Anesthesia for Non-Cardiac Surgery in Congenital Heart Disease

DIU RCCC

Necker le 08/12/2016

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PLAN

- Définitions et Épidémiologie
- Qui fait quoi ?
- Principes de base
- Cas cliniques
- Conclusions

Épidémiologie

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Post-Operative Outcomes in Children With and Without Congenital Heart Disease Undergoing Noncardiac Surgery

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Propensity score matching
Stratification by severity of CHD

COMPARISON OF MORTALITY AND ADVERSE POST OP OUTCOMES

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ACS NSQIP = American College of Surgeons
National Surgical Quality Improvement Program

51 008 children in the database

4520 With CHD underwent non cardiac surgery

Définitions

- Cardiopathies congénitales
- Mineures
- Majeures
- Sévères

- Chirurgies Non-cardiaques

TABLE 1 ACS NSQIP Classification of CHD Based on Residual Lesion Burden and Functional Status

Classification	Definition and Criteria
Minor CHD	• Cardiac condition with or without medication and maintenance (e.g., atrial septal defect, small-to-moderate ventricular septal defect with no symptoms) • Repair of congenital heart defect with normal cardiovascular function and no medication
Major CHD	• Repair of congenital heart defect with residual hemodynamic abnormality with or without medications (e.g., tetralogy of Fallot with wide open pulmonary insufficiency, hypoplastic left heart syndrome including stage 1 repair)
Severe CHD	• Uncorrected cyanotic heart disease • Patients with any documented pulmonary hypertension • Patients with ventricular dysfunction requiring medications • Listed for heart transplant

ACS NSQIP = American College of Surgeons National Surgical Quality Improvement Program; CHD = congenital heart disease.

TABLE 3 Mortality and Post-Operative Outcomes for Matched Controls and Severe CHD Patients

	Controls (n = 417)	Severe (n = 417)			
	Patients	Patients	Odds Ratio (95% CI)	p Value	Risk Difference (95% CI)
30-day mortality	3 (0.7)	24 (5.7)	8.43 (2.52 to 28.21)	**<0.001**	0.050 (0.027 to 0.074)
Overall mortality	5 (1.2)	34 (8.1)	7.32 (2.83 to 18.90)	**<0.001**	0.070 (0.041 to 0.098)
Cardiac arrest	0 (0.0)	13 (3.1)	–	**<0.001**	–
Reintubation	7 (1.7)	21 (5.0)	3.11 (1.31 to 7.39)	**0.005**	0.034 (0.009 to 0.058)
Infection*	18 (4.3)	27 (6.5)	1.54 (0.83 to 2.83)	0.11	0.016 (−0.009 to 0.052)
Renal failure	0 (0.0)	4 (1.0)	–	0.06	–
Neurological failure	3 (0.7)	4 (1.0)	1.34 (0.30 to 6.01)	0.50	0.002 (−0.010 to 0.015)
Thromboembolic complications	1 (0.2)	1 (0.2)	1.00 (0.06 to 16.04)	0.75	−0.000 (−0.007 to 0.007)
30-day reoperation	29 (7.0)	32 (7.7)	1.11 (0.66 to 1.87)	0.40	0.007 (−0.028 to 0.043)
30-day readmission	38 (9.1)	41 (9.8)	1.09 (0.68 to 1.73)	0.41	0.007 (−0.033 to 0.047)

