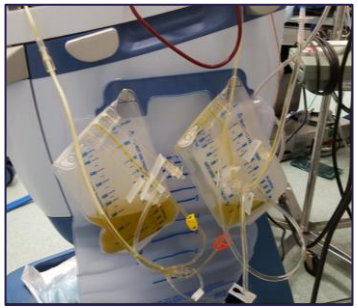
Cardiac Overview and Blood management

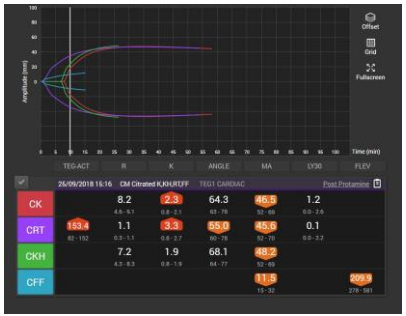
Nick Goddard, UHSFT
Consultant Cardiac Anaesthetist

RTC SC/SE Educational Meeting
February 2021

Cardiac Surgery at UHSFT:

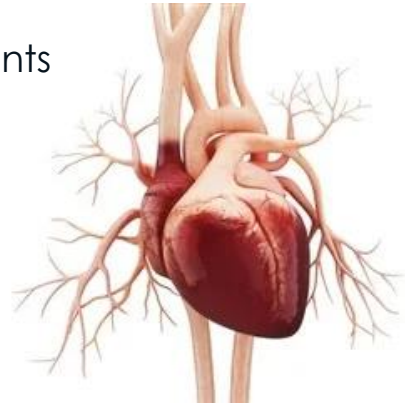
PBM in Cardiac Surgery:





Cardiac[Bypass] Surgery:

- **CABG**
  - IABP/Mechanical Support/ Antiplatelet agents
- **Valve surgery**
  - (L > R sided)
  - Redo Surgery
  - Infective Endocarditis
- Aortic Surgery
  - Aortic Root
  - Aortic Arch
  - Descending Aortic Surgery

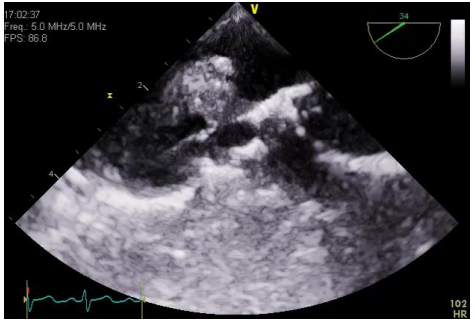


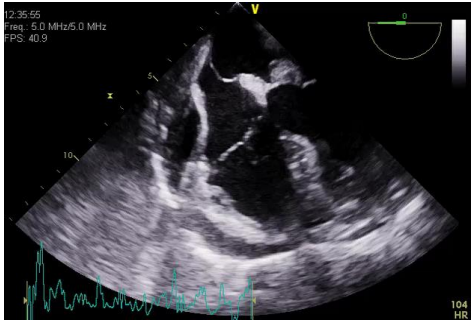
https://www.news-medical.net/?tag=/Cardiothoracic-Surgery

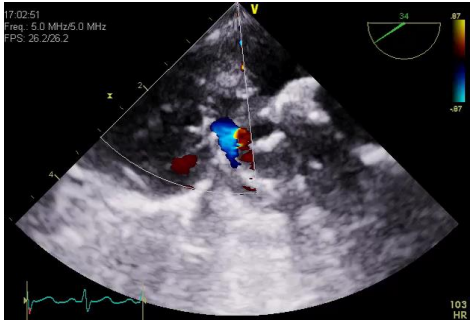
- Congenital
  - Redo Surgery
- Cath labs
  - TAVI/EP
  - hybrid Vascular cases
- Combined:
  - Renal Cell Ca/ IVC
  - LSCS
  - Head + Neck
  - Thoracic
- Trauma
- Paediatric/ ECMO

Non-cardiac CPB:

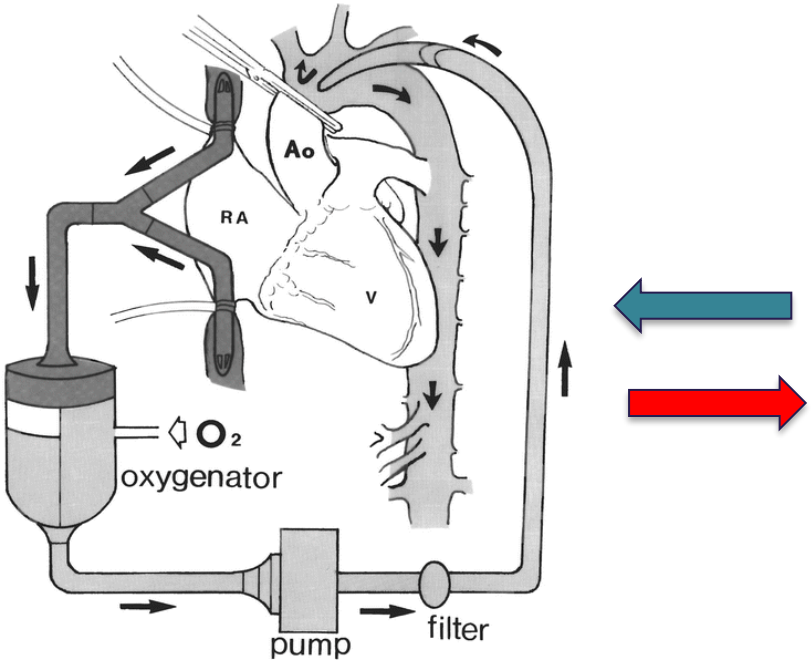
Pushkar et al, Am J Cancer Case Reports 2015

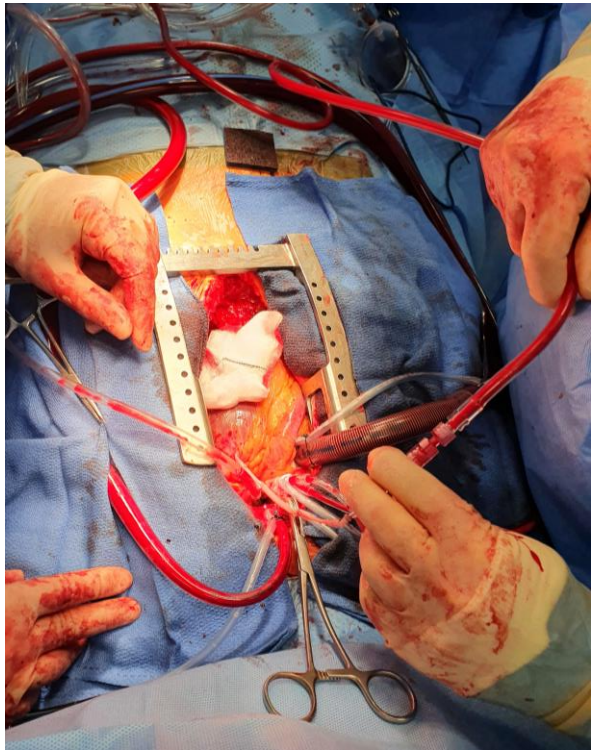






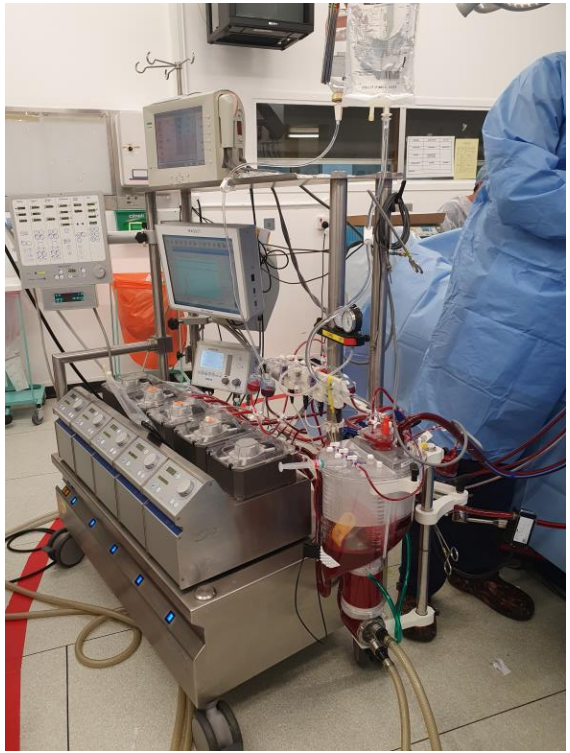
Cardiopulmonary Bypass:

