



Anaesthesia for interventional cardiology procedures

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Interventional cardiology procedures
are growing...

... in ***number***

... in ***complexity***

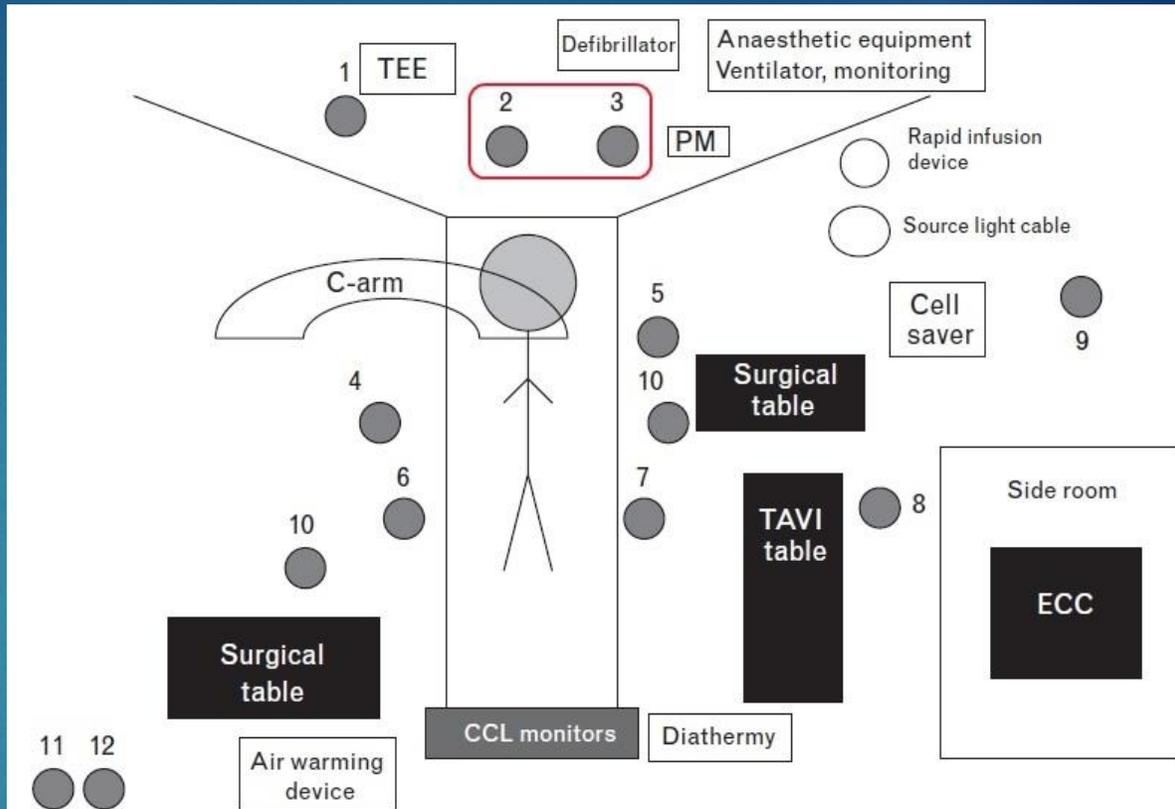
... in ***demand***

Procedures done in cardiac catheterization laboratory (CCL)

- ▶ coronary angiography or coronary catheterization
- ▶ coronary angioplasty or percutaneous coronary intervention (PCI)
- ▶ congenital heart defect closure
- ▶ stenotic heart valve treatment
- ▶ permanent and temporary pacemaker/AICD/CRTD implantations
- ▶ myocardial and endomyocardial biopsy
- ▶ rotablation of heavily calcified vessels
- ▶ left and right sided pressure studies
- ▶ electrophysiological studies
- ▶ radiofrequency catheter ablation
- ▶ endovascular neuromodulation treatment for heart failure patients (ENDO-HF)
- ▶ **HYBRID** procedures

CCL...