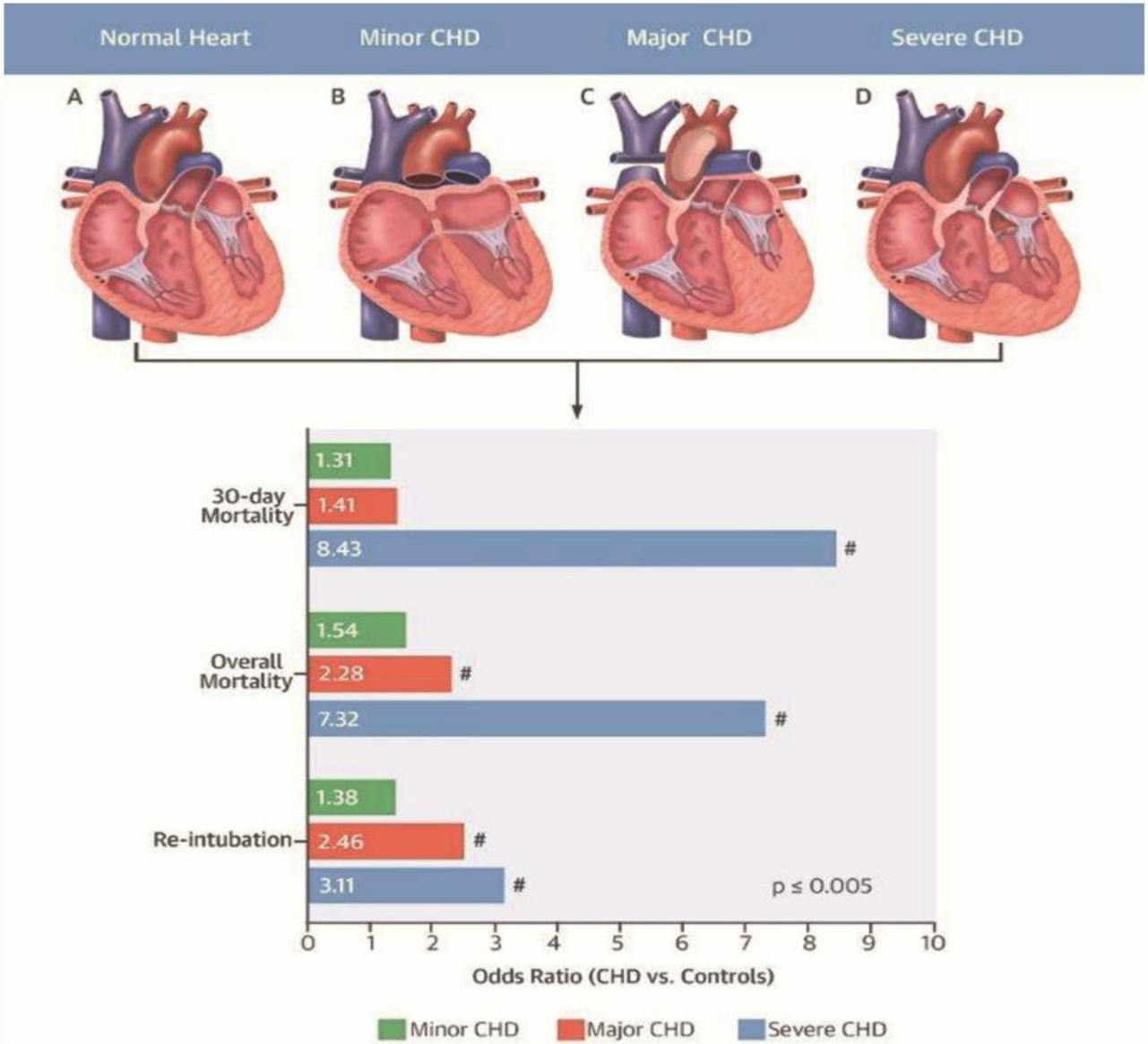
TABLE 4 Mortality and Post-Operative Outcomes for Matched Controls and Major CHD