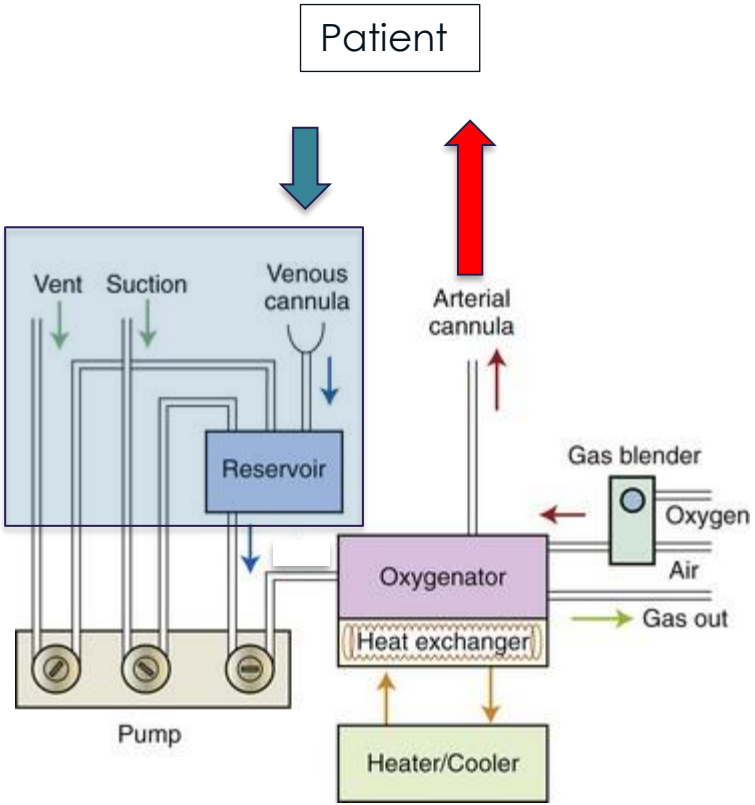




Loor G., Molina J.E. (2015) Cardiopulmonary Bypass and Cardioplegia. In: Iaizzo P. (eds) Handbook of Cardiac Anatomy, Physiology, and Devices. Springer, Cham. https://doi.org/10.1007/978-3-319-19464-6_33

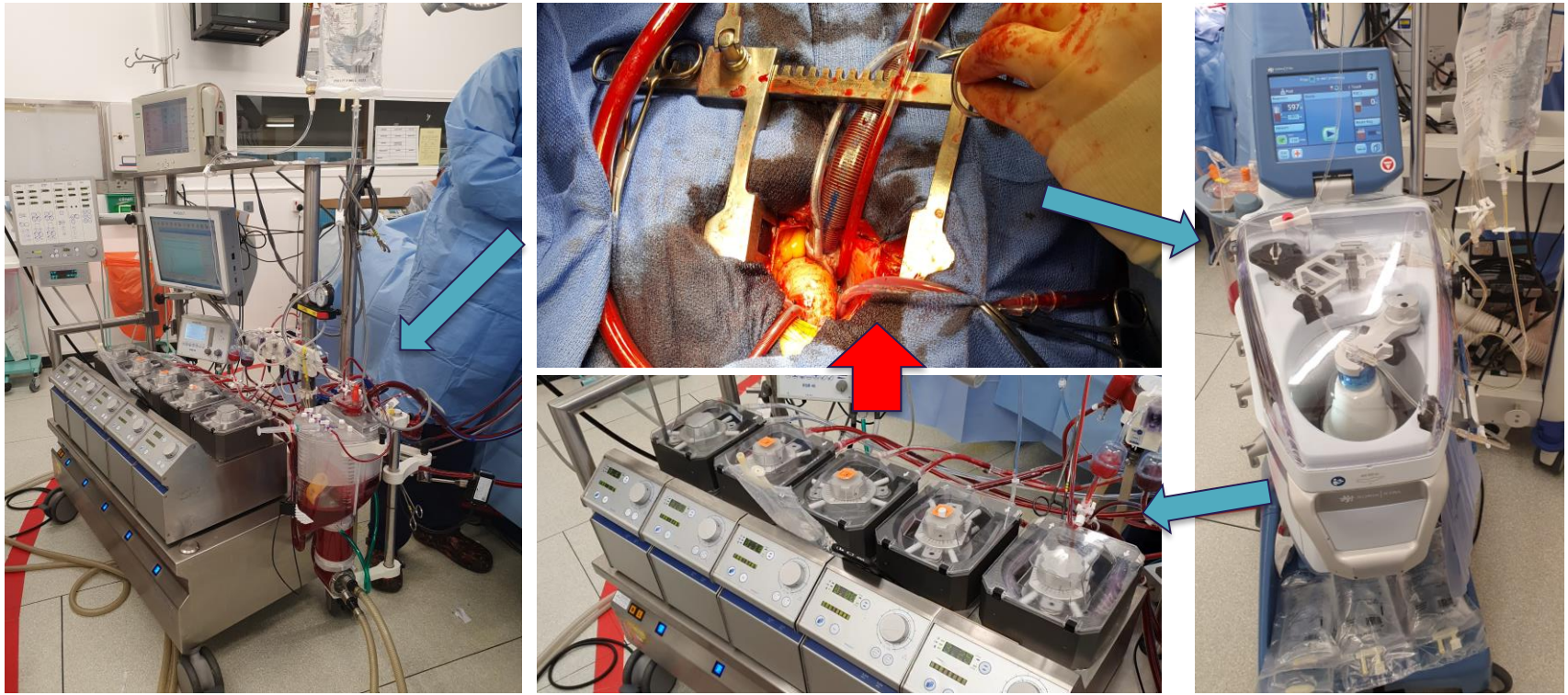
Cardiac Bypass:





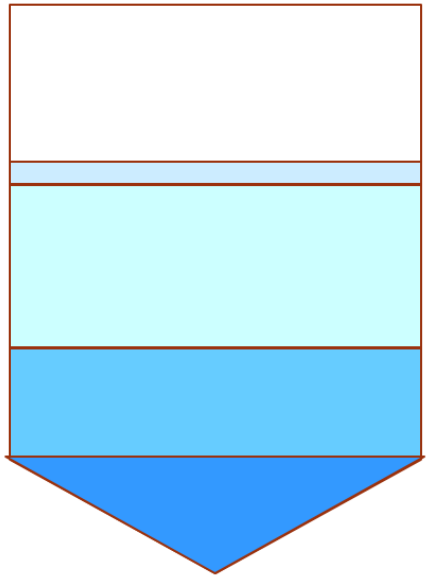
(From Orton EC, Peterson D: Inflow occlusion and cardiopulmonary bypass. In Slatter DH, editor: Textbook of small animal surgery, ed 3, Philadelphia, 2003, Saunders/Elsevier.)

‘Controlled’ Bleeding + replacement:



Initiation of CPB:

Standard Adult Prime



= ~ 1400ml clear prime to safely prime a standard adult (>50kg) CPB circuit

5,000iu Heparin

250-500ml Hartmann's Solution (containing lactate to act as a **buffering** agent. This is metabolised within the hepatic circulation, over time, to generate bicarbonate)

½ g/kg 10% Mannitol (max 50g) i.e 100kg patient = 500ml 10% Mannitol (50g)

500ml Gelofusine

Initiation of CPB:

Calculating Dilutions

- ***Calculating Hb on bypass:***

Weight (kg) x 70ml

= BV x Hb on post intubation gas

= RBCV / BV + prime volume (ml)

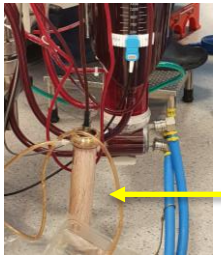
= **approx. Hb on bypass**

75kg x 70ml = 5,250ml (BV) x 12.3

= 64,575 / 5,250 + 1,400ml

= ~ 9.7 Hb

Iatrogenic dilution (CPB):

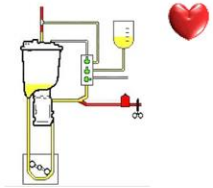


Improving HCT on CPB

Haemofiltration peri-operatively

Addition of cell saver volume

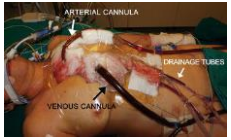
Retrograde Autologous Priming (RAP) Pre-operatively