...a **schematic** view of a cardiac catheterization lab (HYBRID THEATRE)



Personnel

- | | |
|--------------------------------------|--------------------------|
| 1. Echo cardiologist | 7. Cardiologist |
| 2. Anaesthesiologist | 8. TAVI technician |
| 3. Anaesthesia technician | 9. Perfusion technician |
| 4. Cardiothoracic surgical assistant | 10. Surgical scrub nurse |
| 5. Cardiothoracic surgeon | 11. Surgical nurse |
| 6. Cardiology assistant | 12. CCL nurse |

Surroundings and equipment

- ▶ gas outlets
- ▶ scavenging system
- ▶ vacuum (suction)
- ▶ vital signs monitor
- ▶ **etCO₂ monitor** (deep sedation! – ASA 2011)
- ▶ airway equipment
- ▶ cardioverter/defibrillator
- ▶ emergency medications
- ▶ ventilator/anaesthesia workstation
- ▶ dedicated anaesthesia cart
 - ▶ extra iv. lines
 - ▶ medications
 - ▶ difficult airway management equipment

Anaesthesia for cardiac catheterization procedures

- ▶ SEDATION (opioids, benzodiazepines...)
- ▶ LOCAL ANAESTHESIA (lidocaine, bupivacaine...)
- ▶ REGIONAL ANAESTHESIA (local anaesthetic ± opioid)
- ▶ GENERAL ANAESTHESIA
 - ▶ balanced – volatile anaesthetic and intravenous drugs
(*sevoflurane + opioids ± neuromuscular relaxant*)
 - ▶ TIVA – total intravenous anaesthesia
(*propofol + opioids ± neuromuscular relaxant*)

Anaesthesia for cardiac catheterization procedures

- ▶ NO IDEAL TECHNIQUE
- ▶ NO ESTABLISHED GUIDELINES
- ▶ MANAGEMENT DEPENDS ON
 - ▶ patient related factors
 - ▶ procedure related factors
 - ▶ anaesthesiologist's working experience in CCL

Patients presentation

- ▶ wide age gap (neonates to $\geq 80 - 90$ years old)
- ▶ unacceptably *high risk/benefit ratio* for 'classic' surgery

Patient related factors

- ▶ morbid obesity
- ▶ obstructive sleep apnea
- ▶ inability to lie flat
- ▶ suspected difficult airway
- ▶ COPD
- ▶ low oxygen saturation
- ▶ CHF
- ▶ haemodynamic instability
- ▶ anxiety/psychiatric disorders
- ▶ medication that could complicate administration of sedation
- ▶ children
- ▶ out-of-hospital cardiac arrest (neuroprotective systemic hypothermia)
- ▶ patient preference

Procedure related factors

- ▶ duration
- ▶ left main coronary artery stenting
- ▶ percutaneous valve procedure
- ▶ complex arrhythmia ablation
- ▶ complicated lead extraction
- ▶ biventricular pacemaker procedures
- ▶ congenital heart defect closure
- ▶ use of TOE

Case study

- ▶ 208 patients
- ▶ planned sedation in 90%
- ▶ some form of airway device in 40%
- ▶ conversion to general anaesthesia in 10%

Trentman TL, Fassett SL, Mueller JT et al. Airway interventions in the cardiac electrophysiology laboratory: A retrospective review.

J Cardiothorac Vasc Anesth. 2009;23:841-845 .

Prospective randomized trial

- ▶ general anaesthesia (GA) with endotracheal intubation vs sedation
- ▶ higher procedural success rate in GA group – 88% vs 69%
- ▶ better control of movement and respiration in the GA group?

Di Biase L, Conti S, Mohanty P et al. General anesthesia reduces the prevalence of pulmonary vein reconnection during repeat ablation when compared with conscious sedation: Results from a randomized study.

Heart Rhythm. 2011;8:368-372.

Anaesthesia for procedures in CCL

Procedure	Local anaesthesia ¹	Sedation	General anaesthesia
coronary angiography or coronary catheterization	+	±	
coronary angioplasty or percutaneous coronary intervention (PCI)	+	±	± ²
congenital heart defect closure	+	(±)	+
stenotic heart valve treatment	+	(±)	+
permanent and temporary pacemaker/AICD/CRTD implantations	+	±	±
myocardial and endomyocardial biopsy	+	±	
rotablation of heavily calcified vessels	+	±	±
left and right sided pressure studies	+	±	(±)
electrophysiological studies	+	±	±
radiofrequency catheter ablation	+	±	±
endovascular neuromodulation treatment for heart failure patients (ENDO-HF)	+	±	(±)
HYBRID procedures	±		+

¹at the site of puncture

²cardiac arrest

Regional anaesthesia for procedures in CCL

- ▶ feasible for lower extremity revascularization procedures
- ▶ neuraxial anaesthesia carries a high risk of epidural haematoma due to antiplatelet drugs, LMWH, newer anticoagulants
- ▶ not enough data on use in CCL setting

Anaesthetics

- ▶ cardiostable drugs:
 - ▶ opioids
 - ▶ benzodiazepines
 - ▶ etomidate
 - ▶ dexmedetomidine?
- ▶ neuromuscular relaxants:
 - ▶ cisatracurium, atracurium
 - ▶ rocuronium
- ▶ guided FiO_2 and etCO_2 management
- ▶ judicious use of N_2O (pulmonary hypertension!)