	Controls (n = 1,272)	Major CHD (n = 1,272)			
	Patients	Patients	Odds Ratio (95% CI)	p Value	Risk Difference (95% CI)
30-day mortality	20 (1.6)	28 (2.2)	1.41 (0.79 to 2.51)	0.25	0.006 (−0.004 to 0.017)
Overall mortality	22 (1.7)	49 (3.8)	2.28 (1.37 to 3.79)	**0.002**	0.021 (0.009 to 0.034)
Cardiac arrest	6 (0.5)	14 (1.1)	2.34 (0.90 to 6.13)	0.08	0.006 (−0.001 to 0.013)
Reintubation	29 (2.3)	69 (5.4)	2.46 (1.58 to 3.82)	**<0.001**	0.031 (0.017 to 0.046)
Infection*	70 (5.5)	80 (6.3)	1.15 (0.83 to 1.60)	0.40	0.008 (−0.010 to 0.026)
Renal failure	1 (0.1)	4 (0.3)	4.01 (0.45 to 35.92)	0.22	0.002 (−0.001 to 0.006)
Neurological failure	14 (1.1)	14 (1.1)	1.00 (0.47 to 2.11)	1.00	0.000 (−0.008 to 0.008)
Thromboembolic complications	3 (0.2)	2 (0.2)	0.67 (0.11 to 3.99)	0.66	−0.001 (−0.004 to 0.003)
30-day reoperation	72 (5.7)	95 (7.5)	1.34 (0.98 to 1.85)	0.07	0.018 (−0.001 to 0.037)
30-day readmission	114 (9.0)	106 (8.3)	0.92 (0.70 to 1.22)	0.57	−0.006 (−0.028 to 0.016)

TABLE 5 Mortality and Post-Operative Outcomes for Matched Controls and Minor Congenital Heart Disease Patients

	Controls (n = 2,805)	Minor CHD (n = 2,805)			
	Patients	Patients	Odds Ratio (95% CI)	p Value	Risk Difference (95% CI)
30-day mortality	23 (0.8)	30 (1.1)	1.31 (0.76 to 2.26)	0.34	0.003 (−0.003 to 0.008)
Overall mortality	28 (1.0)	43 (1.5)	1.54 (0.96 to 2.49)	0.08	0.005 (−0.001 to 0.011)
Cardiac arrest	6 (0.2)	14 (0.5)	2.34 (0.90 to 6.10)	0.08	0.003 (−0.001 to 0.006)
Reintubation	53 (1.9)	73 (2.6)	1.38 (0.97 to 1.98)	0.07	0.007 (−0.001 to 0.015)
Infection*	106 (3.8)	150 (5.3)	1.44 (1.12 to 1.86)	0.006	0.016 (0.005 to 0.027)
Renal failure	7 (0.2)	4 (0.1)	0.57 (0.17 to 1.95)	0.37	−0.001 (−0.003 to 0.001)
Neurological failure	21 (0.8)	13 (0.5)	0.62 (0.31 to 1.24)	0.17	−0.003 (−0.007 to 0.001)
Thromboembolic complications	3 (0.1)	3 (0.1)	1.00 (0.20 to 4.96)	1.00	0.000 (−0.002 to 0.002)
30-day reoperation	144 (5.1)	167 (5.9)	1.17 (0.93 to 1.47)	0.18	0.008 (−0.004 to 0.020)
30-day readmission	208 (7.4)	230 (8.2)	1.12 (0.92 to 1.36)	0.27	0.008 (−0.006 to 0.022)

CENTRAL ILLUSTRATION **Mortality and Post-Operative Outcomes for Controls and Children With CHD: Stratified by Severity Classification**



Faraoni, D. et al. J Am Coll Cardiol. 2016; 67(7):793–801.

(A) Normal heart, **(B)** atrial septal defect, **(C)** hypoplastic left heart syndrome stage 2 repair, **(D)** uncorrected tetralogy of Fallot. Children with major **(C)** and severe congenital heart disease (CHD) **(D)**, undergoing noncardiac surgery, have an increased risk of mortality and increased incidence of post-operative reintubation compared with children without CHD **(A)** and with minor CHD **(B)**. #p ≤ 0.005.