Bank blood peri-operatively

Modified Ultra Filtration (MUF) post-operatively

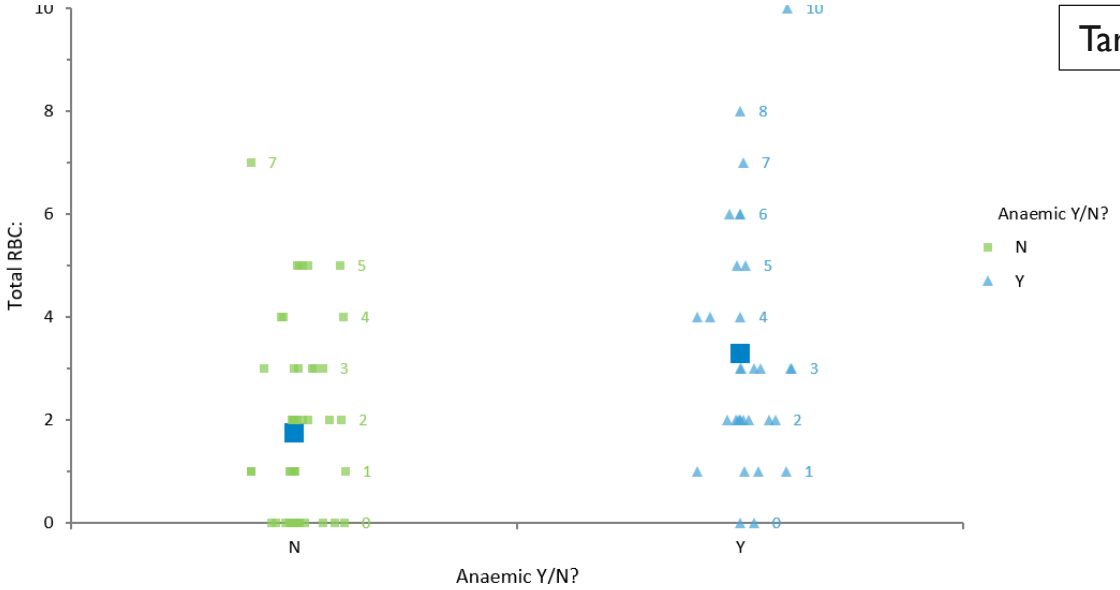
Mini extracorporeal circuits (MECC) / mini bypass



Small adult circuit

University Hospital Southampton NHS

RBC Transfusion (Electives):



Target Hb 80 – 100g/L

Non Anaemic	Mean 1.7 (1.8) units
Anaemic	Mean 3.3 (2.3) units

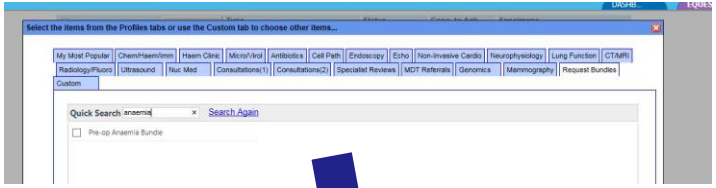
UHS Local Audit 2016

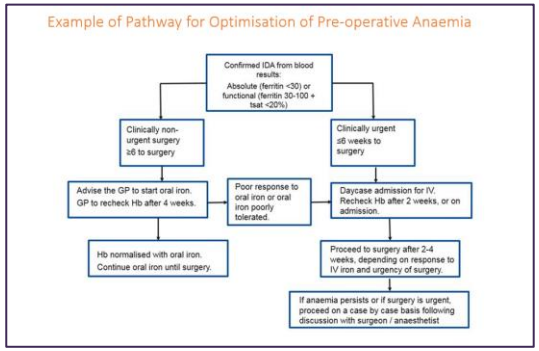
Pre-op preparation:

- 87 yr, CABG x 2 + AVR:
  - CLL, HTN, smoker, BMI 26
  - Clinic Dec 29th 2015: **Hb 90**
    - Film poikilocytosis, anisocytosis, smear cells, lymphocytosis
    - MCV 77.8, Ferritin 9, TSAT 4%
    - Oral iron tablets
  - Surgery March 2016: **Hb140**
    - 11 day admission, Hb 106 discharge

Pre-op preparation:

Screening





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ORIGINAL ARTICLE

A prospective observational cohort study to identify the causes of anaemia and association with outcome in cardiac surgical patients

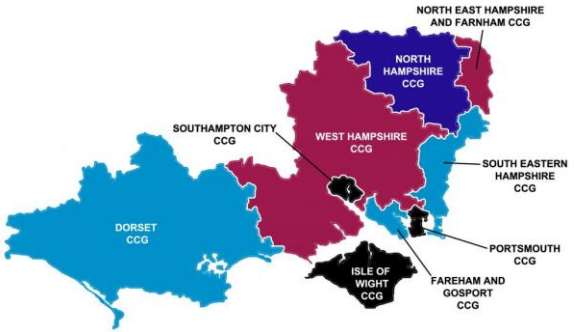
Matthew Hung,[1] Erik Ortmann,[1] Martin Besser,[2] Pedro Martin-Cabrera,[2] Toby Richards,[3] Marcus Ghosh,[1] Fiona Bottrill,[4] Timothy Collier,[5] Andrew A Klein[1]

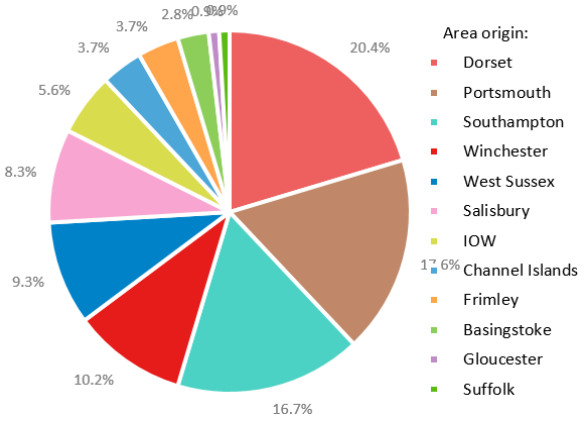
- 12 (7.2%) Absolute iron deficiency
- 78 (47%) Functional iron deficiency

OPD Clinic

Screening

Telephone F/up





ORIGINAL ARTICLE

A prospective observational cohort study to identify the causes of anaemia and association with outcome in cardiac surgical patients

Mat
Tob

- 12 (7.2%) Absolute iron deficiency

NICE National Institute for Health and Care Excellence

Blood transfusion

Quality standard [QS138] Published date: December 2016

NHS

Commissioning for Quality and Innovation (CQUIN)

CCG indicator specifications for 2020-2021

Publishing approval reference number **001361**

NHS England and NHS Improvement – Working together for the NHS

February 2020

NHS

CCG10: Screening and treatment of iron deficiency anaemia in patients listed for major elective blood loss surgery

NHS

Scope
Services: Acute (relevant surgical wards)
Period: Q1 Q2 Q3 Q4

Payment basis
Minimum: 45%
Maximum: 60%
Calculation: Whole period %

Accessing support
NHSE&I policy lead
Matthew Barker
m.barker1@nhs.net

Supporting documents
NICE Guideline NG24

The pre-operative anaemia management CQUIN code table will be available on the 'associated projects' section of the GIRFT website.

2016 Audit of Patient Blood Management in adults undergoing elective, scheduled surgery

Data reporting & performance
Quarterly submission via National CQUIN collection – see section 4 for details about auditing as well as data collection and reporting. Data will be made available approximately 6 weeks after each quarter.

Performance basis: Whole period. The need to allow for screening to take place 6 weeks prior to the procedure requires the denominator to be restricted to only include procedures taking place more than 6 weeks after the start of the 20/21 year. This restriction supports 'whole period', rather than 'quarterly' performance assessment. See section 3 for details about the basis for performance and payment.

Description
Ensuring that 60% of major elective blood loss surgery patients are treated in line with NICE Guideline NG24.

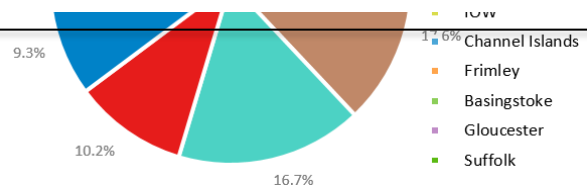
Numerator
Of the denominator, all admissions where the following actions were applied within the 6 week period prior to the procedure:

- Haemoglobin (Hb) measured; and,
- If anaemia present, have serum ferritin level tested; and,
- If diagnosed with iron-deficiency anaemia offered appropriate iron treatment (oral and/or IV iron).

Denominator
Total elective inpatient admissions, within the period 13 May 2020 – 31 March 2021, with a primary procedure in the following groups: Coronary Artery Bypass Graft , Cardiac Valve Procedures, Colorectal Resection, Cystectomy, Hysterectomy, Primary Hip Replacement, Hip Replacement Revision, Primary Knee Replacement, Knee Replacement Revision, Nephrectomy, Carotid Artery (open procedure), Other Aortic/Iliac Occlusive Disease (open procedure).