Electrophysiologic studies and interventions

- ▶ avoidance of sympathomimetics/sympatholytics (**dexmedetomidine**) during ectopic foci mapping
- ▶ volatile anaesthetics:
 - ▶ may depress AV node/His-Purkinje system conduction through normal and accessory pathways
 - ▶ enhance automaticity of secondary atrial pacemakers
 - ▶ prolong QT interval
- ▶ neuromuscular relaxants:
 - ▶ modulate autonomic tone through ganglion stimulation or blockade
 - ▶ act directly at sympathetic nerve terminals
 - ▶ cause vasodilation and reflex tachycardia through histamine release
- ▶ opioids:
 - ▶ high doses cause vagotonic effect
 - ▶ prolong QT interval?

Case study

- ▶ no difference between isoflurane and propofol in ability to induce SVT

Lavoie J, Walsh E, Burrows F, Laussen P, Lulu J, Hansen D. Effects of propofol or isoflurane anesthesia on cardiac conduction in children undergoing radiofrequency ablation for tachydysrhythmias.

Anesthesiology. 1995;82:884-7.

- ▶ no difference in ability to induce SVT
- ▶ slowed AV conduction with propofol use
- ▶ prolonged ventricular repolarization with isoflurane use

Erb T, Kanter R, Hall J et al. Comparison of electrophysiological effects of propofol and isoflurane-based anesthetics in children undergoing radiofrequency catheter ablation for SVT.

Anesthesiology. 2002;96:1386-94.

Complications

- ▶ procedure related (incl. contrast nephropathy, inadvertent local anaesthetic injection, hypothermia)
- ▶ oversedation → respiratory depression
- ▶ positioning (arm overextension → brachial plexus injury)
- ▶ hypotension
- ▶ unwanted arrhythmia
- ▶ airway difficulties (bronchospasm, laryngospasm)
- ▶ aspiration pneumonitis
- ▶ allergic reaction (0.2%)
- ▶ pain, nausea, vomiting, sore throat
- ▶ damage to teeth (1:4500)
- ▶ laryngeal damage

Limitations of CCL to anaesthesia

- ▶ limited patient airway access (fluoroscopy C-arm)
- ▶ elongated breathing circuit (increased respiratory dead space)
- ▶ obtaining central venous access (CCL table often cannot be put into Trendelenburg position)
- ▶ extended pressure lines and iv. pump connections
- ▶ potential lack of space around the patient

- ▶ no gas scavenging system
- ▶ irradiation
 - ▶ dosimeter?
 - ▶ shielded protection?
 - ▶ lead aprons?

Our experience at University Hospital Center Zagreb

- ▶ percutaneous closure of atrial septal defects and patent ductus arteriosus
 - ▶ moderate to deep sedation in most cases, even with use of TOE with zero adverse events so far
- ▶ transcatheter aortic valve replacement
 - ▶ GA with ET intubation, TIVA
- ▶ thoracic endovascular aortic repair
 - ▶ GA with ET intubation, TIVA or balanced anaesthesia
- ▶ permanent and temporary pacemaker/AICD/CRTD implantations
 - ▶ sedation to varying degree, occasional GA
- ▶ electrophysiological studies
 - ▶ sedation to varying degree, GA for long procedures
- ▶ endovascular neuromodulation treatment for heart failure patients (ENDO-HF)
 - ▶ varying degree of sedation, occasional GA

Bottom line

- ▶ quality **interdisciplinary communication** is of utmost importance in planning and executing a CCL/HYBRID procedure
- ▶ although previously not envisioned, **CCL accommodations for anaesthesia** should be made:
 - ▶ stationary anesthetic equipment available at all times (difficult airway cart, emergency cart, ventilator/anaesthesia workstation)
 - ▶ etCO₂ monitoring
 - ▶ gas scavenging system
 - ▶ ample space
- ▶ anaesthesia should be provided by anaesthesiologist
- ▶ assistance in anaesthetic procedures and patient preparation should be provided by anaesthesia technician
- ▶ in time, some guidelines are in order

Back to the future... HYBRID...isation?

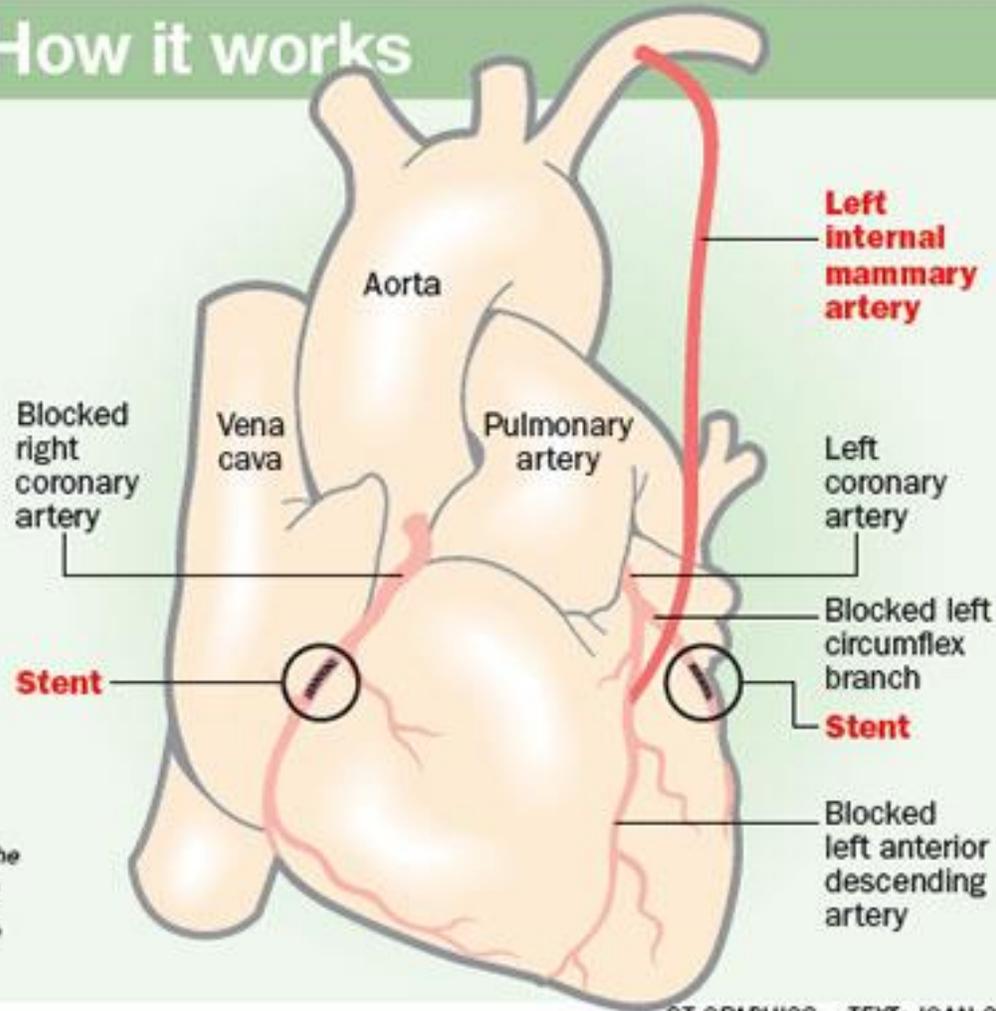
How it works

WHAT IT IS: Two procedures, a heart bypass and an angioplasty, are performed one after another.

HOW IT IS DONE: A bypass, in which a new artery is created to sidestep a blocked one, is usually done first. The left internal mammary artery, a blood vessel inside the chest cavity, is attached to the left anterior descending artery. This is followed by an angioplasty for the other suitable arteries – the right coronary artery and left circumflex branch – which involves inserting stents to keep them open.

ADVANTAGES: Only a small incision (6 to 8cm) on the left side of the body is needed, so the patient recovers faster.

Sources: Associate Professor Theodoros Kofidis, head of the adult cardiac surgery division at the department of cardiac, thoracic and vascular surgery at National University Heart Centre, Singapore (NUHCS); Dr Edgar Tay, consultant at the department of cardiology at NUHCS



ST GRAPHICS TEXT: JOAN CHEW