Autres données

- 19 % de mortalité (Torres 2002)
- 50 % mortalité (Hennein 1994)
- 25 % des ACR pédiatriques lors de chirurgie non cardiaque surviennent sur des CHD (Flick 2007, Ramamoothy 2010
- Plus de patients adultes avec CHD que d'enfants

4 complications majeures

- Arythmies
- Insuffisance cardiaque
- HTAP
- Cyanose

White MC, Pediatr Anesth 2011; 21: 522-9

Arythmies

- Sutures atriales ou ventriculotomies extensives
- Peuvent apparaître tardivement
- Asymptomatiques ou mort subite
- Sinus venosus, CIA, Mustard ou Senning, Fontan
- Progrès chirurgicaux
- QT Longs
- Ectopies Ventriculaires

ECG systématique chez tout patient porteur d'une CHD avant une anesthésie

Défaillance cardiaque

- Surcharge chronique en volume et/ou en pression
- Réduction du tonus sympathique peut précipiter la défaillance (préférer Kétamine au propofol)
- Induction longue : être patient pour éviter les surdosages (IV ou Inhalatoires)
- Evaluer le risque pour la circulation coronaire (Adré prête) même pour une chir « mineure »

HTAP

- > 25 mmHg au repos
- Shunt G->D
- Obstruction sur les VP ou POG haute
- Risque x 8 de cpkt majeure
- CAV, TAC, d-TGV+CIV
- T21
- Gestion des RVP

Carmosino MJ et al, Anesth Analg 2007; 104: 521-7
Friesen RH et al, Pediatr Anesth 2008; 18: 208-16
Fischer LG et al , Anesth Analg 2003; 96: 1603-16

Cyanose

- Shunts D->G, faible Qp mais pas seulement
- Conséquences hémato : Ht
- Thromboses et AVC
- Limiter le jeûn et ramener Ht < 60%
- Fausses crases
- Ne pas arrêter l'aspirine pour les shunts
- $EtCO_2$ sous estime la pCO_2
- Méfiance prémédic et hypoxie postop

QUI ?

- Anesthésiste qui connaît la pathologie cardiaque
- Structure de soins post op adaptée
- Cardio-pédiatres à disposition
- Au minimum assistance téléphonique

