all patients with chemical dependence be evaluated and treated for this problem in addition to having a documented drug- or alcohol-free period of 6 months before being listed for transplantation.

Most centers obtain screening studies for viral infections and immunology studies during the clinic visit, but the general laboratory studies, other routine studies, urologic and cancer screening studies (prostate-specific antigen, mammogram, gynecology examination, Papanicolaou smear, and colonoscopy) can be performed at the patient's referring center and are performed most efficiently before the visit at the transplant center.

EVALUATING RISKS TO SUCCESSFUL TRANSPLANTATION

The goal of the preliminary pretransplantation evaluation is to identify risks to successful transplantation and to long-term patient and graft survival. Improvements in transplantation continue to ameliorate conditions previously considered to be absolute contraindications (see Box 211.1). Generally accepted contraindications include continued noncompliance, active infection, some untreated malignancies, uncontrolled psychiatric illness, and continued illicit drug abuse. Primary oxalosis without prior liver transplantation remains a contraindication in most centers. Severe uncorrectable liver failure, cardiac disease, or pulmonary disease is also a contraindication at most centers, although many centers attempt transplantation in patients with advanced but not end-stage nonrenal disease such as heart failure or liver failure. Patients with near–end-stage nonrenal organ failure may be candidates for transplantation of these organs before kidney transplantation is undertaken.

If there are no contraindications to transplantation, the remainder of the evaluations center on measures to reduce perioperative risk and to improve long-term survival of the patient and allograft.

Elderly Recipients

The number of new ESRD cases for ages 45 to 74 years has risen for the last 20 years. For ages 75 and older, the number of incident ESRD cases has remained more stable. In 2013 almost half of the population that started renal replacement therapy were 65 years of age or older and almost a third were older than 75 years. However, only 1% of these older patients were transplanted.[9] Advances in transplantation have resulted in excellent graft and patient survival for elderly recipients. These improvements in elderly patients largely can be attributed to more careful patient selection and more rigorous pretransplantation medical evaluation. Principal among these measures is a detailed cardiovascular and peripheral vascular examination. The minimum cardiovascular evaluation should include a pharmacologic cardiac stress test and angiography in high-risk patients. Symptoms and signs of peripheral vascular disease should be sought. Symptoms of claudication and diminished peripheral pulses should prompt an evaluation consisting of arterial Doppler studies and angiography of the lower extremities if necessary. Uncorrected peripheral vascular disease may prevent an adequate vascular anastomosis during the surgery, jeopardize perfusion of the extremity, and increase the risk of thrombosis of the allograft after transplantation. Many centers require carotid artery Doppler studies routinely or angiography for selected elderly patients. Vascular disease of all types should be corrected, if possible, before transplantation. The prevalence of frailty in the elderly population is between 7 and 12%.[10] Because frailty and cognitive dysfunction are associated with worse transplant outcomes, including perioperative complications,[11] delayed graft function,[12] and mortality[13] independently of age, some centers will include a comprehensive assessment of cognitive and physical function in the baseline evaluation.

Many centers have arbitrarily instituted an age limitation for transplantation at approximately 75 years. As with all patients, the number of comorbid illnesses has a major impact on outcomes. Some centers have transplanted patients successfully in the ninth decade of life without major complications.

Race and Ethnicity

Race and ethnicity are factors in patient survival on dialysis and after transplantation. Disparities in access to transplantation and clinical outcomes have been documented in many countries including Canada, England, and Australia.[14–16] In the United States, African-American patients survive longer on dialysis than whites but have inferior graft survival after transplantation.[17] African Americans in the United States and other ethnic minorities worldwide also wait longer for deceased donor organs.[18] Living donor kidney transplantation is also less likely to occur in minorities.[19] The new kidney allocation system instituted in December 2014 had as one of its goals to increase access of transplants to minorities. Data recently released from the first year of implementation already shows an increased transplant rate in African Americans and Hispanics.[20] Although well-documented biologic factors contribute to poor survival after transplantation in African Americans, there is a growing recognition that complex socioeconomic, behavioral, and geographic factors may explain the majority of the differences in outcomes.[21] These problems may pose formidable barriers to transplantation, and further research and involvement of not only physicians and patients but also administrators and policy makers will be needed to determine causal pathways and design interventions that can take place early in the transplant process to improve access and outcomes in transplant minorities.

Obesity

Many studies have demonstrated that obesity is an important risk factor for adverse events after transplantation. Obese patients experienced more infections, wound complications, new-onset diabetes, and delayed graft function. They also have higher long-term graft failure and mortality than nonobese patients, although not all data are consistent.[22–25] For these reasons, weight reduction usually is advised before transplantation. Although there is not a generally accepted body mass index (BMI) cutoff point, many transplant centers set the limit for transplant consideration between 30 and 35 kg/m^2. Morbidly obese patients may benefit from gastric bypass or other weight-reduction surgery, but this surgical techniques are reserved for patients with a BMI >40 kg/m^2. The biggest challenge remains the achievement of significant weight loss for patients with BMI between 35 and 40 kg/m^2 while on dialysis. Underweight patients also have increased risk of graft loss and other complications.[26] Fig. 211.2 illustrates the risk imposed by variation from ideal weight. Underweight patients should be evaluated for underlying medical and psychiatric illnesses.

RECURRENCE OF PRIMARY RENAL DISEASE AFTER TRANSPLANTATION

Recurrence of the primary renal disease after transplantation is an important consideration in the recipient evaluation. Glomerular diseases are the most common lesions to recur. Table 211.2 illustrates the risks of recurrence and graft loss in glomerular and nonglomerular diseases. In most cases, recurrence of disease does not preclude further transplantation, because the patients may obtain many dialysis-free years with subsequent grafts.

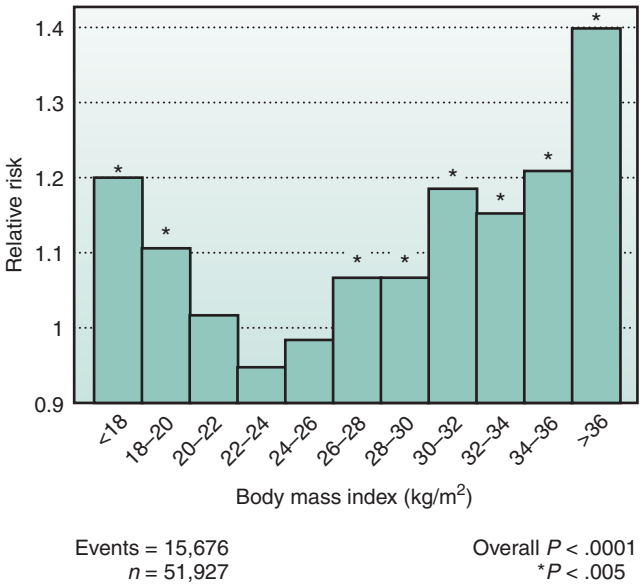

FIGURE 211.2 Relative risk for graft loss by body mass index. (Modified from Meier-Kriesche HU, Arndorfer JA, Kaplan B. The impact of body mass index on renal transplant outcomes: a significant independent risk factor for graft failure and patient death. *Transplantation*. 2002;73:70–74.)

TABLE 211.2

Recurrence of Renal Disease After Transplantation

RENAL DISEASE	RECURRENCE RATE (%)	GRAFT LOSS (%)
Primary Glomerular Diseases		
FSGS	20–30	40–50
Membranous glomerulonephritis	10–20	50
Immune complex-mediated MPGN	20–30	30–40
C3GN	70	50
Dense deposit disease	80–100	Up to 100
IgA nephropathy	40–50	6–33
Anti-GBM nephritis	10	Rare
Secondary Glomerular Diseases		
Henoch-Schönlein purpura	15–35	10–20
Lupus nephritis	<10	Rare
HUS/TTP	28	40–50
Diabetic nephropathy	100	<5
Amyloidosis	30–40	Unknown
Wegener granulomatosis	17	<10
Essential mixed cryoglobulinemia	50	"Frequent"
Metabolic or Systemic Diseases		
Oxalosis	90–100	Majority
Cystinosis	~0	Rare
Fabry disease	100	Rare
Sickle cell nephropathy	Rare	Unknown
Scleroderma	20	"Often"
Alport syndrome	~0 (anti-GBM)	~0

FSGS, Focal segmental glomerulosclerosis; *GBM,* glomerular basement membrane; *HUS,* hemolytic uremic syndrome; *IgA,* immunoglobulin A; *MPGN,* membranoproliferative glomerulonephritis; *TTP,* thrombotic thrombocytopenic purpura.
From Kasiske BL, Cangro CB, Hariharan S, et al. The evaluation of renal transplantation candidates: Clinical practice guidelines. *Am J Transplant.* 2001;1 Suppl 2:3–95.

Focal segmental glomerulosclerosis (FSGS) recurs in approximately 20% to 30% of patients. Graft loss is approximately 50% in primary grafts, but the rate increases once recurrence has occurred and may approximate 100% in patients with prior recurrence. Risk factors for recurrence include shorter times from diagnosis to ESRD, younger age, collapsing variant, white ethnicity, and recurrence in a prior allograft.[27–29] Measurement of circulating permeability factor or soluble urokinase receptor to determine risk of recurrence has yielded conflicting results. No measures reduce the risk of recurrence. Prophylactic plasma exchange has been used, but the data are insufficient to recommend it (evidence support C). Despite this gloomy picture, patients with FSGS benefit from renal transplantation, and it is recommended after patients are warned about the risk of recurrence (evidence support C).

The recurrence rate of membranous glomerulonephritis is 10% to 20%. Graft loss resulting from recurrence develops in 50%. Now that testing for anti-PLA2R antibodies is more available, there are authors that recommend testing for anti-PLA2R antibodies and expression of PLA2R antigen in the native kidney biopsies pretransplantation to determine the risk of early recurrence. Posttransplant antibody monitoring also may help to determine recurrence cases with more protracted course of the disease.[30] No treatment reverses the recurrent membranous disease. Patients should be informed of the risk of recurrence but should be offered transplants (evidence support C).

The new classification of membranoproliferative glomerulonephritis (MPGN) describes to main subtypes, immune complex-mediated MPGN and C3 glomerulopathy. Patients with MPGN type I refers mainly to immune complex-mediated MPGN and have been found to have recurrence rates of 20% to 30%,[31] but others have reported rates as high as 70% in primary grafts of children.[32] The histologic picture of transplant glomerulopathy is similar to MPGN type I, and this may have led to overestimation of recurrence in earlier studies. Recipients of living renal transplant may experience higher recurrence rates.[33] Risk of recurrence is associated with persistent or recurrent hypocomplementemia,[34] although serum complement levels are usually normal in recurrent disease compared with primary MPGN type I.[35] Graft loss develops in 30% to 40% of patients with recurrence.

C3 glomerulonephritis (C3GN) includes the old MPGN classification of the type I and III subtypes that present only with complement deposition in the immunofluorescence analysis of biopsies. The pathogenesis includes a variety of abnormalities in the alternative pathway of complement activation. Recent reports have determined that C3GN recurs in approximatively 70% of the transplants and causes 50% of graft loss.[36]

In dense deposit disease (DDD), recurrence is almost universal after transplantation. Reported rates are 80% to 100%.[37] Loss of grafts resulting from recurrence has been reported also in up to 100% of recurrences, although the rate of graft loss reported in different series is not consistent. Risk factors for earlier graft loss included younger age and the presence of crescents at presentation.[38] Eculizumab, a humanized monoclonal antibody that is a terminal complement inhibitor, has been used successfully for treatment of recurrent DDD after transplantation[39] and may have a role in prevention of recurrence too.

