Early SCPC: strategical trend or bail out procedure?

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1

No disclosures or declarations

2

Outline

- Predominantly talking about patients who have undergone an initial palliation and this is 'second stage'
  - Not talking about comprehensive 1+2
- Why don't we do SCPC as 'first stage' for all?
- Why might you consider early SCPC?
- Criteria for successful SCPC and assessment

3

Poll Question

For well patients who have had a shunt, eg. Norwood, when do you electively perform SCPC?

A <3 months
B 3-4 months
C 5 months
D 6 months
E >6 months

4

Why don't we do SCPC as first stage for all?

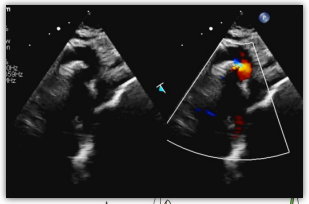
- SVC blood flow increases after birth
- Initially low, and therefore would not work
- Generally from 3 months onwards there is good SVC flow
- Size of blood vessels – easier anastomosis later, and can also reconstruct branch pulmonary arteries
- In interrupted IVC, this will be Kawashima
  - Lungs will need to take more flow
  - Less hepatic factor to lungs ?pulmonary AVMs

5

Why might you consider early SCPC?

6

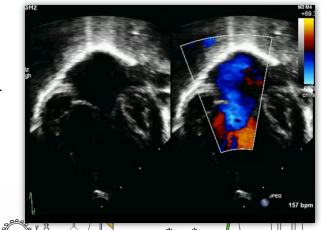
Need to increase pulmonary blood flow



7

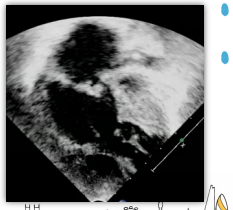
Reduce volume loading

- Atrioventricular valve regurgitation



8

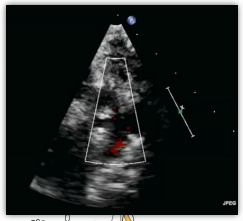
Reduce coronary steal



- Impaired ventricular function
- Ischaemia

9

Need for additional procedure



10

Emergency SCPC

- Can anything else be done in interim if the patient is young?
- Stent shunt/PAs/arch
- Medication to balance

11

Criteria for successful SCPC

- SVC(s) in proximity to branch pulmonary artery(s)
- No obstruction to passive pulmonary blood flow
  - Undistorted, non hypoplastic branch pulmonary arteries
  - Low pulmonary artery pressures and vascular resistance
  - Low atrial pressure
    - Systolic and diastolic dysfunction
    - Atrioventricular valve regurgitation
    - Arrhythmias

12

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Early vs late SCPC

- ✓ Reduced time at risk on shunted circulation
- ✓ Earlier volume offloading and reduction of coronary steal to help later ventricular function
- ✓ Somatic growth usually better after SCPC
- ✓ If there is narrowing from shunt etc, can be addressed surgically rather than stent (as stent will need continual upsizing)

- ✗ Arterial shunt is main time PAs will grow, risk of later underdevelopment of pulmonary arterial tree
- ✗ Technical difficulties with smaller SVC/PAs
- ✗ SCPC failure?

13

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Evelina Experience (Norwood)

- Traditionally echo and GA MRI assessment, SCPC (hemi-Fontan) at ~6 months of age
- From 2017 re-structuring of Norwood programme
  - Single operator
  - Digoxin interstage
  - NPC-QIC (unable to share data yet….GDPR)
  - Echo and CT interstage assessment (feed and wrap/sedation)
  - Glenn (beating heart)
  - At 3-4 months of age (unless bilateral SVCs)
- Home monitoring introduced 2014 so spans eras

14

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Learning Points from Surgeon

- Prefer ~5kg, as then SVC around 6-7mm, happy with CT/echo combination for imaging
- Bigger for bilateral SVC given usually smaller calibre
- Aim old as possible/safe if Kawashima
- Caution in PAPVD – the SVC below the anomalous veins may be a good size, but have recently had a case with bilateral SVC and the SVC above PAPVD could not be cannulated (and LSVC even smaller)

15

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Bellsham-Revell et al, EJCTS 2022

- Era 1 2005-2016 (early mortality 23.6%)
- Era 2 2017 to 2020 (early mortality 10.7%)
- Pre-SCPC imaging 99 days vs 77 days (p<0.005)
  - 9 patients dying in era 1 between imaging and SCPC, 1 in era 2
- SCPC 3.4 months vs 5.6 months

Table 1: Demographics

	Era 1 (n = 191)	Era 2 (n = 28)	P-Value
Male (%)	68.9	60.7	0.406
HLHS (%)	77.4	78.6	0.898
Antenatal diagnosis (%)	84.2	96.4	0.052
Age at NW (days)	4 (3–7)	3 (2–4)	0.180
Weight at NW (kg)	3.2 (2.9–3.4)	3.0 (2.8–3.5)	0.187
Early mortality[a] (%)	23.6	10.7	0.124
Interstage mortality[b] (%)	17.8	8.0	0.221

Results are given as median (interquartile range) or mean (standard deviation).
[a]Death in the post-operative period.
[b]Death after discharge from ICU.
HLHS: hypoplastic left heart; NW: Norwood.