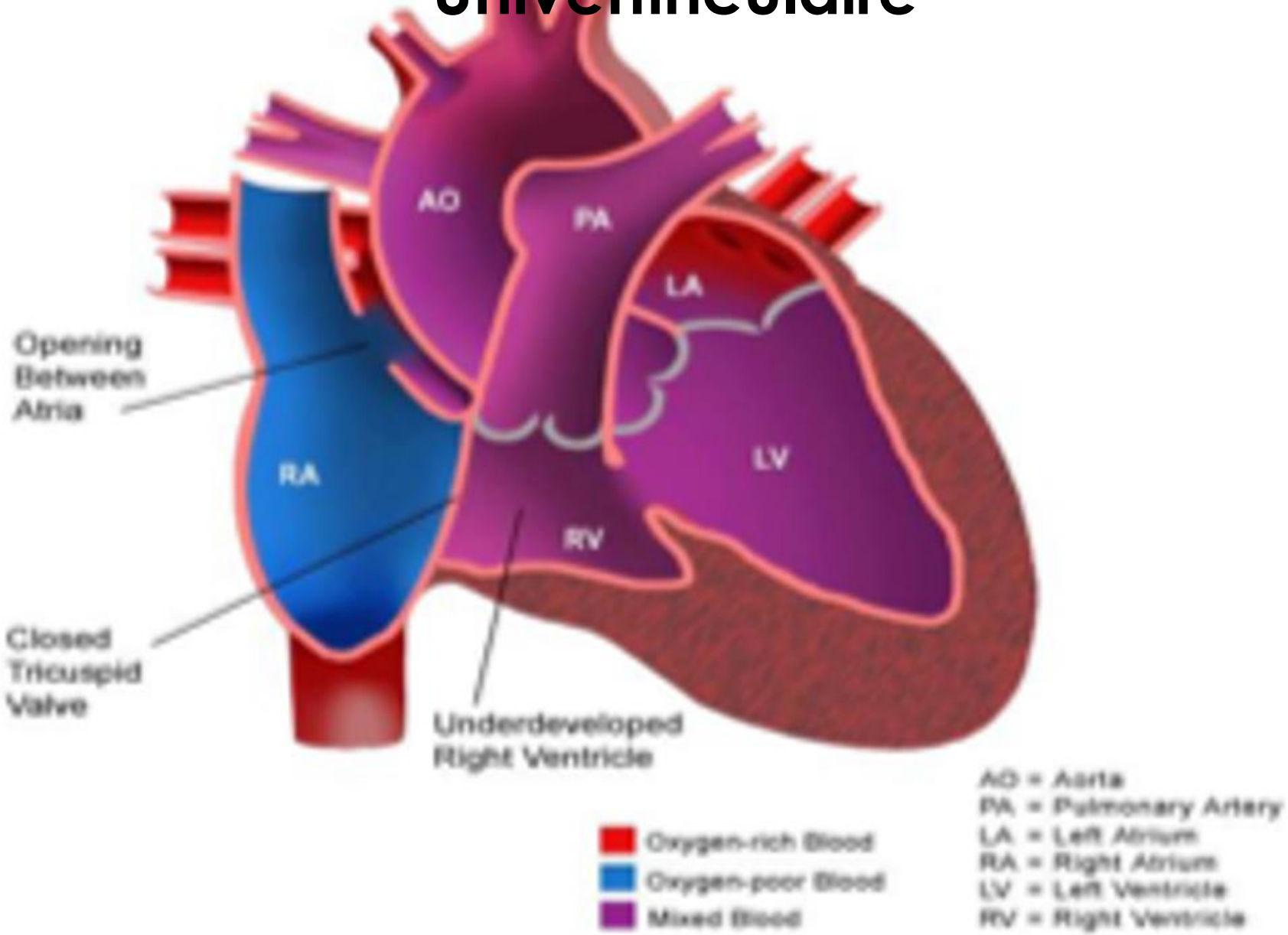
Visite préopératoire

- Attention aux IVRS
- ECG, arrythmies, HTAP ?
- Capital vasculaire ?
- Médicaments ? En général, les continuer
- Prémédication ? Monitorer les cyanogènes
- Prophylaxie de l'EI
- Ne pas minimiser les risques, en parler à la famille et avoir un référent dispo si nécessaire

Cas clinique

- Jeune femme de 28 ans, Hypoplasie cœur G, Norwood puis Fontan depuis 26 ans.
- Va plutôt bien (NYHA II) sauf un long QT et une arythmie
- Programmée pour une cholécystectomie sous laparoscopie

Cœur Univentriculaire



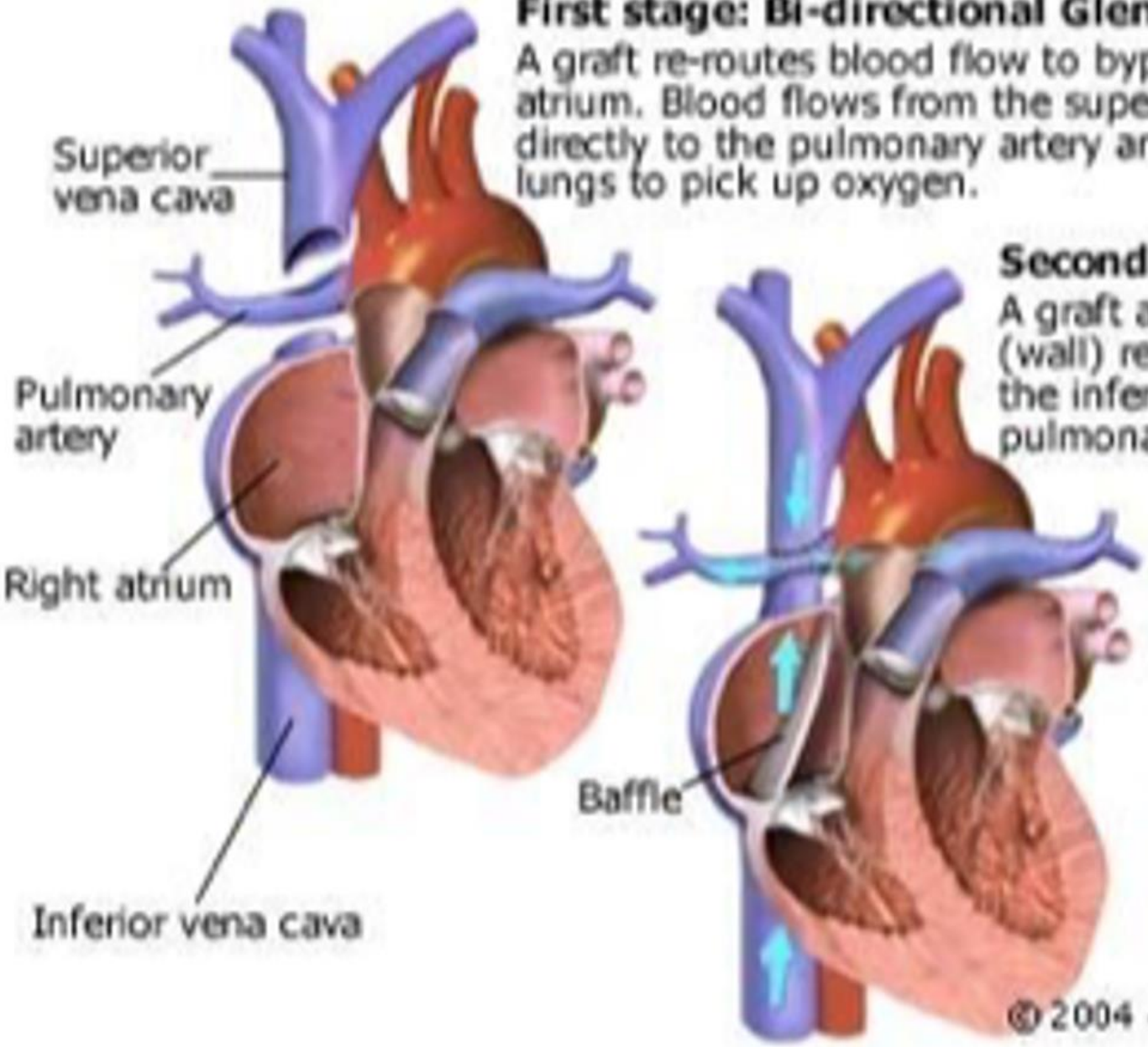
Fontan Procedure

First stage: Bi-directional Glenn:

A graft re-routes blood flow to bypass the right atrium. Blood flows from the superior vena cava directly to the pulmonary artery and then to the lungs to pick up oxygen.

Second stage: Fontan:

A graft and an internal baffle (wall) re-route blood flow from the inferior vena cava to the pulmonary artery.