OPCS procedure codes are provided in the pre-operative anaemia management CQUIN code table.

www.nhs.uk 29



Anaesthesia 2020 doi:10.1111/anae.15271

Original Article

Anaemia in cardiac surgery – a retrospective review of a centre's experience with a pre-operative intravenous iron clinic

C. Quarterman,[1] **M. Shaw,**[2] **S. Hughes,**[3] **V. Wallace**[4] and **S. Agarwal**[5]

1 Consultant, Department of Anaesthesia, 2 Senior Research Analyst, 3 Specialist Nurse, 4 Transfusion Practitioner, Liverpool Heart and Chest Hospital, Liverpool, UK
5 Consultant, Department of Anaesthesia, Manchester University NHS Foundation Trust, Manchester, UK

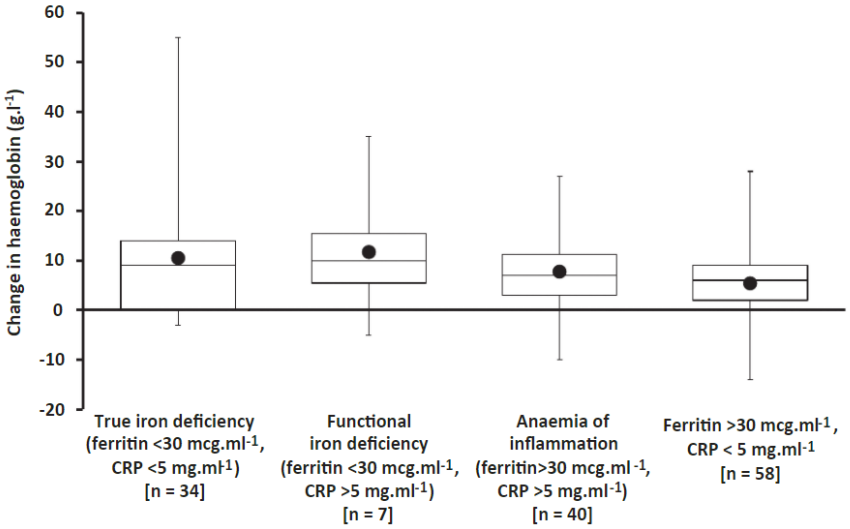


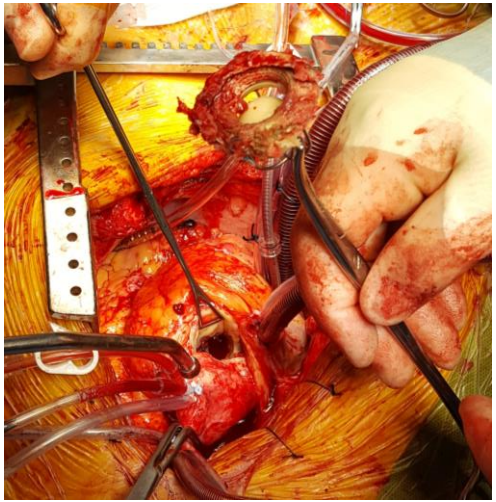
Table 2 In-hospital outcomes of patients included in the study. Values are number (proportion) or median (IQR [range]).

	Hb < 130 g.l^{-1} and received i.v. iron n = 190	Pre-op Hb < 130 g.l^{-1} and did not receive i.v. iron/not iron-deficient n = 581	Pre-op Hb ≥ 130 g.l^{-1} n = 2093	p value*	p value**
RBC transfused	114 (60.0%)	368 (63.3%)	548 (26.2%)	0.41	< 0.001
Number of RBC units (all patients)	1 (0–2 [0–17])	1 (0–3 [0–13])	0 (0–1 [0–31])	0.29	< 0.001
Number of RBC units (transfused patients only)	2 (1–3 [1–17])	2 (1–4 [1–13])	2 (1–3 [1–31])	0.50	0.24
In-hospital mortality	3 (1.6%)	14 (2.4%)	17 (0.8%)	0.78	0.23
Sternal wound infection (all)	7 (3.7%)	16 (2.8%)	42 (2.0%)	0.51	0.12
Deep sternal wound infection	0	3 (0.5%)	5 (0.2%)	> 0.99	> 0.99
Superficial sternal wound infection	6 (3.2%)	11 (1.9%)	33 (1.6%)	0.39	0.13
Other sternal wound infection	1 (0.5%)	2 (0.3%)	4 (0.2%)	0.57	0.35
CVA	7 (3.7%)	11 (1.9%)	24 (1.2%)	0.17	0.01
New RRT	7 (6.7%)	9 (1.6%)	13 (0.6%)	0.08	< 0.001
Re-operation (all)	9 (4.7%)	24 (4.1%)	73 (3.5%)	0.72	0.36
Re-operation for bleeding/ tamponade	6 (3.2%)	15 (2.6%)	56 (2.7%)	0.67	0.70
Re-operation for bleeding/ tamponade and ≥ 4 units blood transfused during admission	5 (2.6%)	12 (2.1%)	28 (1.8%)	0.69	0.19

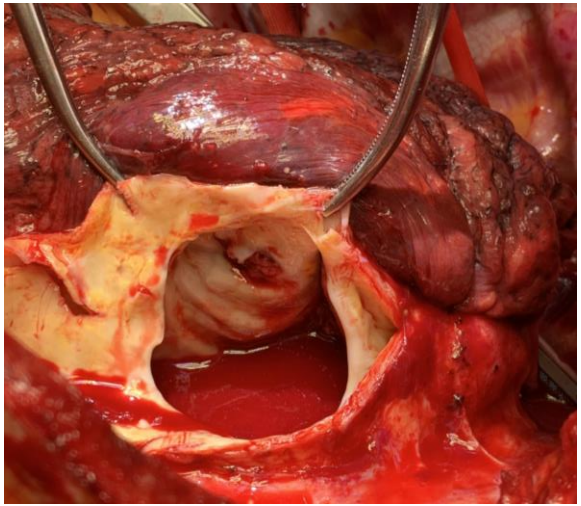
Bleeding:

- Controlled Haemorrhage
  - RBC replacement
- Uncontrolled/ Major Haemorrhage
  - Secondary coagulopathy
  - Logistics
- Intrinsic coagulopathy
  - Bypass duration (complex cases)
  - Redo surgery
  - Endocarditis/ dissection
  - DHCA
  - Drugs

Higher Bleeding Risk:



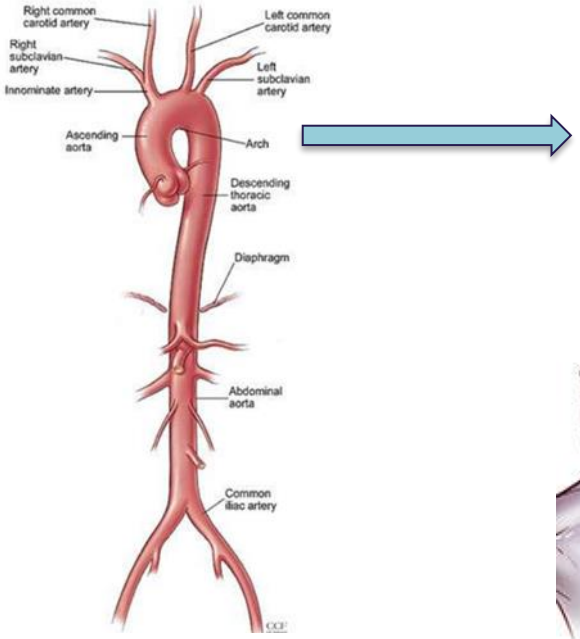
Valve Extraction

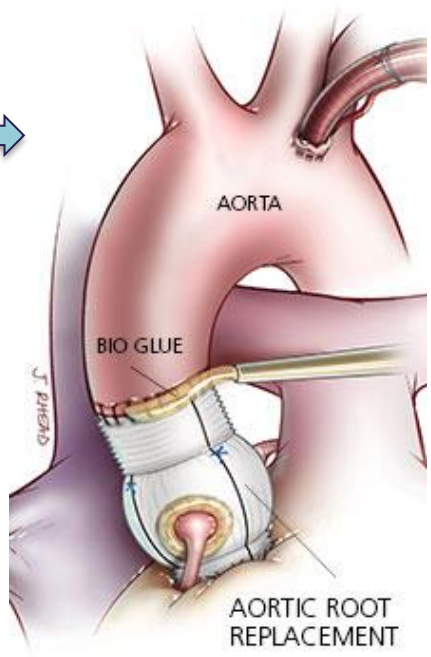


Aorto-bronchial fistula

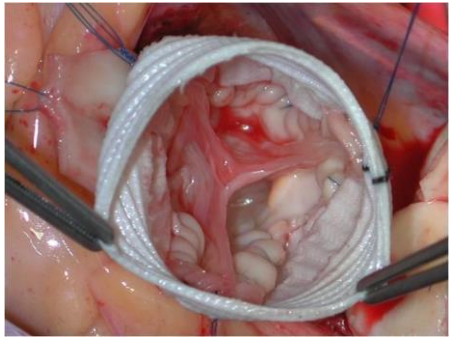
TEVAR Extraction

Aortic Surgery (Ascending):

