INSTITUT DE CARDIOLOGIE DE MONTRÉAL

Anesthésie du patient transplanté cardiaque

Cours aux résidents

A.Courbe

Université de Montréal

Plan

- Indications et contre-indications de la transplantation cardiaque
- Sélection du donneur
- Technique chirurgicale
- Transplantation cardiaque : principes anesthésiques
- Devenir du transplanté cardiaque
- Physiopathologie du coeur transplanté
- Prise en charge du transplanté cardiaque

- 5 000 transplantations cardiaques par année dans le monde

- 50 000 patients en attente de TC

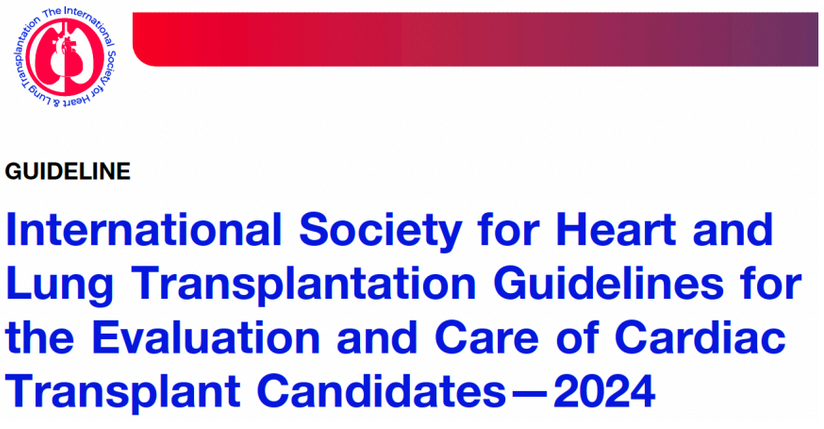
- Médiane de survie 12 ans après TC

ISHLT
A Society that Includes Basic Science, the Failing Heart, & Advanced Lung Disease

Fast Facts

Indications de la transplantation

- **Insuffisance cardiaque très symptomatique**
- **Choc cardiogénique**
- **Arythmies ventriculaires incontrôlées**
- Cardiomyopathies restrictives
- Cardiomyopathie hypertrophique
- Cardiopathies congénitales
- Quelle que soit l'étiologie: patient dont la *situation clinique est limitée malgré le traitement médical optimal* (incluant resynchronisation et/ou Mitraclip)
- *2 ECP :* 1) le test d'effort pour déterminer la VO2 max du patient ambulatoire (VO2 max ≤ 12 ml/kg/min supporte l'inscription sur liste) 2) le cathétérisme du coeur droit



2.1.1. Indications for Heart Transplantation

Recommendations for Indications for Heart Transplantation		
COR	**LOE**	**RECOMMENDATIONS**
1	**B-NR**	1. In patients with HF, when consistent with the patient's goals of care, the presence of clinical indicators of advanced HF (AvdHF) should trigger evaluation for AdvHF therapies, including HT.
1	**B-NR**	2. In ambulatory adult HF patients referred for transplant evaluation (and pediatric patients when age-appropriate), CPET should routinely be performed to quantify exertional intolerance, inform HF prognosis, and guide transplant listing.
1	**C-LD**	3. In adult HF patients evaluated for transplantation, right heart catheterization (RHC) should be performed prior to listing to assess for potentially prohibitive PH and for cardiogenic shock requiring inotropic support and/or temporary MCS.
2b	**C-EO**	4. In pediatric HT candidates, RHC may be performed prior to listing.
2a	**C-LD**	5. In adult HT candidates, HF prognosis scores can be considered in the context of other data collected during transplant evaluation to guide listing decisions.

Table 3 Markers of Advanced Heart Failure

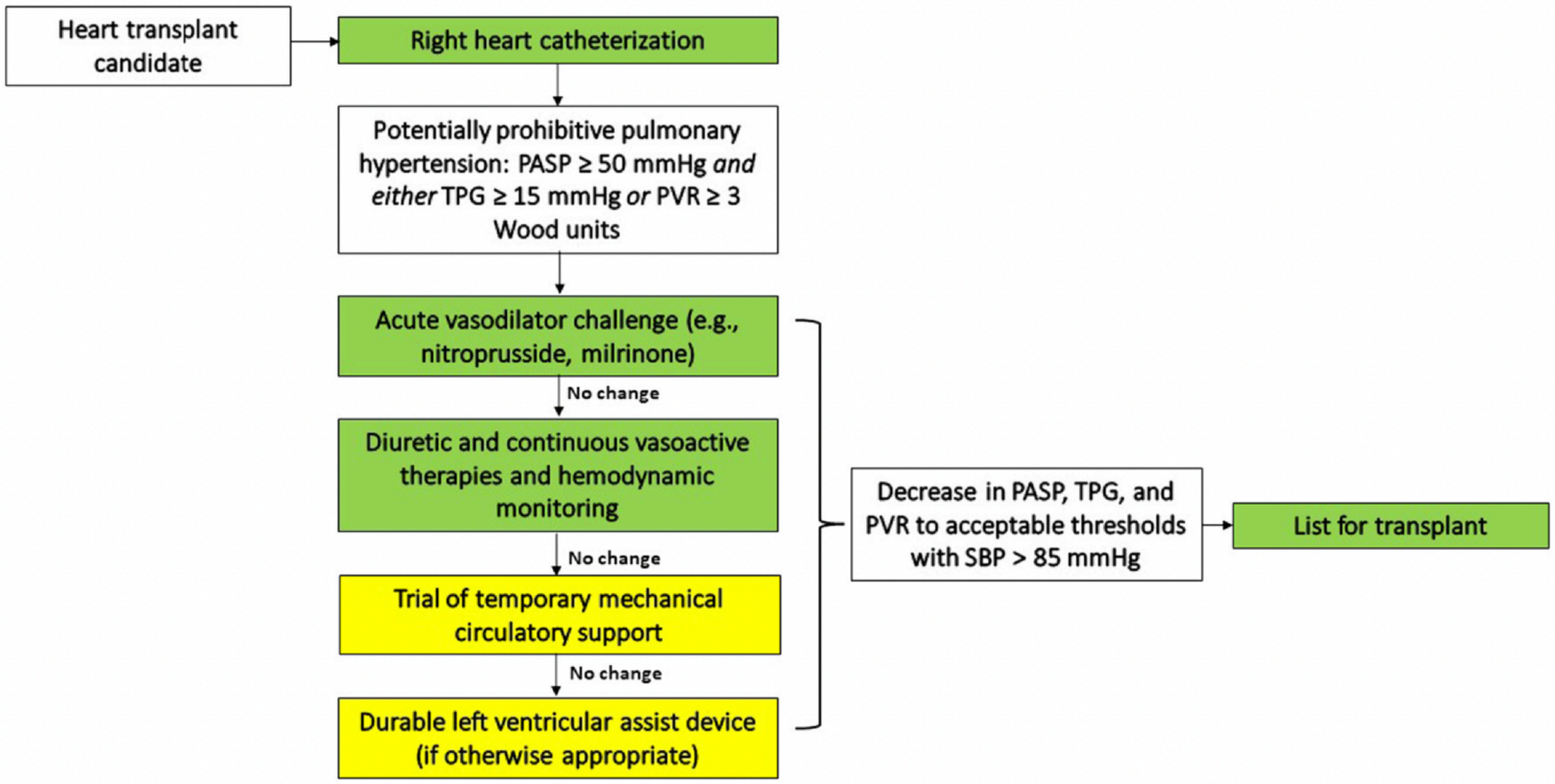
	Parameter	Description
I	*I*notropes	Previous or ongoing requirement for dobutamine, milrinone, dopamine, or levosimendan
N	*N*YHA class/*N*atriuretic peptides	Persisting NYHA class III or IV and/or persistently high BNP or NT-pro-BNP
E	*E*nd-organ dysfunction	Worsening renal or liver dysfunction in the setting of heart failure
E	*E*jection fraction	Very low LVEF < 20%
D	*D*efibrillator shocks	Recurrent appropriate defibrillator shocks
H	*H*ospitalizations	More than 1 hospitalization with HF in the last 12 months
E	*E*dema/*E*scalating diuretics	Persisting fluid overload and/or increasing diuretic requirement
L	*L*ow blood pressure	Consistently low blood pressure with systolic < 90-100 mm Hg
P	*P*rognostic medication	Inability to up-titrate (or need to decrease/cease) GDMP