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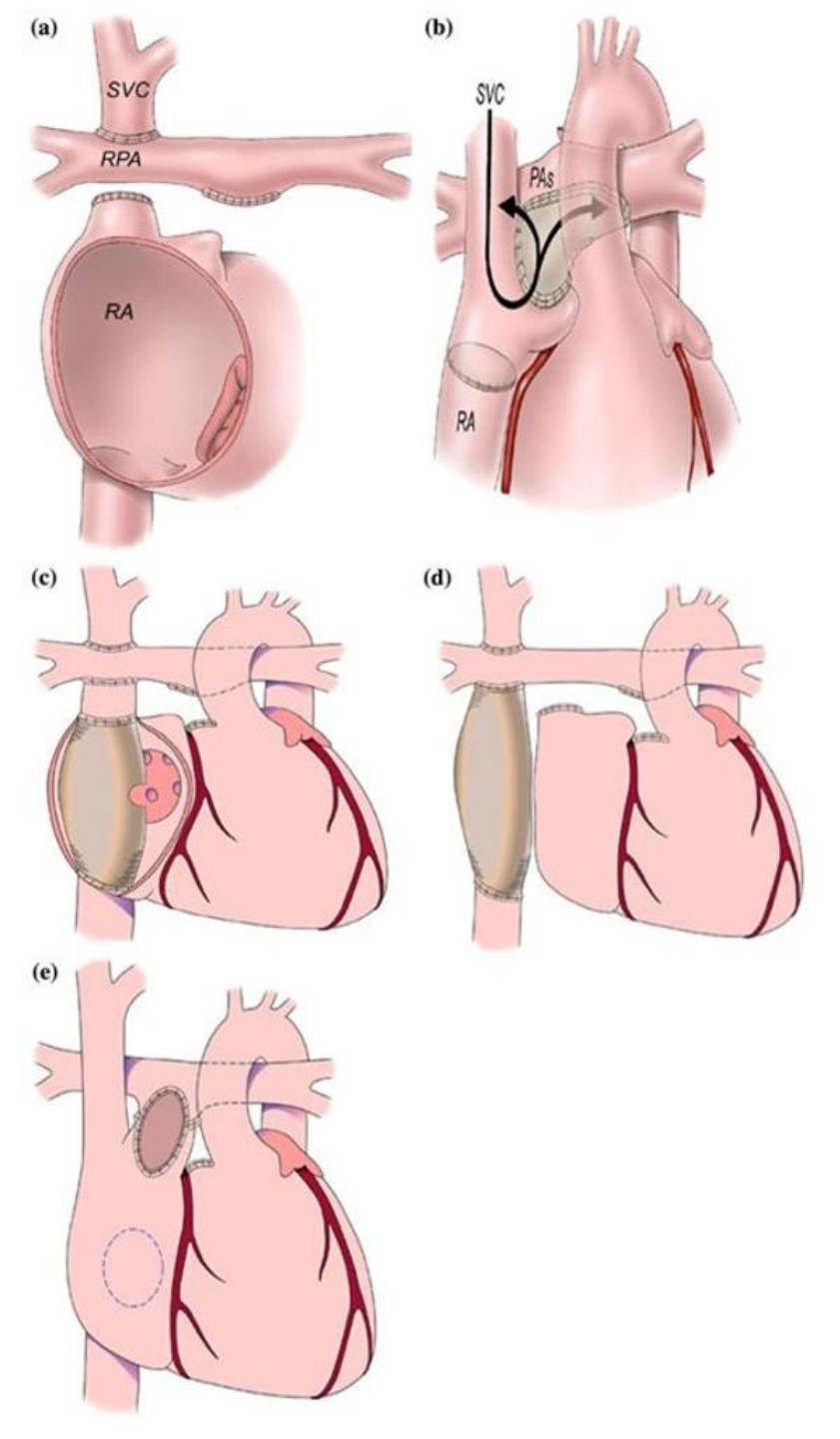