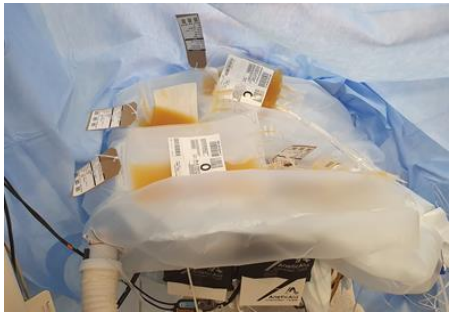




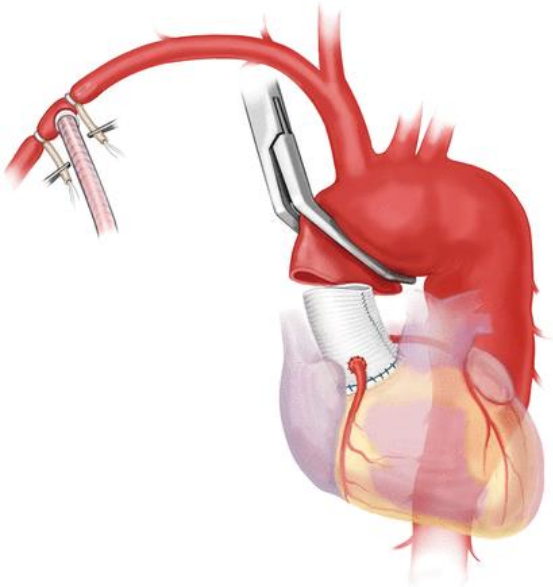
https://intermountainhealthcare.org/services/heart-care/treatment-and-detection-methods/valve-sparing-aortic-root-replacement/

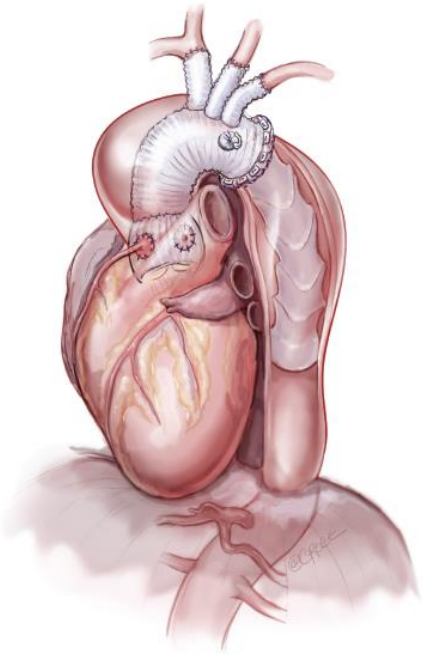


https://www.aorta.ca/treatment/valve-sparing-root-replacement/

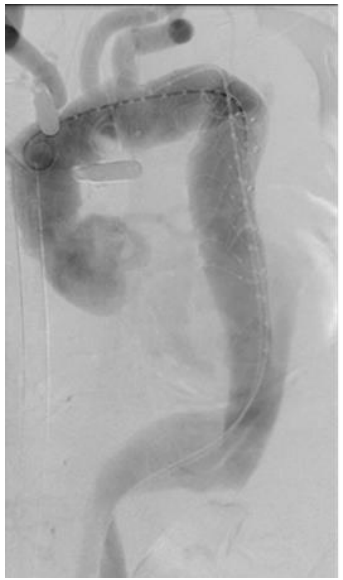


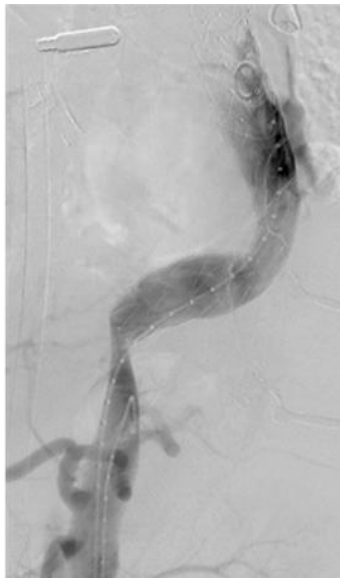
Aortic Surgery (Arch):





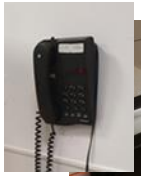
https://mmcts.org/tutorial/8



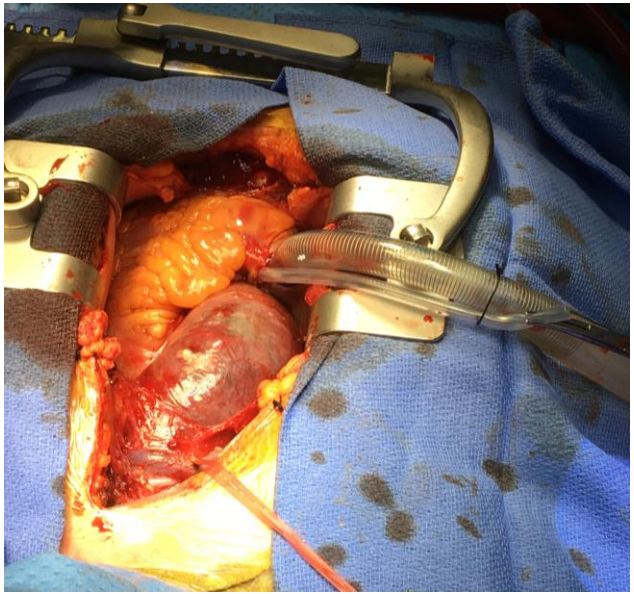


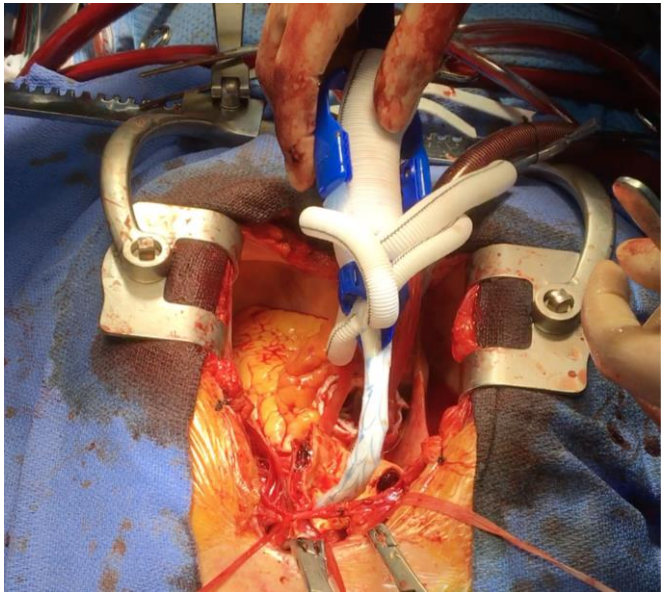
https://www.tristanyan.com/total-arch-replacement-and-frozen-elephant-trunk/

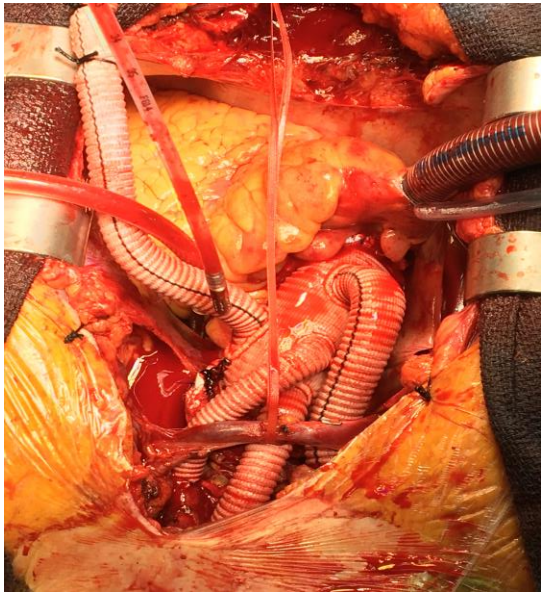
Deep hypothermic arrest:



Aortic Surgery (Arch):

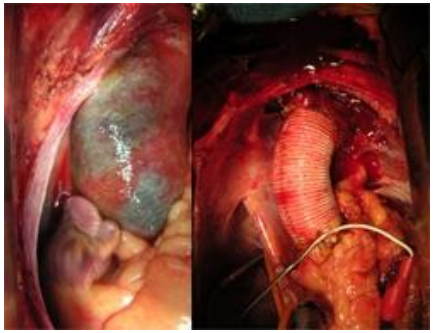


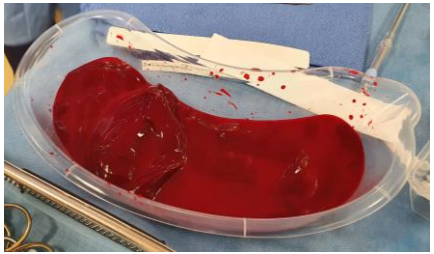




Aortic Dissection:

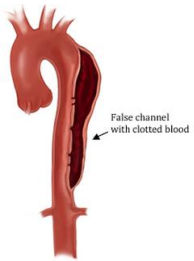
Type A Aortic Dissection

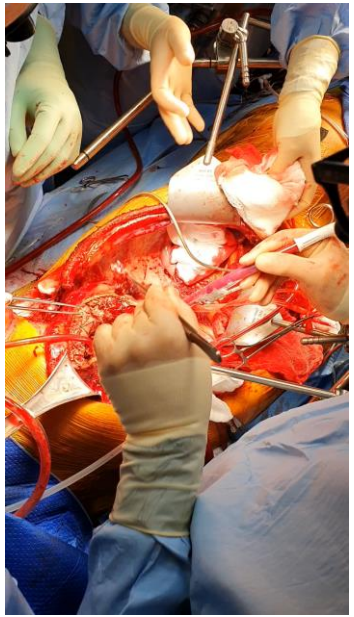




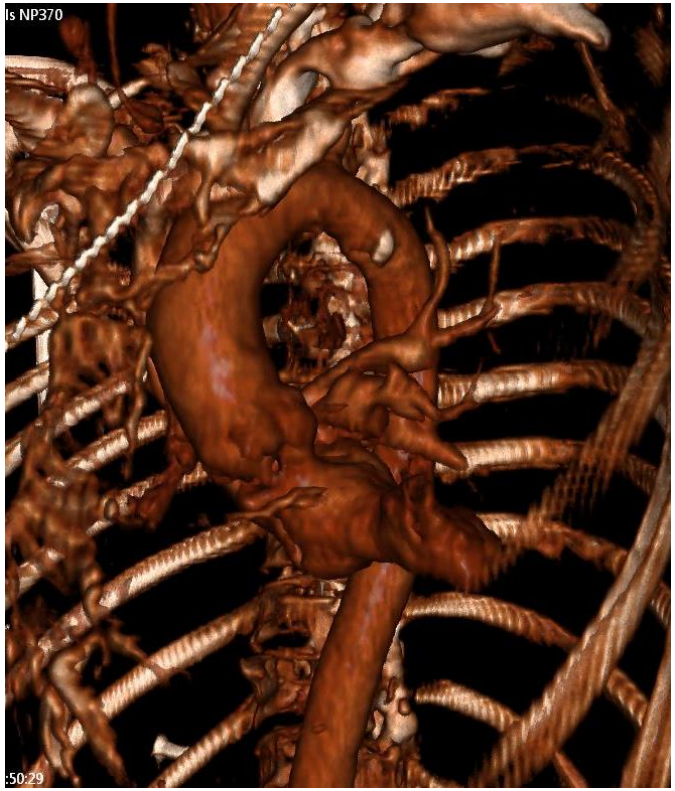
https://columbiasurgery.org/conditions-and-treatments/aortic-dissection

Type B Aortic Dissection

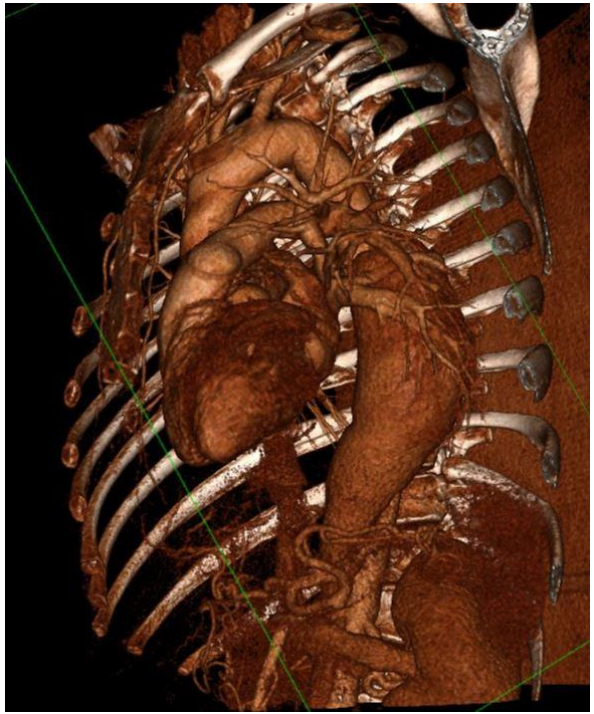


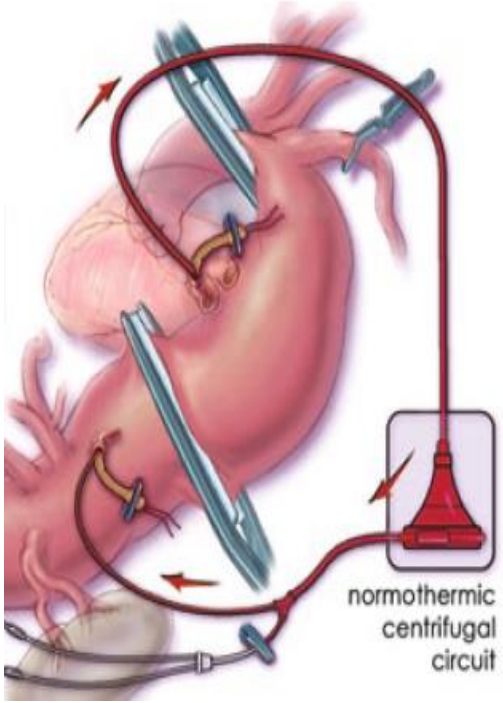


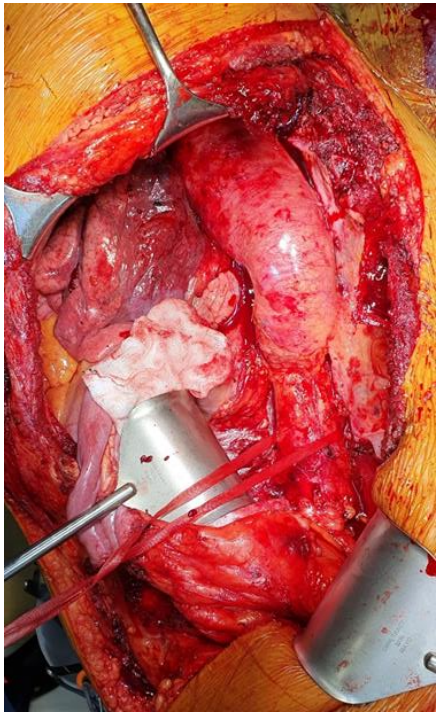
Descending Aorta (Trauma):