Table 2: Survivors to superior cavopulmonary connection

	Era 1 (n = 120)	Era 2 (n = 23)	P-Value
Time NW-SCPC (days)	168 (112–202)	102 (95–119)	<0.001
Age at SCPC assessment (days)*	99 (81–120)	77 (47–102)	0.004
Age at SCPC (days)*	174.5 (117–208)	106 (102–122)	<0.001
Weight at SCPC (kg)*	6.2 ± 1.2	5.1 ± 0.8	0.002
Intubation (days)	1 (1–2)	1 (1–3)	0.227
ICU length of stay (days)*	2.5 (2–4)	3 (2–5)	0.024
Hospital length of stay (days)	8 (7–12)	11 (7–24)	0.089
Bypass time	73 (64–90)	47 (41–68)	<0.001
Cross-clamp time	35 (25–50)	0 (0–0)	<0.001
TCA time	20 (0–25)	0 (0–0)	<0.001
Discharge O_2 saturations	80% (77–84)	82% (80–85)	0.088
Catheter/interventions	11/4	4/2	0.264/0.240
Additional CT/MRI	4	2	0.240
Stroke	2	0	0.492
Early SCPC death	6	0	0.227
Late SCPC death	5	1	0.886

Results are given as median (interquartile range) or mean (standard deviation).
*P < 0.05.
CT: computer tomography; ICU: intensive care unit; MRI: magnetic resonance imaging; NW: Norwood; SCPC: superior cavopulmonary connection; TCA: total circulatory arrest time.

- ICU stay slightly longer (3 days vs 2.5 days)
- No difference in sats or complications

16

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Bellsham-Revell et al, EJCTS 2022

- Era 1 2005-2016
- Era 2 2017 to 2020
- Pre-SCPC imaging 99 days vs 77 days (p<0.005)

Now waiting for cohort to have Fontan and assess branch PA growth comparatively…

- ICU stay slightly longer (3 days vs 2.5 days)
- No difference in sats or complications

17

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Literature

- One of main issues is separating elective early SCPC from emergency procedure
- Mostly single institution experiences, mixed bag of diagnoses

18

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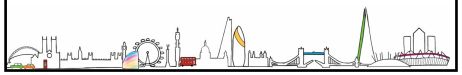
Unseld et al, Ped Cardiol 2017

- Looking at PLE and PB 2005-2013, all Fontan
- No differences in PLE/PB no PLE/PB in gender/ventricle/technique/fenestration/age at Fontan/need for diuretics
- More in HLHS, and in PLE/PB group age at Glenn 4/12 vs 8/12



19

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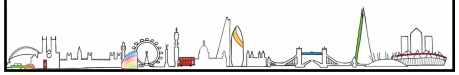
Viegas et al, Ann Thorac Surg 2020

- 2004-2018, primary Fontan, secondary mortality/Tx
- 114 patients
  - 79 days early group, 107 days non-early group
- Overall Fontan completion 76%
- No operative mortalities, no differences in late mortality



20

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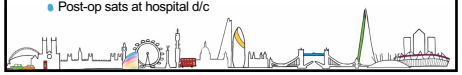
Petrucci et al, JTCVS 2010

- 1998-2007 169 patients <3/12 (20) vs >3/12
- Comparable anatomy
- ITU stay, ventilation time, hospital stay longer in <3/12
- Sats, early and late mortality and time to Fontan similar
- HLHS survival comparable
- Independent variables for death:
  - Pre-op mean PAP
  - AVVR
  - Post-op sats at hospital d/c



21

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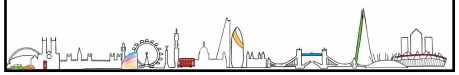
Dohain et al, J Cardiac Surg 2020

- 2002-2018 <4/12 (32) vs >4/12 (181)
- Pre-op PAP higher in <4/12, no differences in Qp:Qs, EDP, PVRi, pre-op sats
- Initial post-op sats lower in <4/12
- Duration of ventilation, pleural drainage, ICU stay, hospital stay were longer in <4/12 group
- Early mortality higher <4/12 but NS (p 0.283)
- No change late mortality



22

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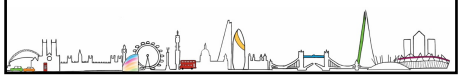
Summary

- Elective early SCPC can be successful in short and medium term
- Later outcomes after Fontan are still under deliberation and further work needs to be done
  - May be trading off less shorter term risk and ventricular risk against PA/Fontan circulation risk
- Emergency SCPC may be only choice, post-operative course may stormy



23