Abbreivations: BNP, B-type natriuretic peptide; HF, heart failure; LVEF, left ventricular ejection fraction; NT-ProBNP, N-terminal pro–b-type natriuretic peptide; NYHA, New York Heart Association.

Adapted from.[16]

Hypertension pulmonaire

- ***Enjeu principal de la transplantation cardiaque***
- RVP ≥ 2.5 U Wood augmente mortalité précoce post TC
- Hypertension pulmonaire augmente postcharge VD augmente risque d'IVD donc morbi-mortalité



Contre-indications

- Age > 70 ans : relative transplantation envisageable selon statut fonctionnel et comorbidités
- Patient trop fragile (frailty)
- BMI : il est recommandé d'atteindre un BMI < 35 avant l'inscription sur liste
- Diabète : il est recommandé de retarder l'inscription sur liste si HbA1C > 7.5%
- Maladie vasculaire : patient avec ACV ou MVAS invalidante : TC ne rétablira pas la QOL.
- Maladie pulmonaire sévère : contre-indication, greffe coeur-poumons possible si patient jeune
- Maladie hépatique : si fibrose sévère ou cirrhose : transplantation coeur-foie
- Cancer : ATCD de cancer pré-TC augmente mortalité post TC (via cancer et autres). Collaboration avec oncologue++

Recommendations for Comorbidities and Potential Contraindications to Heart Transplantation: Cancer

COR	LOE	RECOMMENDATIONS
2a	B-R	1. All HT candidates should be s for the general population:[10] A. **Colorectal cancer:** patient (Class 1) with an average r screening with either a hig immunochemical, high-ser multitarget stool DNA high (colonoscopy, computed t sigmoidoscopy), dependin part of the screening proc
1	B-R	who have quit smoking wi dose chest CT. Screening should be discontinued once a patient reaches 15 years of smoking cessation.[107] CT chest done in all heart transplant candidates should be evaluated for the early detection of lung cancer.
2a	B-NR	2. Skin cancer screening by a full-body skin examination completed by a dermatologist for all heart transplant candidates can be useful to reduce skin cancer morbidity and mortality.
1	C-LD	3. In heart transplant candidates with a history of malignancy, collaboration with oncology specialists is recommended for individualized risk stratification to assess malignancy-related survival and risk of recurrence in the context of immunosuppression.
1	C-LD	4. In heart transplant candidates with a history of malignancy, HT is recommended when malignancy-related survival will not impact post-transplant survival and the risk of recurrence is low based on tumor type, response to therapy, and negative metastatic evaluation.

Table 5 Recommended Wait Times Pre-transplantation for Patients With a History of Skin Cancer Before Transplantation

Skin malignancy	Wait time before transplantation after treatment
Cutaneous squamous cell carcinoma (cSCC)	
No history of SCC but at risk for development of SCC	No delay necessary
Low risk	No delay necessary
High-risk SCC (not including perineural invasion)	2 years
High-risk SCC with perineural invasion or 2 risk factors	2-3 years
High risk with local nodal metastatic disease	5 years
Distant metastasis	Not eligible for transplantation
Merkel cell carcinoma	
Local with negative sentinel lymph node biopsy	2 years

Table 6 Recommended Wait Times Pre-transplantation for Patients With a History of Hematological Malignancies Before Transplantation

Histology	Wait time before transplantation after treatment
Diffuse large B cell lymphoma	2 years
Follicular lymphoma	2 years
Peripheral T-cell lymphoma	2 years
Burkitt lymphoma	2 years
Hodgkin lymphoma	2 years PET scan negative patients after initial treatment have a low rate of relapse
Monoclonal B cell lymphocytosis	No wait time
Chronic lymphocytic leukemia	2-3 years after treatment

Modified from pre-existing melanoma and hematological malignancies consensus expert opinion statement.[116]
Abbreviation: PET, positron emission tomography.

antation 3 months

ant Diagnosis of
ational Transplant

- Insuffisance rénale : la question centrale est la **réversibilité** de l'insuffisance rénale post-TC