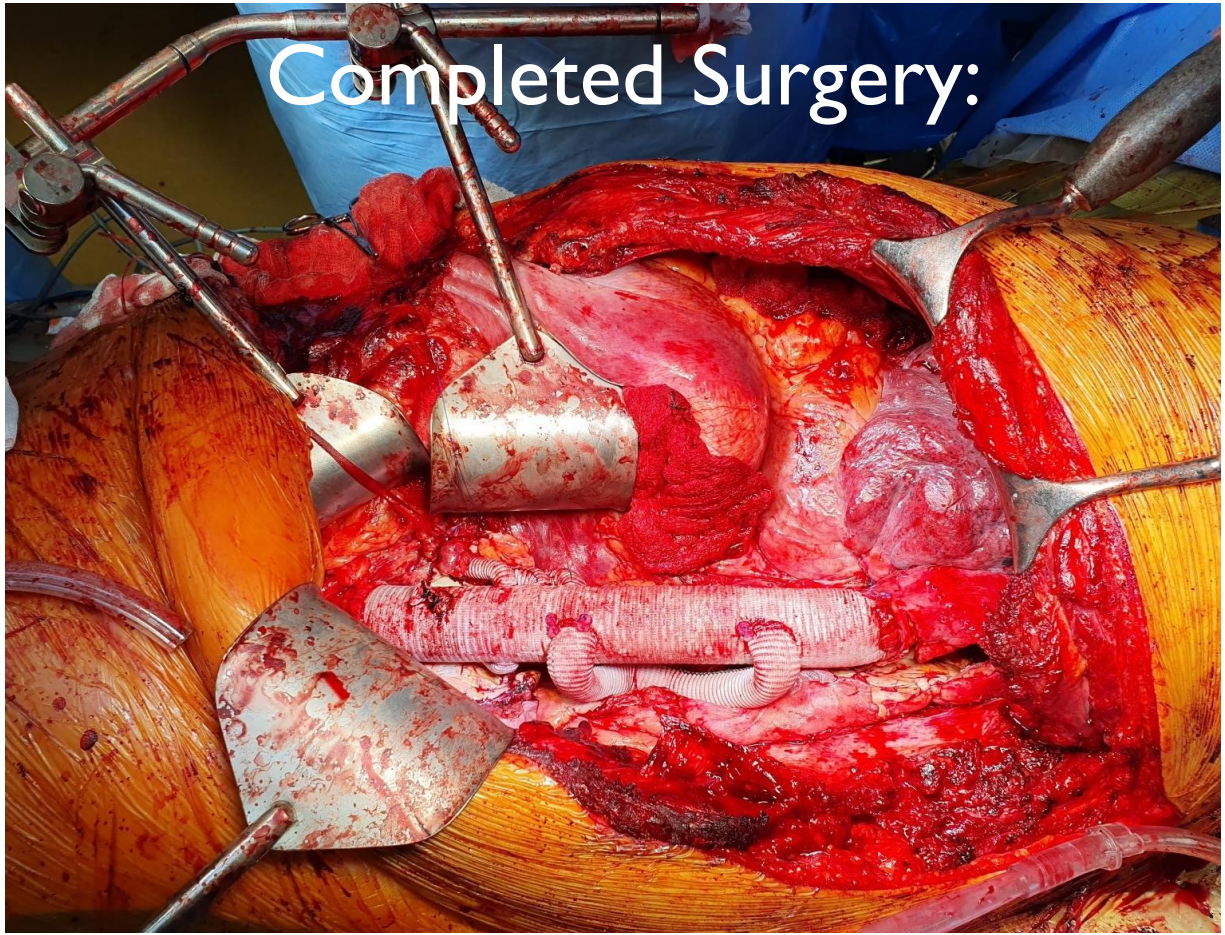
Descending Aortic Surgery:



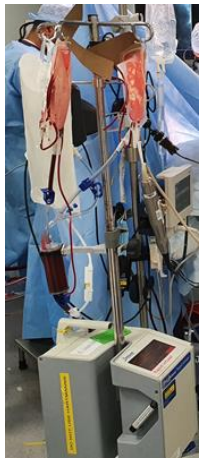


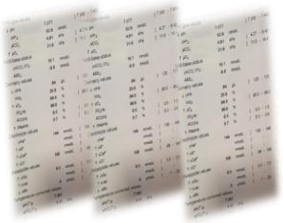


Completed Surgery:

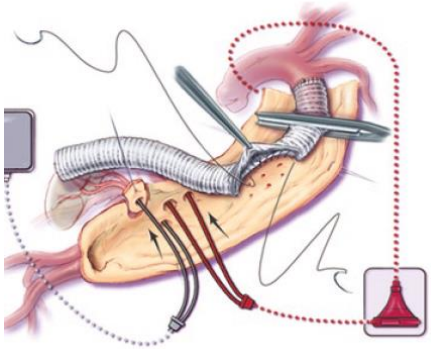


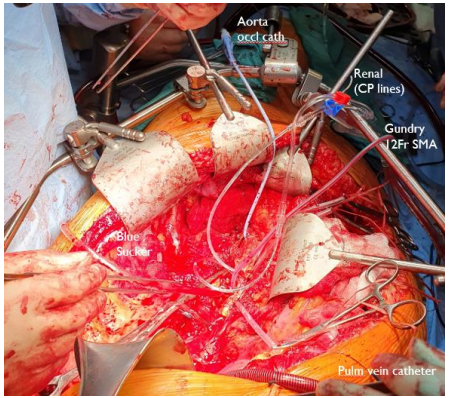
Anaesthesia setup:



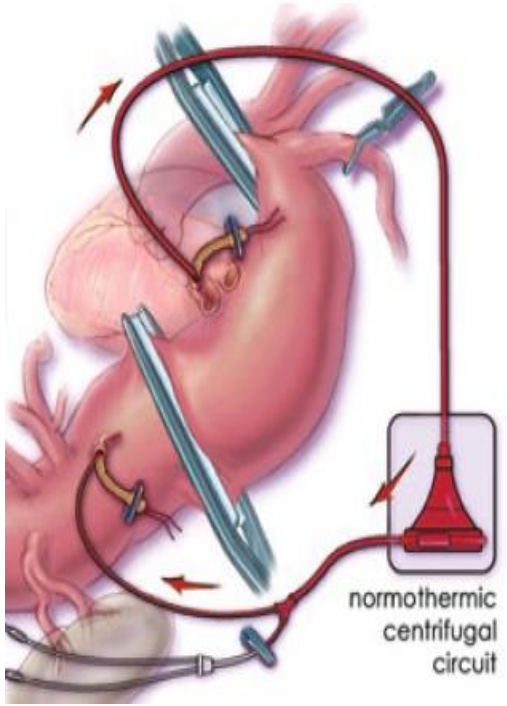


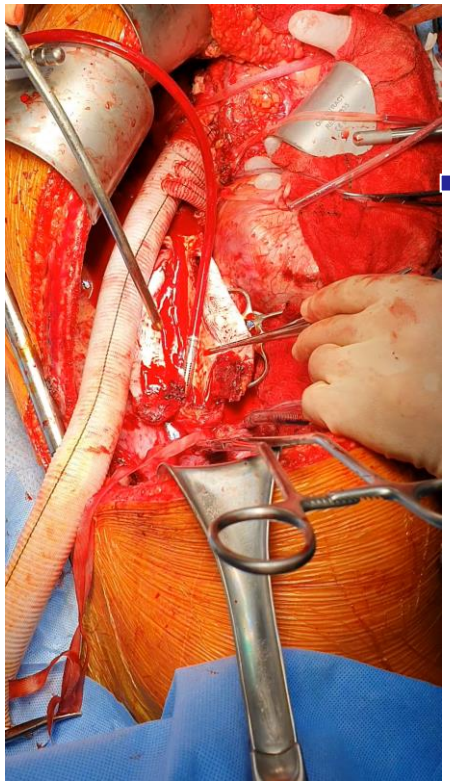
Organ perfusion:





Left heart bypass:





UHS 2019 - LHB:

8 x cases UHS

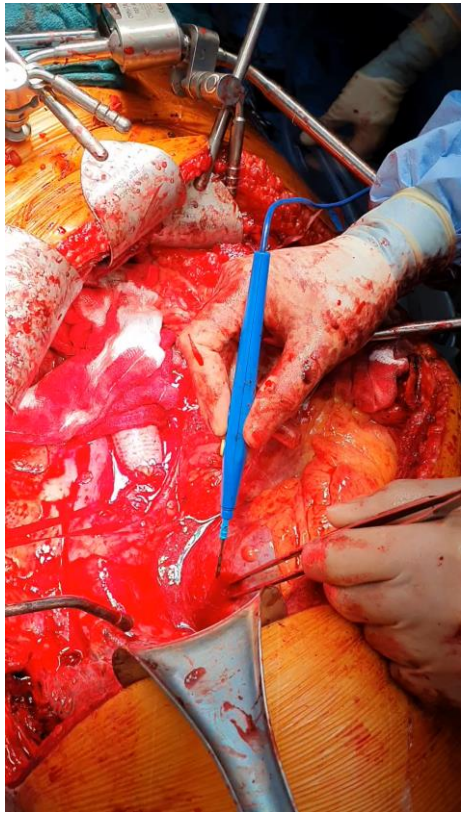
(May 2019 – Jan 2020)