IgA nephropathy recurs in 40% to 50% of patients.[40] Patients with living related transplants and those with B35 and DR4 human leukocyte antigens also may be at greater risk for recurrence.[41] However, graft loss resulting from recurrence develops in less than 6% to 33% of patients. Because graft loss is uncommon and waiting times for

recipients in the deceased donor list are considerably longer with increased mortality, there is no reason for opposing living related transplantation in IgA nephropathy. The type of immunosuppression does not affect recurrence.[42]

Antiglomerular basement membrane (GBM) disease recurs in approximately 10% of renal transplants, but graft loss appears to be rare. Renal transplantation should be delayed until circulating anti-GBM antibodies are undetectable because higher antibody titers at the time of transplantation increase the risk of recurrence[43] (evidence support C).

Clinically evident Henoch-Schönlein purpura recurs in less than 15% to 35% of recipients by 5 years, and the graft failure rate is 11%. Recurrence may be higher in children (75% to 88%) and in recipients of living related transplants.[43a]

Recurrent lupus nephritis should be uncommon (10%) if patients are not transplanted until the disease is inactive (evidence support C). Serologic evidence for inactivity and clinical quiescence characterizes what has been termed "burned out" lupus. Graft loss is rare in appropriately selected cases.

Hemolytic uremic syndrome (HUS) and thrombotic thrombocytopenic purpura (TTP) recur in 28% of recipients, with graft failure developing in up to 50%.[43b] Risk of recurrence of aHUS depends on the genetic background. Patients with higher risk of recurrence are those that present Factor H, C3 and CFB mutations, or those with CFH/CFHR1 hybrid gene. Patients with CFI, MCP, combined mutations or with two at risk CFH haplotype should be considered to have lower risk of recurrence.[44] Recurrence may be reduced by use of preemptive plasma therapy,[44,45] and the commercialization of eculizumab opens new possibilities for the prevention and treatment of recurrent aHUS post-kidney transplantation.[46] Development of HUS/TTP in a prior transplant should not preclude retransplantation (evidence support B).

Diabetic nephropathy is the most commonly recurring glomerular disease after transplantation. Histologic recurrence can be seen in as many as 100% of cases.[47] However, few patients develop clinically evident diabetic nephropathy. Loss of graft function to recurrence of diabetic nephropathy is less than 5%.

Other forms of glomerular disease are less common, and evidence often consists of relatively small case series. Amyloidosis recurs in 30% to 40% of recipients, and the graft loss rate is unknown because of small sample sizes. Wegener granulomatosis recurs in 17% with less than 10% graft loss. Essential mixed cryoglobulinemia recurs in 50% with "frequent" loss of grafts.

Other metabolic and systemic diseases associated with renal failure also have been reported to recur. Oxalosis recurs in 100% of renal recipients if not preceded by liver transplantation. Isolated kidney transplantation can be attempted in patients without severe systemic disease (evidence support B). Preemptive liver transplantation alone before ESRD or simultaneous liver/kidney transplantation should be considered for some patients (evidence support B).

Cystinosis is primarily a pediatric disease and is caused by an inborn error of metabolism that leads to deposition of cystine crystals in the renal interstitium. Because the transplanted kidney corrects the deficiency, recurrence or graft loss does not develop. Fabry disease is caused by a hereditary deficiency of α-galactosidase that leads to accumulation of glycophospholipids in the kidney and other organs. It initially was hoped that a transplanted kidney could provide sufficient enzyme to correct the disturbance, but this is not the case. Histologic recurrence develops in 100% of cases, but graft loss is rare.

Sickle cell disease is associated with ESRD because of chronic interstitial fibrosis or FSGS. Recurrence of these diseases and graft loss are rare after transplantation, but the risk of long-term graft failure is greater in African-American patients without sickle cell disease. Transplantation is the preferred treatment for these patients (evidence support C), and there are few data supporting the practice of delaying surgery in patients with frequent sickle cell crisis (evidence support C).

Scleroderma is an uncommon cause of renal failure. The recurrence rate therefore is based on relatively small case series. Recurrence develops in 20%, and graft loss occurs "often." Renal transplantation is believed to be the preferred treatment for patients without severe disease precluding surgery (evidence support B).

GASTROINTESTINAL EVALUATION

Evaluation of the gastrointestinal tract gains great importance because postoperative complications can be life threatening. Patients with a previous history of peptic ulcer disease should undergo upper gastrointestinal endoscopy before transplantation (evidence support C). The prevalence may be as high as 25% of potential recipients, and 10% of patients develop peptic ulcer disease de novo after transplantation. Routine endoscopy is not warranted in asymptomatic patients without a prior history.

Colonic perforation is caused most commonly by diverticulitis and occurs in 0.5% to 2.0% of patients after transplant, with a mortality rate of 17% to 43%.[48] Routine screening is not warranted (evidence support D), but patients 50 years of age or older should have a colonoscopy for cancer screening. Patients with a prior history of diverticulitis should have a colonoscopy and should be considered for elective partial colectomy before transplantation if there is extensive disease or symptomatic diverticulitis persists (evidence support C).

The evaluation and management of cholelithiasis remain controversial. Some centers screen all patients and perform elective pretransplantation cholecystectomy if cholelithiasis is found. Others do not screen and only remove the gallbladder if symptoms are present. The incidence is 5% to 10% for patients without diabetes but 25% in patients with diabetes.[1] The ATC guidelines suggest that (1) patients with a history of cholecystitis should have an ultrasound examination with consideration given to cholecystectomy (evidence support C) and (2) diabetics should have an ultrasound examination and should be offered cholecystectomy if gallstones are found (evidence support C).

Preexisting liver disease requires close attention during the evaluation. Liver disease develops in 7% to 24% of kidney recipients in the early postoperative period and is the cause of late death in 8% to 28% of patients.[49,50] Hepatitis B (HBV) and hepatitis C (HCV) are the leading causes of viral hepatitis, and all patients should be screened for these infections (evidence support C). Patients with HBV and active viral replication and patients who are carriers of the HBV surface antigen (HBsAg) should be offered nucleos(t)ide analogues (NAs) before transplantation to achieve viral replication suppression and prevent liver fibrosis and decompensation posttransplant. NAs are classified into nucleosides (lamivudine, telbivudine, and entecavir) and nucleotides (adefovir dipivoxil, tenofovir disoproxil fumarate) analogues. A positive anti-HCV serology result should prompt testing for viral replication; if that result is positive, patients should be evaluated by hepatology to consider HCV treatment before transplantation. The possibility of transplantation with an HCV donor kidney and subsequent treatment posttransplantation also should be

evaluated because the waiting time for an HCV kidney is considerably shorter. Liver biopsy is encouraged strongly in many centers to determine the stage of liver disease. More recently, liver ultrasonographic elastography measured by Fibroscan has replaced liver biopsy in some centers in the evaluation of liver disease. Advanced liver disease is usually a contraindication to renal transplantation, but appropriate patients should be referred for combined liver/kidney transplantation (evidence support C).

CARDIAC EVALUATION

Cardiovascular disease is the leading cause of death after transplantation, with a relative risk between 3 and 10 times that in the general population.[51] Cardiac evaluation can be expensive, and angiography carries significant risk. Most programs have instituted attempts to apply risk stratification models, but there is a great variability in screening practices between different transplant centers. There is also lack of consensus within the clinical guidelines proposed by several national agencies, but all agree on the need to look for transplant-specific risk factors at the time of considering cardiac screening in asymptomatic patients.[1,52–54] As an example, the American Heart Association and the American College of Cardiology have reviewed their guidelines in 2012 acknowledging risk factors specific from the transplant population such as diabetes mellitus, prior cardiovascular disease, more than 1 year on dialysis, left ventricular hypertrophy, age greater than 60 years, smoking, hypertension, and dyslipidemia.[55] The ATC guidelines suggest the following: (1) patients at high risk (e.g., diabetic nephropathy, prior intermittent hemodialysis) should have cardiac stress testing (evidence support B); (2) patients with positive stress tests should have angiography (evidence support B); and (3) revascularization should be performed in those with critical coronary lesions before transplantation[1] (evidence support B).