- Cause irréversible et GFR < 30 : transplantation coeur-rein recommandée

- Cause irréversible et GFR 30-45 avec signes de maladie rénal chronique (reins atrophiés ou protéinurie >0.5g/24h) : transplantation coeur-rein raisonnable

- Cause irréversible, GFR < 30 et patient non éligible à la transplantation rénale : TC contre-indiquée

Infections et Vaccinations

- L’immunosupression post-TC rend le patient *sensible aux infections*
- Screening infectieux très large préop pour éviter une infection active post-TC
- Infection bactérienne active : reporter la TC (sauf infection de LVAD)
- HIV : patient hautement sélectionné peut être transplanté

- Endocardite Infectieuse : TC envisageable dans des cas extrêmes (pas de data robustes, case reports)
- **Vaccination pré-TC essentielle** : réponse meilleure que sous IS° en post-TC. Idéalement 2 semaines avant TC, 4 semaines pour vaccin vivant atténué (risque de réplication post-TC)
- Le refus des vaccinations peut être une CI° à la greffe cardiaque

Table 9 Screening for Latent Disease Requiring Pre-transplant Treatment and/or With the Potential for Post-Transplant Reactivation

Infection	Who to check	What to check	Pre-transplant management	Contraindications to HT
HIV[240]	All candidates	HIV RNA CD4 count	Consultation with HIV specialist to ensure stable anti-retroviral regimen that is safe post-HT	• Opportunistic infections or related malignancy (Kaposi sarcoma, lymphoma) • Chronic wasting or severe malnutrition • Lack of stable antiretroviral regimen • Detectable HIV RNA • CD4 count < 200 cells/microliter during the 3 months before transplantation
Chagas disease[250,251]	Born in Latin America (Central and South America or Mexico) or have spent significant time in Latin America, those with a Latin American mother, or received unscreened blood products	• Chronic Chagas disease diagnosed by serologic methods to detect IgG antibodies to *T. cruzi*, most commonly enzyme-linked immunosorbent assay (ELISA) and immunofluorescent antibody assay (IFA). • A positive result by a single assay does not constitute a confirmed diagnosis; 2 serologic tests based on different antigens (e.g., whole-parasite lysate and recombinant antigens) and/or techniques (e.g., ELISA and IFA) are used in parallel to increase the accuracy of the diagnosis.	Benefit of prophylactic therapy is not established.	None
TB[252]	All candidates	Tuberculin skin test (TST) and/or interferon-γ release assay (IGRA) where available	• Candidates with a positive IGRA or TST ≥5-mm induration should be treated pre-transplant with isoniazid and pyridoxine, if tolerated. • Candidates from a TB-endemic area with a positive IGRA or TST ≥5-mm induration should have at least 1 other risk factor (evidence of a recent seroconversion, evidence of old TB lung disease, history of untreated or inadequately treated TB, close contact with a person with TB) before commencing isoniazid prophylaxis.	Treatment for latent TB infection should be for 6-9 months and should not interfere with the timing of transplantation
HBV[253]	All candidates	HBV surface antigen, HBV core antibody, HBV surface antibody	Resolved or prior HBV infection (HBcAb+ and/or HBsAb+ but HBsAg-): serology and DNA viral load testing at 3-month intervals while listed. Complete viral HBV evaluation before HT should also include HBV nucleic acid test, HBe antigen, HBe antibody, hepatitis delta virus (HDV) antigen, HDV antibody, serum alfa-fetoprotein	Presence of cirrhosis on liver biopsy; heart-liver transplantation may be offered in select patients
HCV[253]	All candidates	HCV antibody and nucleic acid test	Chronic HCV: direct-acting antiviral therapy, choice based on genotype and other medications to achieve sustained virologic response	Presence of cirrhosis on liver biopsy; heart-liver transplantation may be offered in select patients

Abbreviations: HBV, hepatitis B virus; HCV, hepatitis C virus; HT, heart transplantation; HIV, human immunodeficiency virus; HBcAb+, hepatitis B core antibody positive; HBsAb+, hepatitis B surface antibody positive; HBsAg-, hepatitis B surface antigen negative; HBe , Hepatitis B e.

Table 10 Pre-transplant Vaccinations for Adult Heart Transplant Candidates

Vaccine	Pre-transplant serology	Pre-transplant vaccination	Confirm response pre-transplant	Special circumstances
Hepatitis A	Yes	Yes	Yes	Recommended for those with increased risk; travel or residence in high-risk areas; occupational or lifestyle exposure risk
Hepatitis B	Yes	Yes	Yes	
Pneumococcus	Consider	Yes	Consider	PCV20 single dose or PCV15 followed by PPSV23
Tetanus (dT)	Yes	Yes	No	Administer Tdap to all who have not previously received Tdap
Pertussis (Tdap)	No	Yes	No	Administer Tdap to all who have not previously received Tdap
Influenza	No	Yes	No	Seasonally, vaccination is also recommended for close contacts
SARS-CoV-2	No	Yes	No	Vaccination is also recommended for close contacts; up-to-date booster vaccination is recommended.
Meningococcus	No	Yes	No	Recommended for those at increased risk, including asplenia/polysplenia, high-risk travel, terminal complement deficit, including before eculizumab
Rabies	No	No	No	Consider those with a risk of significant post-transplant exposure
Human papilloma virus	No	Yes	No	Approved age 9-26 years
Live viral vaccines				
Varicella	Yes	Yes	Yes	Not needed if seropositive
Herpes zoster		Yes		The recombinant subunit zoster vaccine is preferred over the live-attenuated vaccine for transplant candidates and should be given in accordance with local vaccination guidelines[254]
Mumps, measles, rubella	Yes	Yes	Yes	Not needed if born before 1957

Abbreviation: SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

Risque chirurgical

2.1.2.13. Surgical Risk

Recommendations for Comorbidities and Potential Contraindications to Heart Transplantation: Surgical Risk		
COR	**LOE**	**RECOMMENDATIONS**
1	**B-NR**	1. In HT candidates with prior cardiac surgery, this additional risk should be factored into the comprehensive assessment of transplant eligibility.
2b	**C-LD**	2. In heart transplant candidates with circular aortic calcification (“porcelain” aorta), the benefit of HT is uncertain due to the high risk of perioperative mortality and stroke.