Yuki K et al, J Anesth 2011; 25: 247-56

Table 3 Management of lesions with single ventricle physiology

Physiology	Management
Balanced flow	
Qp: Qs = 0.7–1.5: 1	No intervention
SaO_2 75–80%	
SaO_2–$SmvO_2$ 25–30%	
Overcirculated	
Qp: Qs > 2–3: 1	Raise PVR: Controlled hypoventilation, mild acidosis, Low FiO_2
Causes: Low PVR, large MBTS or Sano shunt, residual arch obstruction	Increase systemic O_2 delivery: Afterload reduction, inotropic support, hematocrit > 40%
SaO_2 > 85–90%	
SaO_2–$SmvO_2$ 35–40%	
Undercirculated	
Qp: Qs <0.7: 1	Lower PVR: Controlled hyperventilation, alkalosis, sedation/paralysis, aggressively treat atelectasis, nitric oxide
SaO_2 < 65–75%	Increase systemic O_2 delivery: inotropic support
SaO_2–$SmvO_2$ 25–30%	
Causes: High PVR, small MBTS or Sano shunt, pulmonary venous desaturation with underestimation of actual Qp: Qs	
Low cardiac output	
SaO_2 < 70–75%	Minimize O_2 consumption: Sedation/paralysis, inotropic support, afterload reduction
SaO_2–$SmvO_2$ 35–40%	
Causes: Ventricular dysfunction, myocardial ischemia, depressed contractility, afterload mismatch (Residual arch obstruction), AV valve regurgitation	

PVR pulmonary vascular resistance, *MBTS* modified Blalock-Taussig shunt, *AV* atrioventricular

Yuki K et al, J Anesth 2011; 25: 247-56

Complications de la circulation de Fontan

- Dysfonction ventriculaire
- Arythmies
- Thromboembolies
- Shunts
- Entéropathie exsudative
- Anomalies du développement
- Bronchites plastiques

Déterminants du succès du Fontan

- RVS
- RVP
- Fonction AV
- Rythme
- Fonction ventriculaire

La moindre anomalie rejaillira sur le Qc

Monitoring : définir ce qui est obligatoire

- ECG
- Oxygène
- Ventilation

EtCO$_2$ sous estime

- Neuro : NIRS ?

Surcharge ? Hyper

- VVC ?

Localisation ?

- Artère invasive ?

Induction et maintien

Chute du Qc ?

Dépression myocardique

Ventilation mécanique

Vasodilatation systémique

Induction et maintien

- Éviter d'augmenter les RVP
- Maintenir
  - Les RVS
  - La contractilité myocardique
  - Le rythme cardiaque sinusal

Ventilation mécanique

- Éviter d'augmenter les pressions des VA

FR faible

Petits Vt (5-6 ml/kg)

Peu de PEEP

Temps inspiratoire court

Risques de la Ventilation mécanique

- Augmente les P Intrathoraciques
- Diminue le retour veineux
- Diminue le flux dans les AP
- Diminue le Qc

Anesthetic Management

Laparoscopic Surgery

Chirurgie laparoscopique

- Avantages :

Réduit la douleur post op et le temps d'hospitalisation

- Inconvénients

Hypercapnie

Embolie gazeuse

Instabilité hémodynamique

Emphysème médiastinal

Pneumothorax

Gestion pendant la Laparoscopie

- Limiter la Pintra abdo à 10 mmHg pour conserver le retour veineux et le Qc
- Limiter le temps de chirurgie (chirurgien expérimenté)
- Maintenir une ventilation eucapnique
- Maintenir une bonne volémie

D-tgv, CIA, CIV

2 mois ½,
2.5 kg

Arrivé la veille de Tunisie pour correction de sa cardiopathie

Vient des
USI
Sous VNI
Pas de VVP

On aimerait le renutrire avant la chir cardiaque

Cachéxie, tirage, fébrile, adénopathies (BG- et CG+), mycose buccale, inguinale et du siège, Insuff rénale

Sat O2 50-60 % AA

Broviac en axillaire

Stratégie anesthésique ?

AG ?

ALR ?

TOT ou VNI ou autre ?

Organisation, précautions à prendre ?

CONCLUSIONS

- Comprendre la pathologie de base
- Connaitre le stade de réparation et la physiologie actuelle du patient
- Rechercher tout facteur de risque additionnel IVRS, Ht, thrombose…
- Excellente coopération avec le chirurgien, le cardiopédiatre et l'intensiviste