MALIGNANCIES

Malignancies are more prevalent in patients with ESRD than in the general population. Age-appropriate screening should be performed for all patients before they are placed on the waiting list.[1,56] Most centers perform abdominal ultrasound examinations that include the kidneys to detect renal carcinoma, given the increased prevalence in ESRD patients.

An appropriate waiting period should be observed in patients with prior malignancy (Table 211.3) before listing. Most cancers require 2 years of waiting ("2-year rule"), but others, such as large renal cell, breast, colon, and melanoma cancers, may demand at least 5 years before attempting transplantation. Insufficient information is available to determine an appropriate waiting period for nonmelanotic skin cancers and myeloma. Patients with in situ lesions of all cancers probably can be listed earlier than the standard period, but patients should be informed that the risk of recurrence after transplantation is uncertain. Patients with incidentally found renal cell cancers and basal cell skin cancers usually can be listed without waiting. The Israel Penn International Transplant Tumor Registry, created in 1967, collects data about malignancies in organ transplantation and offers patient consultation for suggested waiting times. Other possible sources of information include Australia and New Zealand Data Registry; Organ Procurement and Transplantation Network/United Network for Organ Sharing; and European Dialysis & Transplantation Association—European Renal Association.

TABLE 211.3

Minimum Recommended Cancer-Free Waiting Period Based on American Society of Transplantation Guidelines

TUMOR	RECOMMENDED WAIT (yr)	AST CATEGORY*
Renal cell cancers		
Incidental renal cancer (<5 cm)	None	B
Symptomatic	2	B
Lesions >5 cm	5	B
Testicular	2	B
Cervix or uterus	2	B
Thyroid	2	B
Lymphoma	2	B
Leukemias	2	B
Wilms	2	B
Colon	5	B
Prostate	2	B
Breast	5	B
Bladder	2	B
In situ	None	B
Melanoma	5	B
Basal cell skin	None	C
Other nonmelanoma skin	Unknown	C
Myeloma	Unknown	C

AST, American Society of Transplantation.
*AST category B—There is fair evidence to support the recommendation that the condition be considered in the evaluation process; AST category C—There is poor evidence regarding the inclusion of the condition in the evaluation process, but recommendations may be made on other grounds.
From Kasiske BL, Cangro CB, Hariharan S, et al. The evaluation of renal transplantation candidates: clinical practice guidelines. *Am J Transplant.* 2001;1(Suppl 2):3–95.

ORGAN ALLOCATION SYSTEMS

Once patients have been placed on the waiting list for kidney transplantation, the organs are allocated based on models developed by national organizations that usually are monitored by their governments. The models are constantly evolving, and any attempt at delineating them is outdated quickly. In Europe, Eurotransplant International Foundation, UK Transplant, and France Transplant, among others, oversee the process. In the United States, the United Network of Organ Sharing assumes this responsibility. Current policy can be found on the websites of these and other organizations.

CONCLUSION

Evaluation of potential renal transplant recipients is increasingly challenging, but careful attention to elimination of potential barriers has resulted in continued improvements in patient and allograft survival.

Key Points

1. Given evidence that earlier transplantation can result in improved long-term survival, prominent guidelines for renal transplant support preemptive transplantation, but many also recommend waiting until the GFR is less than 20 mL/min.
2. Many centers limit transplant candidacy to persons younger than 75 years and those who have a body mass index lower than 35.
3. Many glomerular and systemic diseases can recur after renal transplant, but survival will still be better than dialysis and the original kidney disease hardly ever contraindicates transplantation.
4. Prior history of cancer does not preclude transplantation in many cases, if disease-free survival has been achieved after some time.
5. Cardiac evaluation is an important part of the workup for patients being evaluated for renal transplant because cardiovascular disease is an important comorbidity in patients with end-stage renal disease. When indicated, coronary revascularization should be performed before renal transplant.

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