- Aorte porcelaine est le reflet de la maladie athérosclérotique
- L’irradiation médiastinale est aussi une cause d’aorte porcelaine

Cardiopathies congénitales

Recommendations for Assessment of Transplant Eligibility in Special Populations: Congenital Heart Disease		
COR	**LOE**	**RECOMMENDATIONS**
1	**B-NR**	1. In heart transplant candidates with CHD, care at centers with established medical and surgical experience in both pediatric and adult CHD and transplantation is recommended to confirm that transplant evaluation is appropriate and that all non-transplant medical, interventional, and surgical therapies have been exhausted prior to evaluation.
1	**C-LD**	2. In heart transplant candidates with CHD, detailed assessment is recommended, including: a. The position and anatomy of the abnormalities within the chest (via cardiac MRI and/or chest CT) to guide the surgical strategy; b. Evaluation of PH, and all potential sources of pulmonary flow; c. Patency of major veins and arteries and venous collaterals across the chest wall; d. Disease in organ systems that can affect post-transplant care and/or cannot be reversed with transplantation (including but not limited to lung, liver, gastrointestinal, and kidney disease); e. Anti-human leucocyte antigen (HLA) antibody sensitization; f. Psychosocial evaluation of the patient, family, and caregiver support.
1 **2a**	**B-NR**	3. In patients with single ventricle CHD and a Fontan circulation (total cavopulmonary anastomosis), HT evaluation is recommended to improve QOL and survival in the following situations: a. Symptomatic HF and reduced systolic function (Class 1); b. Symptomatic HF, preserved systolic function, and abnormal systemic ventricular filling pressures (Class 1); c. Lymphatic abnormalities including plastic bronchitis and protein-losing enteropathy refractory to lymphatic interventions and medical management (Class 2a); d. Cirrhosis or CKD attributed to chronically elevated central venous pressures (Class 2a).
1	**B-NR**	4. In patients with single ventricle CHD, HT evaluation is recommended to improve QOL and survival in the following situations: a. Palliation to a shunted circulation or a superior cavo-pulmonary anastomosis (first procedure of a staged Fontan) and prohibitive risk for further single ventricle palliation; b. Cyanotic heart disease with severe atrio-ventricular valve regurgitation and prohibitive risk for operative repair; c. Pulmonary atresia with an intact ventricular septum, right ventricular dependent coronary circulation, and atresia of at least one aorto-coronary ostium; d. Neonatal hypoplastic left heart syndrome with high-risk features including HF symptoms, ventricular dysfunction, left ventricular-coronary artery fistulae.
1 **2a**	**B-NR**	5. In patients with CHD, HT evaluation is recommended to improve QOL and survival in the following situations: a. HF symptoms or ventricular arrhythmias refractory to medical, interventional, and device therapies (Class 1). b. Reactive PH and a potential risk of developing fixed, irreversible elevation of PVR that could preclude HT in the future (Class 1) c. Neonatal cyanotic CHD with high-risk features as determined by an experienced pediatric CHD and cardiac surgery center (Class 2a).
2b	**B-NR**	6. The benefit of HT for CHD is not well established and may be considered as significant risk in the following CHD-specific situations: a. Increased surgical risk including multiple prior cardiac surgeries, aortopulmonary collaterals not amenable to catheter-based or surgical interventions; and/or prior mediastinitis b. Congenital absence, or near-total venous thromboembolism, of major systemic venous connections.
2b	**B-NR**	7. In patients with Fontan-associated liver disease and cirrhosis, the specific indications for heart alone versus heart-liver transplantation are not well-established and include: a. HT alone in patients with no stigmata of liver disease based on Child-Pugh Class A function and no portal hypertension; b. Heart-liver transplantation in patients with stigmata of liver disease based on Child-Pugh Class B/C function and/or portal hypertension (varices, ascites, splenomegaly, and/or thrombocytopenia). For patients with FALD score ≥ 2 combined heart-liver transplants may confer a survival advantage vs. isolated HT.

Retransplantation

Recommendation for Assessment of Transplant Eligibility in Special Populations: Retransplantation		
COR	**LOE**	**RECOMMENDATIONS**
2a	**B-NR**	1. In heart transplant recipients with ISHLT Grade 3 CAV, evaluation for retransplantation is reasonable.
2b	**C-LD**	2. In heart transplant recipients with the following, the benefit of retransplantation is not well established: a. Graft failure due to active rejection b. Advanced age c. Need for DMCS as a bridge to retransplantation.

Grade 3 CAV is defined as (1) angiographic left main stenosis ≥50%; (2) 2 or more primary vessels ≥70% stenosis; isolated branch stenosis ≥70% in all 3 systems; (3) ISHLT CAV1 or CAV2 with allograft dysfunction (defined as LVEF ≤45% usually in the presence of regional wall motion abnormalities); or (4) evidence of significant restrictive physiology based on symptoms, echocardiogram, and/or RHC.
Mortalité CAV grade 3 75% à 5 ans

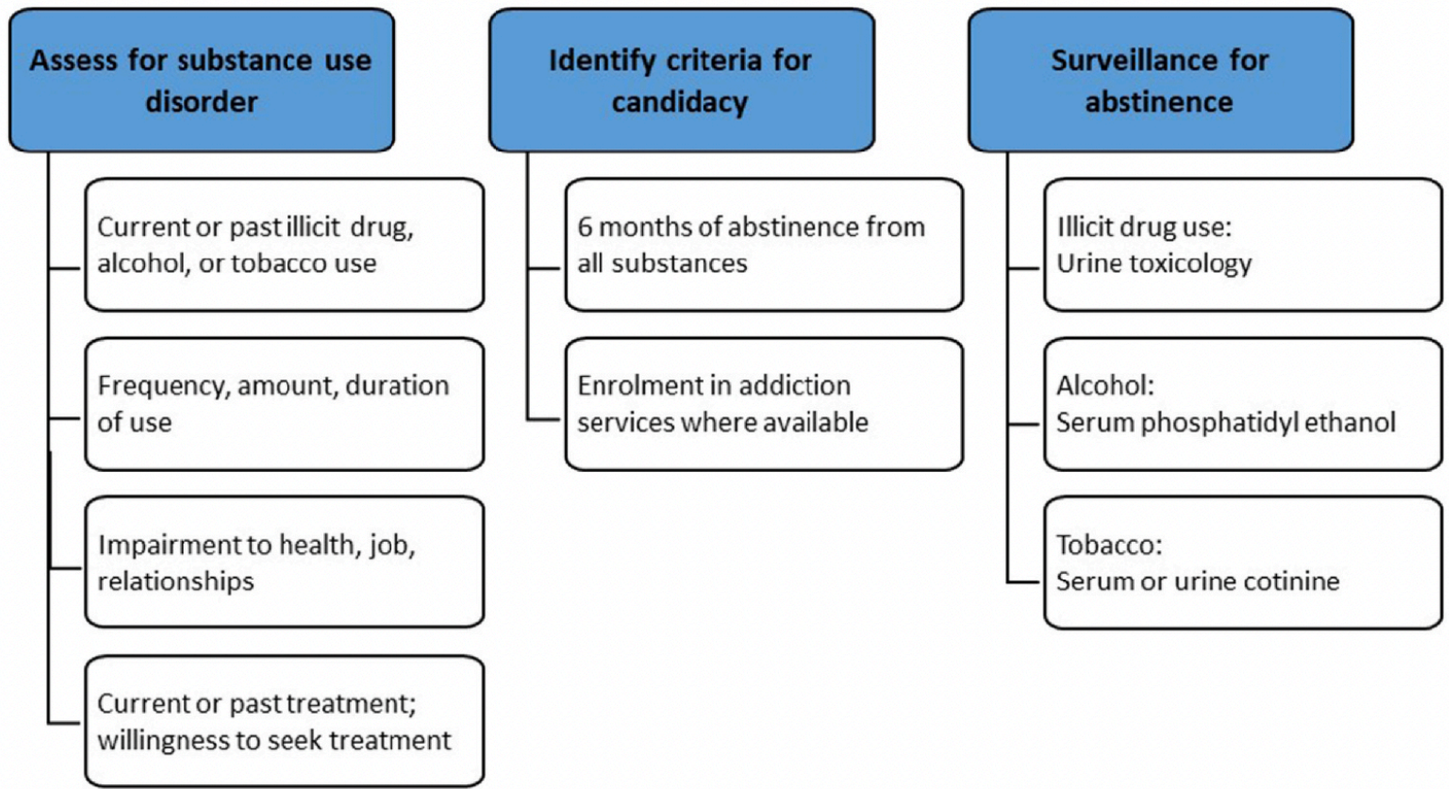
<u>Retransplantation à haut risque</u> :
- contexte de rejet aigu
- dans les 2 ans suivant première TC
- besoin d'une assistance en bridge to retransplantation (peut être considéré comme une CI° à une retransplantation)

De même si **âge > 60a** : mortalité augmentée

Consommation de drogues préop

Recommendations for Psychosocial Evaluation: Evaluation of Substance Use		
COR	**LOE**	**RECOMMENDATIONS**
1	**C-EO**	1. In heart transplant candidates with a history of active illicit drug use, at least 6 months of abstinence is recommended prior to transplant listing.
2a	**B-NR**	2. In heart transplant candidates with a history of active cannabis use, recommendation for abstinence prior to evaluation and listing is reasonable due to reported infectious risk and potential drug-drug interaction post-transplant.
1	**B-NR**	3. In heart transplant candidates with a history of active alcohol use disorder, at least 6 months of abstinence is recommended prior to transplant listing.
1	**B-NR**	4. In heart transplant candidates with a history of active tobacco smoking, at least 6 months of abstinence is recommended prior to transplant listing.

Figure 5 Summary of substance use disorder assessment.



Etat psychologique

- Patient en bonne condition psychique

- Importance de l entourage ++

2.2.2. Evaluation of Support, Adherence, and Mental Health

Recommendations for Psychosocial Evaluation: Evaluation of Support, Adherence and Mental Health		
COR	**LOE**	**RECOMMENDATIONS**
1	**B-NR**	1. In heart transplant candidates, confirmation of social support is recommended, including caregivers who: 1) understand the severity of patient's illness and their role as caregiver toward a potential transplant recipient; 2) can support both the patient's emotional and physical needs; 3) are dedicated to providing dependable care.
1	**B-NR**	2. Heart transplant candidates should exhibit adherence to medical recommendations, medications, and healthy lifestyle behaviors including optimal diet and physical activity as well as an understanding of expectations regarding the post-transplant regimen of medications and follow-up.
1	**B-NR**	3. In heart transplant candidates, assessment of adequate control of mental health problems is recommended with screening by a healthcare professional with expertise in mental health for 1) past and current mood disorders (including suicidal ideation or other self-injurious behavior), anxiety disorders, and other mental health problems (e.g., psychosis, personality disorders); 2) willingness, response, and adherence to treatment for past or current mental health problems; and 3) mental health issues in their social support network.
2a	**B-NR**	4. In candidates for HT, the use of psychosocial screening tools (e.g., PACT, SIPAT, TERS) can be useful as part of a comprehensive and multifaceted psychosocial evaluation to highlight risk factors for which further supportive interventions pre- and post-transplant are needed.

Approche MULTIDISCIPLINAIRE

Recommendations for Multidisciplinary Team Approach		
COR	**LOE**	**RECOMMENDATIONS**
1	**B-NR**	1. Heart transplant candidates should be cared for by a multidisciplinary collaborative team comprising HF cardiologist, cardiac surgeon, transplant nurse coordinator, experts in transplant infectious diseases, transplant pharmacist, immunologist, mental health expert, social worker, registered dietician, physical and occupational therapist, and palliative care specialist, with other specialists included based on the patient's specific needs.
1	**C-EO**	2. The responsibilities of the multidisciplinary heart transplant team should include 1) coordination of care unique to their area of expertise; and 2) participation in heart transplant selection committee meetings, held on a regular basis, to assess heart transplant candidacy.
1	**C-EO**	3. Pediatric heart transplant candidates should be cared for, in addition to the multidisciplinary specialists assembled for the care of adult heart transplant candidates, by specialists with expertise in assessing capacity to assent; child-life specialists to optimize education and participation of the pediatric patient and family in the transplant process; and mental health experts with specific expertise in pediatric mental health.

Table 18 Summary of Heart Transplant Evaluation

Test (COR)	Baseline	While listed	Comments
Assessment of HF severity			
CPET (Class 1, Baseline; Class 2b Waitlist)	x	x	Table 4 Should not be used as the sole determinant of need/ listing status for HT
RHC (Class 1)	x	x	For patients with potentially prohibitive PH, a vasodilator challenge should be administered to document reversibility to acceptable levels
HF prognosis scores (Class 2a)	x	x	Should not be used as the sole determinant of need for HT
Evaluation of organ function and comorbidities			
Frailty assessment (Class 2a)	x	x	Table 11
Nutritional status (Class 1)	x	x	Table 20
BMI ≥35 kg/m^2 is a potential contraindication (Class 2a)	x	x	
Routine laboratories (comprehensive metabolic profile, complete blood count, PT/INR)	x	x	
Natriuretic peptides (Class 1, Baseline; Class 2a Waitlist)	x	x	
HbA1c >7.5% is a potential contraindication (Class 2a)	x	x	
Ophthalmologic examination (if diabetic) (Class 2a)	x	x	
Urinalysis	x	x	
Serum creatinine, eGFR (Class 1)	x	x	Use race-free equation for eGFR
24-hour urine for creatinine clearance (Class 1)	x	x	If there is abnormal kidney function, further investigation with nephrology consultation, renal ultrasonography, and estimation of proteinuria for assessment of intrinsic renal disease
Liver function tests (albumin, bilirubin, INR); biochemical assays (AST, ALT, GGT); MELD-XI score (Class 1)	x	x	Further investigation should be considered when worsening liver function is suspected
Abdominal ultrasound or CT (Class 1)	x	x	If there is abnormal liver function further investigation with hepatology consultation and liver biopsy
Pulmonary function testing (spirometry, lung volume assessment, and diffusion capacity; Class 1)	x	x	
Chest CT (Class 1)	x		Pulmonary evaluation, risk assessment (presence of circular aortic calcification, porcelain aorta)
Carotid ultrasound in select patients (Class 1)	x	x	For patients with history of stroke or neurologic signs or symptoms concerning for cerebrovascular disease
Ankle brachial indices in select patients (Class 1)	x		If symptoms of peripheral arterial disease, known atherosclerotic disease, risk factors for atherosclerotic disease

Table 18 Summary of Heart Transplant Evaluation

Test (COR)	Baseline	While listed	Comments
Infectious serologies (Class 1): CMV IgG, EBV (EBV VCA IgG, IgM), Toxoplasma IgG, Syphilis, HAV serology Tetanus serology Varicella serology (IgG) HSV IgG Mumps serology Measles serology Rubella serology *Strongyloides* IgG, *Strongyloides* stool culture (if from endemic areas) *Coccidioides* serology (if from endemic areas) Trypanosomiasis serology (if from endemic areas)	x	x	Table 9 Repeat screening waitlist for >1 year or relevant infectious disease exposure
Screen for latent infection (Class 1): HIV serology and/or viral load IgG antibodies to *T. cruzi*, TST/IGRA HBVsAg, HBVcAb, HBVsAb, HBV nucleic acid test HCV antibody and nucleic acid test	x	x	Table 9
Vaccination (Class 1)	x	x	Table 10
Dual X-ray absorptiometry (DEXA scan) (Class 1)	x		
Immunocompatibility			
ABO HLA tissue typing PRA and flow cytometry	x x x	x	HLA antibody every 3-6 months/3 weeks after sensitizing event
Age-appropriate routine health maintenance			
Dental evaluation	x	x	
Skin cancer screening (Class 2a)	x	x	Section Cancer, Table 19
Colorectal cancer screening (Class 1-2a)	x	x	Section Cancer, Table 19
Mammogram (Class 1)	x	x	Section Cancer, Table 19
HPV/Pap smear (Class 1)	x	x	Section Cancer, Table 19
Prostate-specific antigen with/without digital rectal exam (Class 1)	x	x	Section Cancer, Table 19
Consultations			
Psychosocial evaluation (Class 1)	x	x	Evaluation of substance use, support, adherence and mental health; Figure 5, Tables 14-16

Abbreviations: ALT, alanine aminotransferase; AST, aspartate aminotransferase; BMI, body mass index; CMV IgG, Cytomegalovirus Immunoglobulin G; CPET cardiopulmonary exercise test; CT, computed tomography; EBV, Epstein-Barr virus; eGFR, estimated glomerular filtration rate; GGT, gamma-glutamyl transferase; HAV, hepatitis A virus; HBV, hepatitis B virus; HCV, hepatitis C virus; HF, heart failure; HLA, human leukocyte antigen; HPV, human papillomavirus; HT, heart transplantation; INR, international normalized ratio; IGRA, interferon-γ release assay; LVAD, left ventricular assist device; MELD-XI, model for end-stage liver disease excluding INR; PH, pulmonary hypertension; PRA, panel-reactive antibody; PT, prothrombin time; QOL, quality of life; RHC right heart catheterization; TST, tuberculin skin test.

Sélection du donneur

- Basée sur le genre et les mensurations

- Receveurs masculins de donneurs féminins ont présenté une mortalité + élevée à 1 an. Cela pourrait s'expliquer par la différence de masse cardiaque entre les 2 sexes d'où l'intérêt pour **predicted heart mass pHM**

- Mensurations : ***undersizing délétère***, surtout si le receveur présente de l'HTP. L'oversizing n'a pas démontré d'avantages

- Poids : coeur refusé si poids du donneur < 70% du poids du receveur (mortalité augmentée)

- **pHM** : masse estimée du coeur (G + D) calculée selon âge/sexe/taille/ poids. pHM ratio donneur-receveur < 0,86 augmente mortalité. Guidelines ISHLT 2022 (donor heart selection) accepte 20-30% d'écart

Sélection du donneur

- *Compatibilité ABO* respectée (adulte) : idem transfusion

- *Système HLA* : **P**anel **R**eactive **A**ntibodies : Ac réagissant contre un panel d'Ag HLA. PRA calculé : estimation du pourcentage de donneurs avec lesquels le receveur risque de présenter une incompatibilité. PRAc ≥ 80% : patient prioritaire

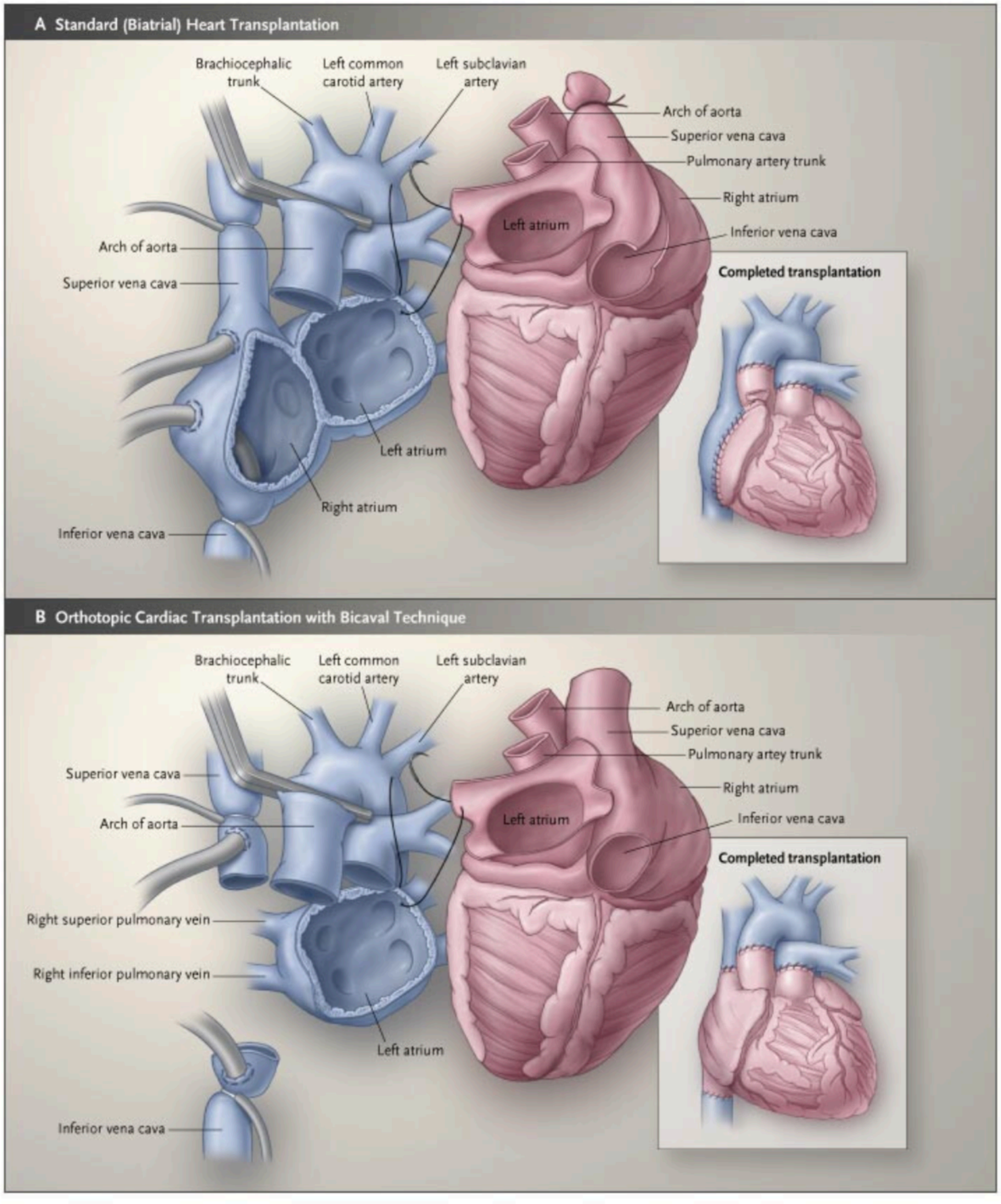
- Comparaison des Ac anti-HLA du receveur aux antigènes HLA du donneur : crossmatch virtuel

Société canadienne du sang
SANG
PLASMA
CELLULES SOUCHES
ORGANES
ET TISSUS

TRANSPLANT QUÉBEC

Technique chirurgicale

- Arythmies et IT vs sténoses veines caves



Taking Heart — Cardiac Transplantation Past, Present, and Future

The NEW ENGLAND JOURNAL of MEDICINE

TC: principes anesthésiques

- Préop : gestion des anticoagulants / défibrillateur / risque de défaillance VD (HTP++)
- Antibioprohylaxie
- Induction d'un patient IC
- Maintien d'une hémodynamique stable jusqu'au départ en CEC
- Redo fréquents : techniques complexes, pads défib, héparine, culots en salle
- Immunosuppression au déclampage
- Prévention/traitement de l'IC droite
- Décision d'assistance circulatoire
- Hémostase et transfusion

Evolution du transplanté cardiaque

- Survie : 85-90% à 1an, 70-80% à 5 ans, 50-60% à 10ans

- Long terme : tumeurs et infections favorisées par l'immunosuppression au long cours, insuffisance rénale, défaillance cardiaque (rejet chronique ou dysfonction ventriculaire), *vasculopathie du greffon*

- **Vasculopathie du greffon :**

- - coronaropathie artérielle +/- veineuse

- - origine immunologique

- - ***silencieuse*** (coeur dénervé)

- - Traitement : gestion des FRCV / immunosuppression / PCI / retransplantation

Physiopathologie du coeur transplanté

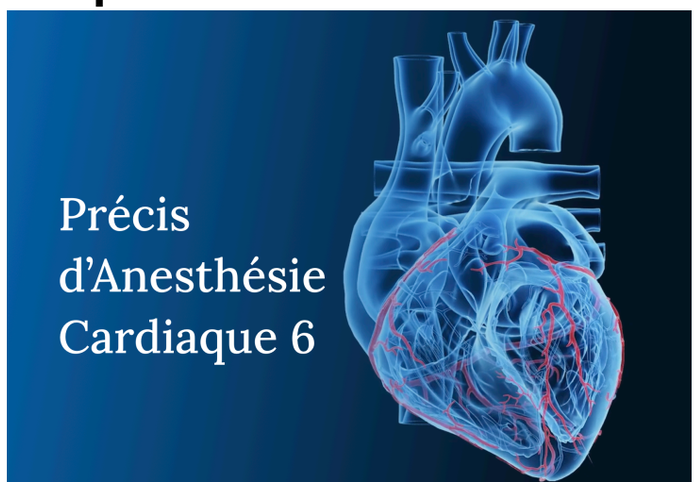
- <u>Le coeur transplanté est ***dénervé:***</u>

- Perte des réflexes cardiaques : pas de baroréflexe, pas de réponse à la manoeuvre de Valsalva, au massage carotidien,…

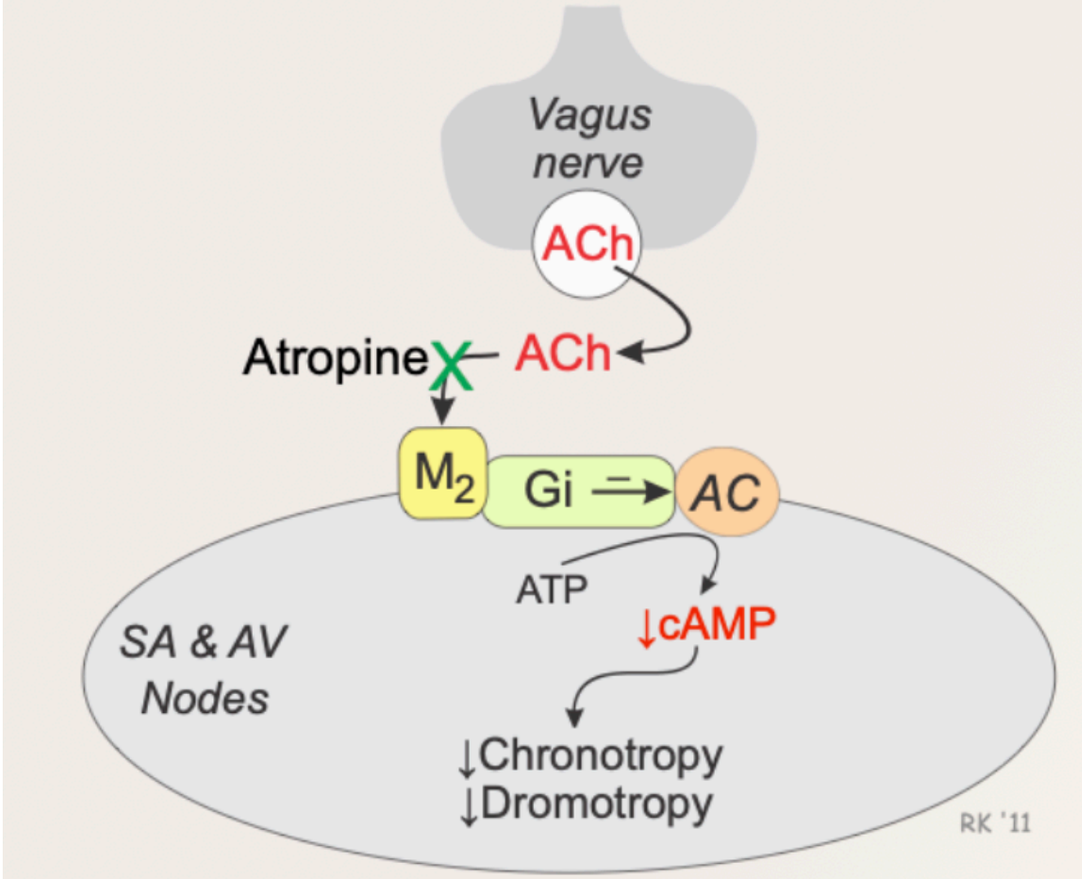
- Pas de mécanisme physiologique d'adaptation rapide = ***titrer les médicaments d'anesthésie***

- Pas de réaction aux gestes anesthésiques : laryngoscopie, intubation

- **Pas de réponse aux agents stimulants indirects** : atropine, glycopyrolate, éphédrine (mécanisme principal), dopamine



General Pharmacology



Abbreviations: ACh, acetylcholine; M_2, muscarinic receptor; AC, adenylate cyclase; SA, sinoatrial; AV, atrioventricular

CARDIOVASCULAR PHARMACOLOGY CONCEPTS

RICHARD E. KLABUNDE, PHD

- <u>Il persiste :</u>

- Une réponse à la précharge via Frank-Starling

- Une réaction aux catécholamines circulantes intrinsèques

- Une réponse aux médicaments ayant une action directe sur les cardiomyocytes : adrénaline, noradrénaline, dobutamine, isoprénaline, milrinone

PEC du transplanté cardiaque

- Poursuivre le traitement immunosuppresseurs +++
- Bio préop: TTT ISeur => anémie, leucopénie, thrombopénie, insuffisance rénale, perturbations du BH
- Risque infectieux majoré : asepsie rigoureuse
- HSHC si CTCD
- Suivi régulier donc accès à un bilan cardiaque récent : coronaropathie silencieuse (coroCT, coronaro), fonctions VG et VD,…

Considérations hémodynamiques

- FC basale plutôt élevée (perte du tonus vagal). *Pas de réponse à l'atropine ni au glycopyrolate*
- Précharge : « normale haute » car pas de tachycardie réflexe à l'hypovolémie compensatrice, coeur fréquemment atteint de dysfonction diastolique, réponse à Frank-Starling préservée
- En cas de vasodilatation veineuse (neuraxiale) ou artérielle anticiper l'absence d'adaptation réflexe
- Idéalement éviter les vasodilatations rapides puisqu'il n y a pas d'adaptation rapide par les mécanismes réflexes habituels : titrer les médicaments

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- Postcharge : ventricule d'autant plus sensible à la postcharge que sa fonction systolique est abaissée (à G comme à D)
- Si besoin d'inotropie : *pas de réponse à l'éphédrine (mécanisme principal) ou à la dopamine*
- Attention à la possible coronaropathie malgré l'absence de symptômes
- Arythmies + fréquentes (auriculaires, mais aussi ventriculaires) : pads défib si vasculopathie du greffon ou mauvaise fonction ventriculaire