- X 7 LHB
- x 1 DHCA

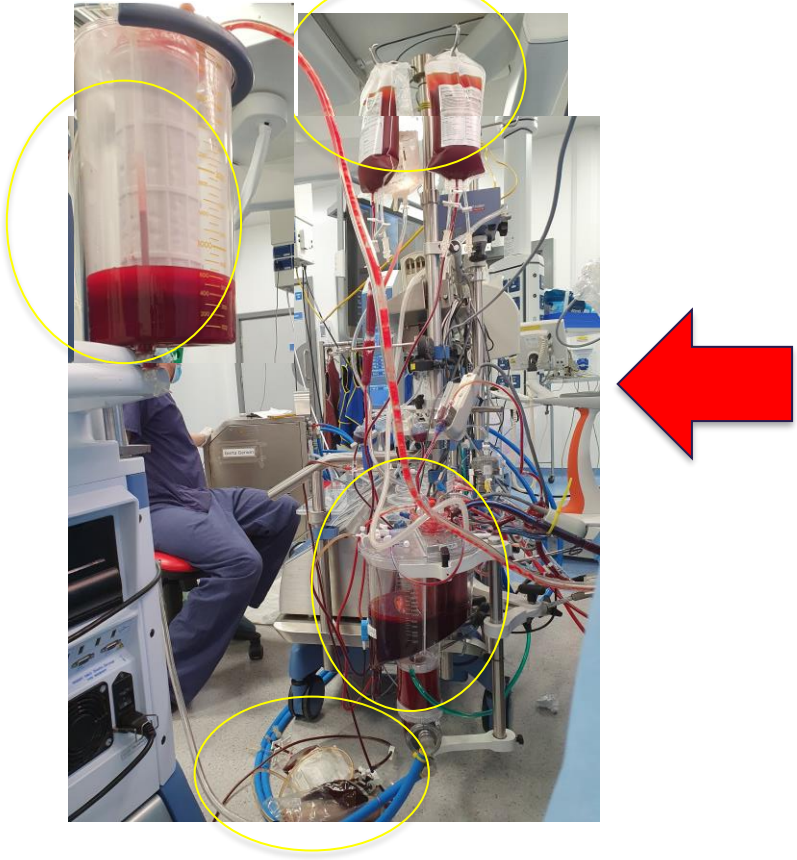
- Death x 1
- Paraplegia x 1
- AKI x 3

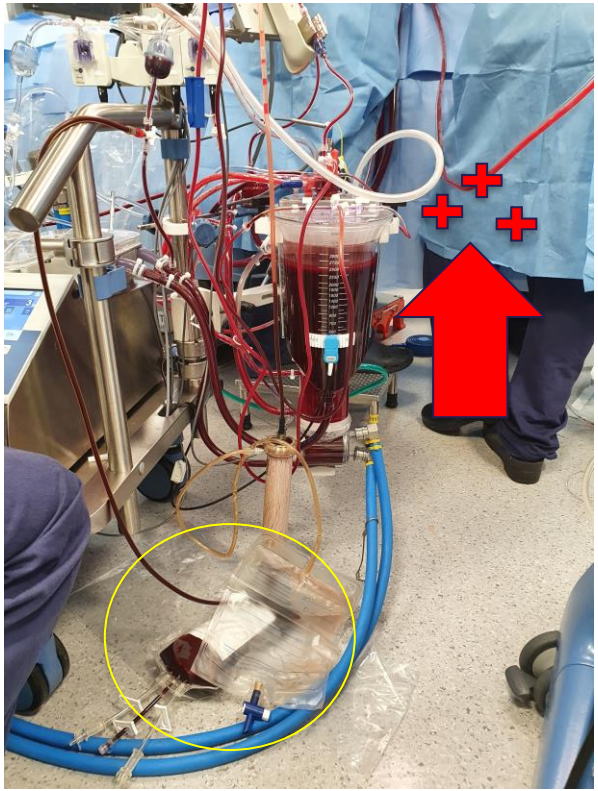
‘Uncontrolled/Major’ Haemorrhage:

- Definition (Major -> Massive):
  - > 10 RBC
  - > x 1 blood volume 24 hrs
  - > 150mL/min
  - > CVS compromise (30-40%)
- RV rupture/ LV rupture/ vessel injury
- ECMO



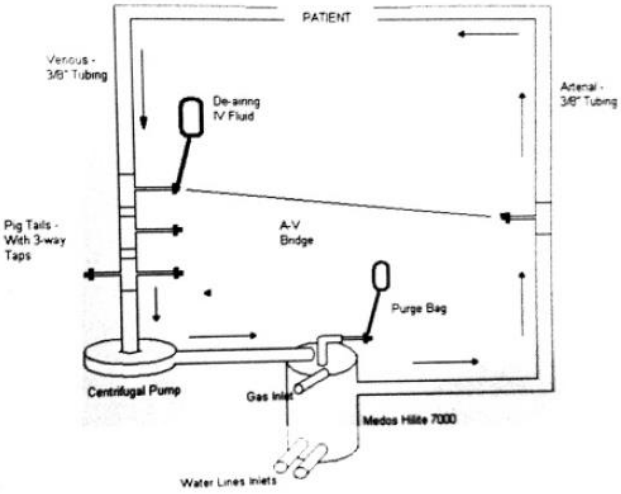
‘Uncontrolled’ Bleeding:

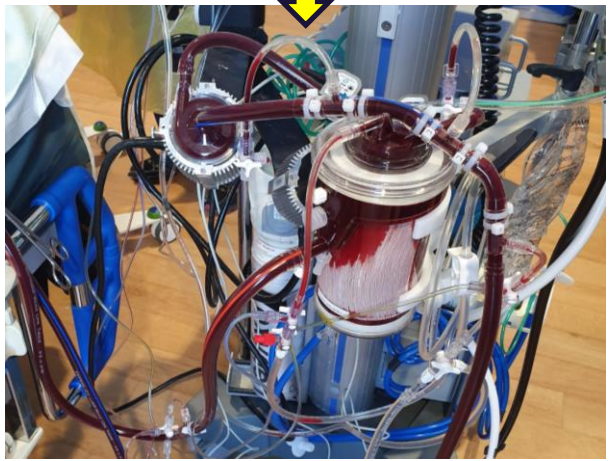




Veno Arterial (VA) ECMO:

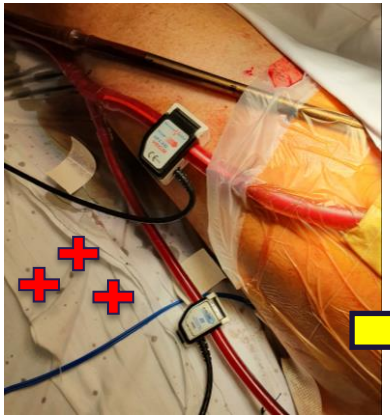
Figure 57.2 Levitronix Centrimag VAD.

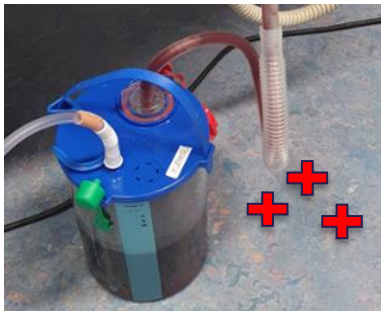


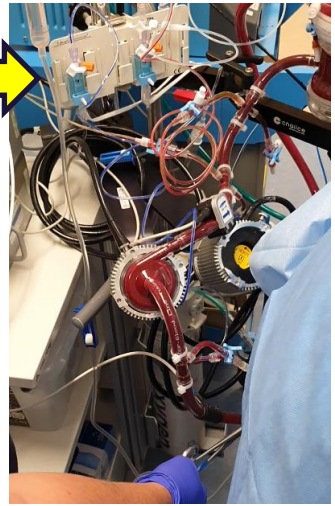


Acknowledgement: Papworth ECMO Training Course - 2019

‘Uncontrolled’ ECMO:







- Unfunded service
  (VA ECMO)
- High demand on lab support/ blood products
- X 2 successful cases [March 2020 – 2021]

Case Example - Myocarditis:

- 49 yr female AMU Nurse
- Covid +ve April 2020
  - Follow up Cardiology
  - 'Long' covid/ adrenal failure
- Profound hypotension Oct 2020
  - AKI, arrythmia
  - IABP, Inotropes
  - Maximal therapy
- Emergency ECMO
  - Black hands/ feet
  - Fem – Fem (peripheral pipes)
  - Bleeding + Antibodies (London)
  - T/fer Brompton
- Decannulation > 10 days
  - T/fer UHS (High care, Normal MRI)
  - RSH -> home
  - Phased return to work from March 2021

Questions: