Minimalinvasive Herzchirurgie – ein Überblick

8. Kardiologie-Symposium des Herzzentrum Hirslanden Zentralschweiz

INSELSPITAL
UNIVERSITÄTSSPITAL BERN
HOPITAL UNIVERSITAIRE DE BERNE
BERN UNIVERSITY HOSPITAL

David Reineke

UNIVERSITÄT BERN

Minimal Invasive Surgery in CABG

Decrease the invasiveness off CABG

Eliminate cardiopulmonary bypass

- *Beating heart surgery*

Reduction of multi-organ complication

- *Renal failure*
- *Pulmonary failure*
- *Cognitive dysfunction*

Reduction of hospital stay

Less blood transfusions

Less costs

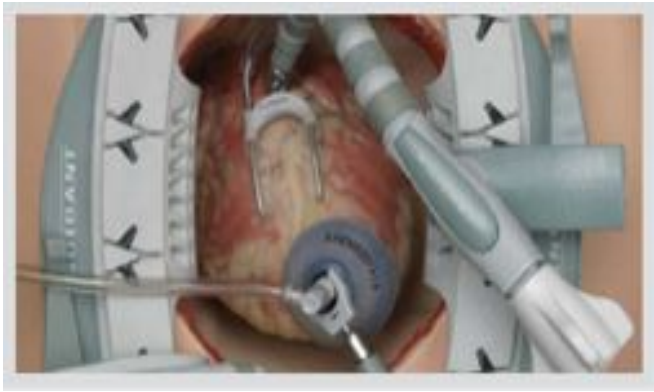
Decrease the size of the incision

- *MID CAB, endoscopic, robotic surgery*

Countless Options

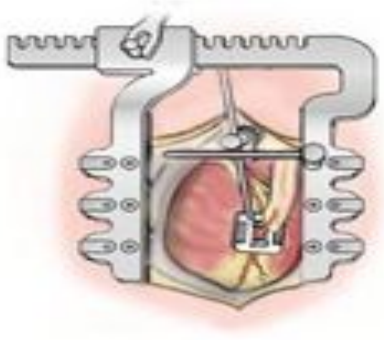
- OPCAB

  Off Pump Coronary Artery Bypass



- MIDCAB

  Minimal Invasive Direct Coronary Artery Bypass



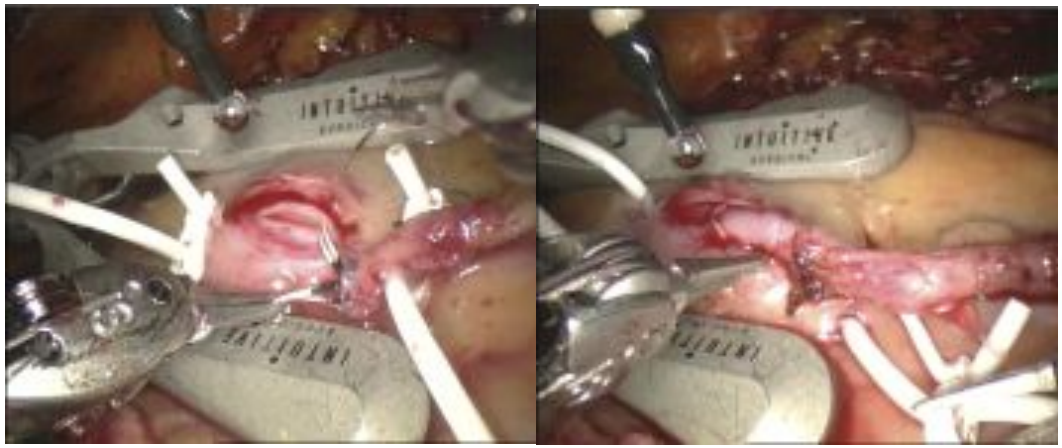
Countless Options

- MIDCAB in hybrid revascularisation

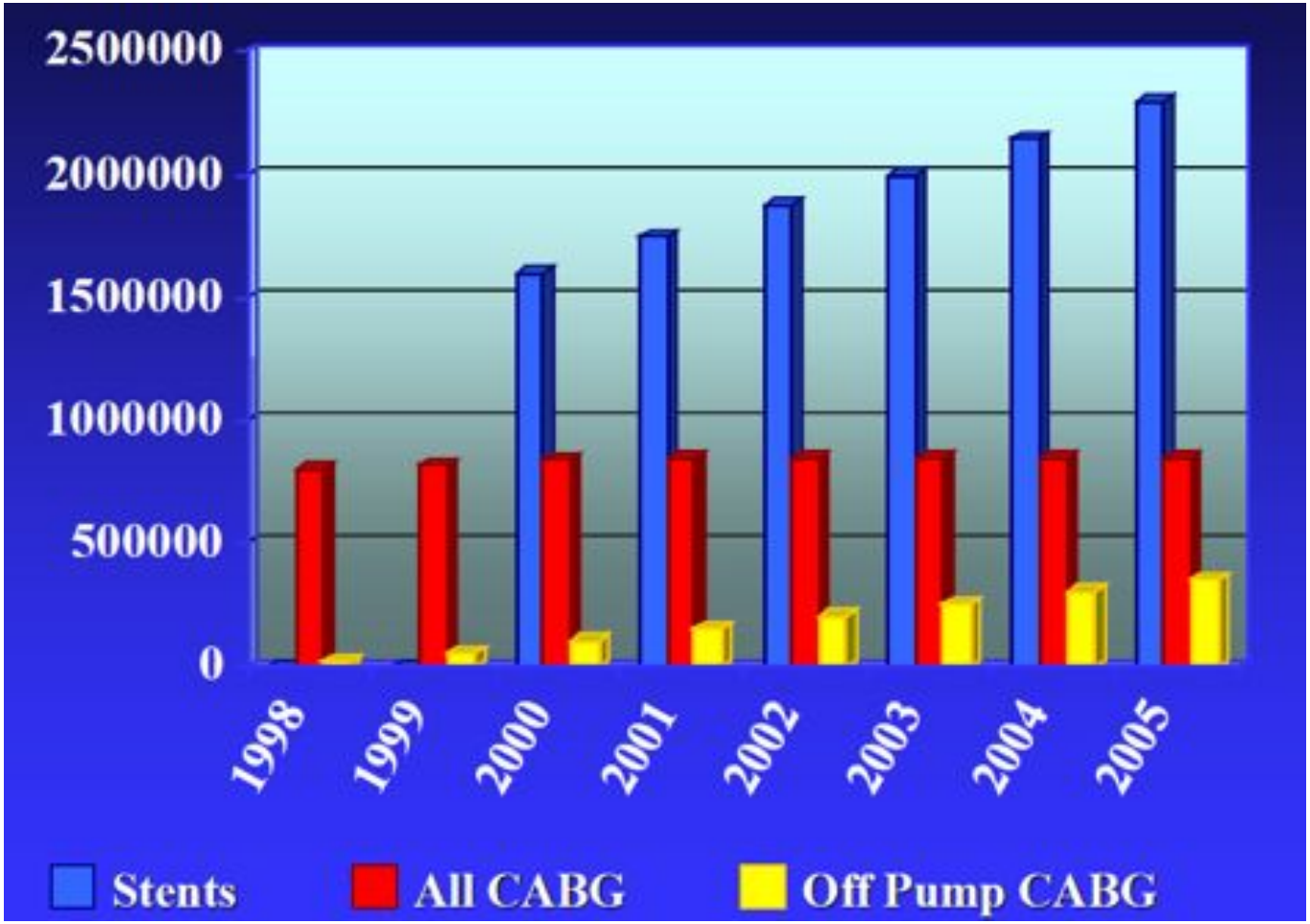
  CABG combined with coronary stenting

- TECAB Robotic-Surgery

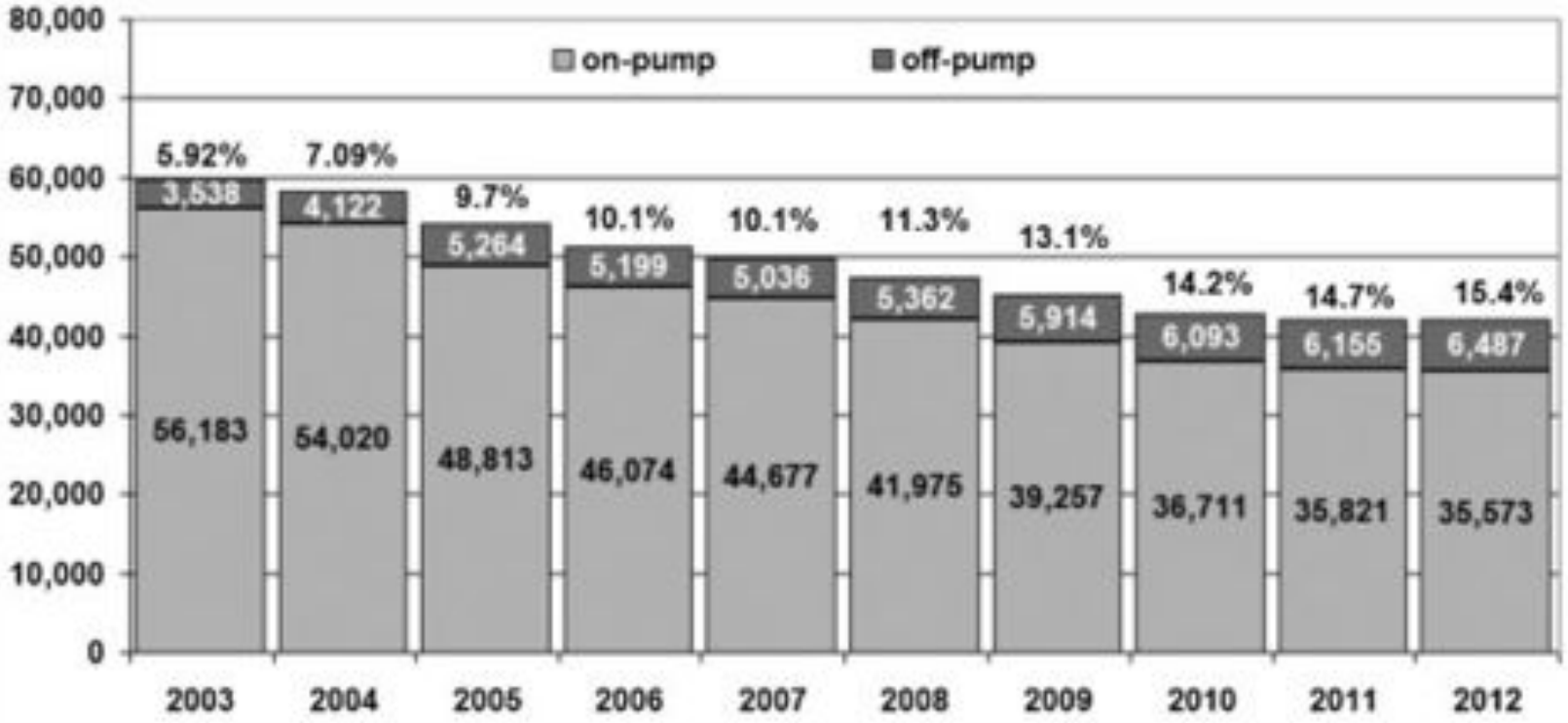
  Total Endoscopic Coronary Artery Bypass



Adoption of Off Pump CABG in the US up to 2005



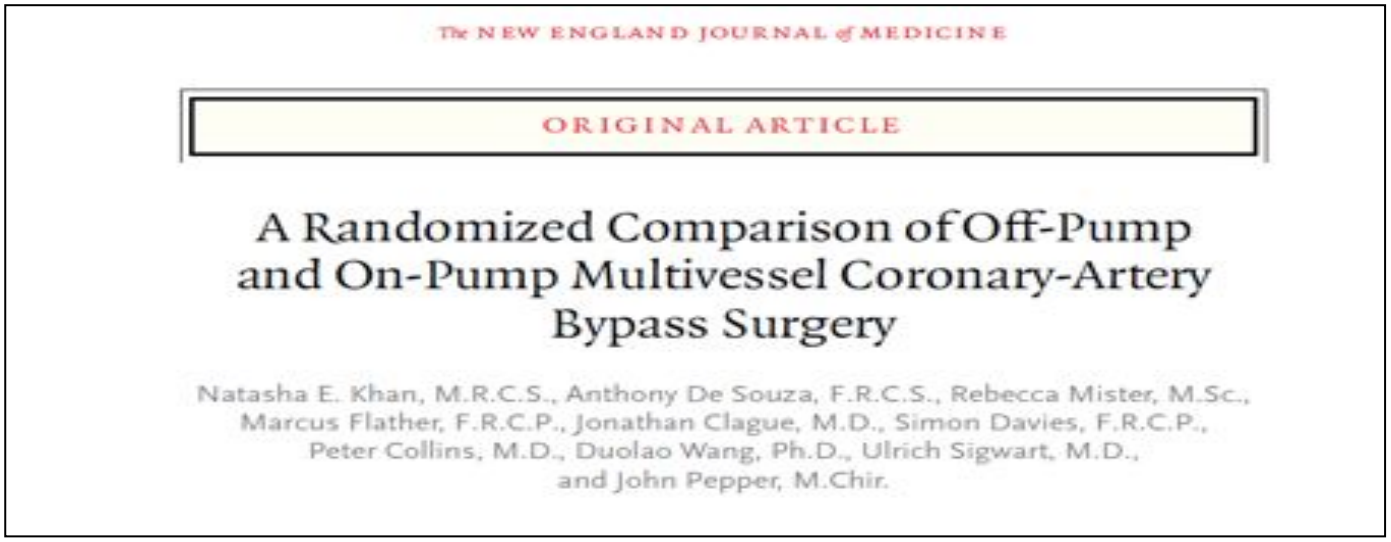
Isolated CABG and Off-pump procedures



Beckmann et al. Thorac cardiovasc Surg 2014; 62(01):005-017

The Failed promise of OPCAB

- The objective data failed to live up to the promise and the hype
- High profile randomizes studies have failed to support the benefit of OPCAB
- Maybe the pump is not so bad



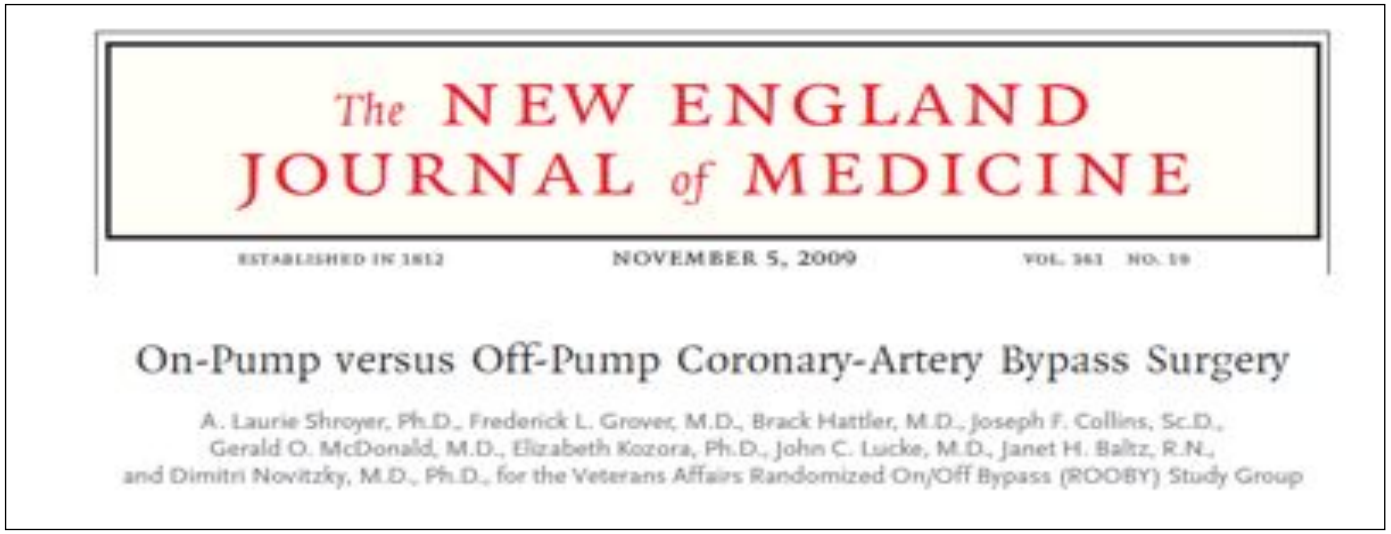
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

A Randomized Comparison of Off-Pump and On-Pump Multivessel Coronary-Artery Bypass Surgery

Natasha E. Khan, M.R.C.S., Anthony De Souza, F.R.C.S., Rebecca Mister, M.Sc., Marcus Flather, F.R.C.P., Jonathan Clague, M.D., Simon Davies, F.R.C.P., Peter Collins, M.D., Duolao Wang, Ph.D., Ulrich Sigwart, M.D., and John Pepper, M.Chir.

Khan NE et al. N Engl J Med 2004;350:21-28



The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 NOVEMBER 5, 2009 VOL. 361 NO. 19

On-Pump versus Off-Pump Coronary-Artery Bypass Surgery

A. Laurie Shroyer, Ph.D., Frederick L. Grover, M.D., Brack Hattler, M.D., Joseph F. Collins, Sc.D., Gerald O. McDonald, M.D., Elizabeth Kozora, Ph.D., John C. Lucke, M.D., Janet H. Baltz, R.N., and Dimitri Novitzky, M.D., Ph.D., for the Veterans Affairs Randomized On/Off Bypass (ROOBY) Study Group

Shroyer AL et al. N Engl J Med 2009;361:1827-37

Off-Pump Coronary Artery Bypass Surgery Is Associated With Worse Arterial and Saphenous Vein Graft Patency and Less Effective Revascularization

Results From the Veterans Affairs Randomized On/Off Bypass (ROOBY) Trial

Brack Hattler, MD; John C. Messenger, MD; A. Laurie Shroyer, PhD; Joseph F. Collins, ScD; Scott J. Haugen, MD; Joel A. Garcia, MD; Janet H. Baltz, RN; Joseph C. Cleveland, Jr, MD; Dimitri Novitzky, MD, PhD; Frederick L. Grover, MD; for the Veterans Affairs Randomized On/Off Bypass (ROOBY) Study Group

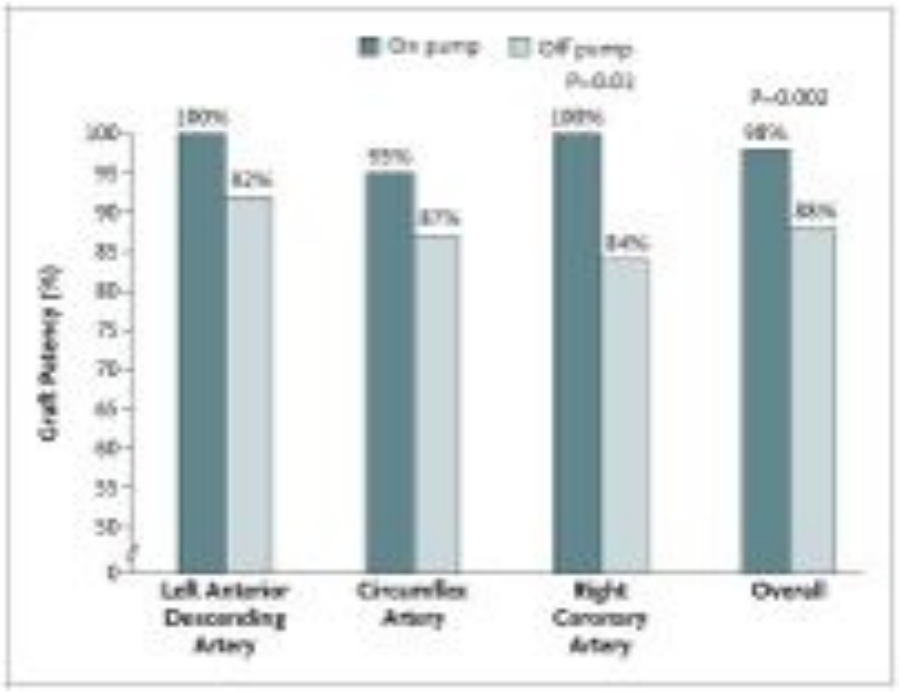
Hettler et al. Circulation. 2012; 125:2827-2835

Off-pump versus on-pump coronary artery bypass grafting for ischaemic heart disease (Review)

Møller CH, Penninga L, Wetterslev J, Steinbrüchel DA, Gluud C

THE COCHRANE COLLABORATION®

Moller CH, et al. Cochrane Database Syst Rev 2012; 3:CD007224



Khan NE et al. N Engl J Med 2004;350:21-28

The Rooby-Trial: 2203 patients randomized

- 1 year composite enpoint of death, repeat revasc, nonfatal MI higher for the OPCAP group (9.9 versus 7.4%, p=0.04)
- Graft patency lower in the OPCAP group (82.6 versus 87.8, p<.01)
- OPCAB with lower patency rate for arterial (85.5% versus 91.4%, p=.003) and vein grafts (72.4% versus 80.4%)
- Only 50.1 OPCAP versus 63.9% of ONCAB patients were effectively revascularized (p<.001)
- No difference in neuropsycohological outcomes or major resource untilisation

Shroyer AL et al. N Engl J Med 2009;361:1827-37

Hettler et al. Circulation. 2012; 125:2827-2835

- Systemic review did not demonstrate significant benefit of off-pump compared with on pump CABG regarding mortality, stroke or myocardial infarction

- Better long-term survival in the group of patients undergoing on-pump CABG with the use of cadiopulmonary bypass and cardioplegic arrest

- Acceptable when there are containdications for cannulation of the aorta and cardiopulmonary bypass

Moller CH, et al. Cochrane Database Syst Rev 2012; 3:CD007224

The failed promise of OPCAB

Why are these results in disagreement with large retrospective single center series and database reports?

They did not controll for the most important variable:

«Surgeon variability»

In experienced hands, OPCAB has has good results!

Off-pump coronary artery bypass grafting provides complete revascularization with reduced myocardial injury, transfusion requirements, and length of stay: A prospective randomized comparison of two hundred unselected patients undergoing off-pump versus conventional coronary artery bypass grafting

J. D. Puskas, MD,[a] W. H. Williams, MD,[a,d] P. G. Duke, MD,[c] J. R. Staples, MD,[c] K. E. Glas, MD,[c] J. J. Marshall, MD,[b] M. Leimbach, MD,[b] P. Huber, MD,[b] S. Garas, MD,[b] B. H. Sammons, RN,[a] S. A. McCall, RN,[a] R. J. Petersen, RN,[a] D. E. Bailey, RN, PA-C,[a] H. Chu, PhD,[d] E. M. Mahoney, PhD,[d] W. S. Weintraub, MD,[d] and R. A. Guyton, MD[a]

J Thorac Cardiovasc Surg 2003;125: 797-808

Similar graft patency and quality of life at reduced cost

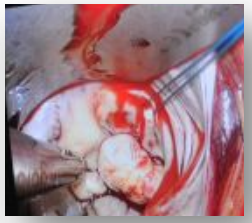
Really an alternative?

- Learning curve
- Less anastomotic quality due to blood-flow and moving artefact
- Less complete revascularisation
- Fewer anastomoses
- More downgrading (planned vs. performed)
- No safety net
- Distal anstomosis site
- No advantage concerning relevant factors in randomized studies

No operation is truly successfull until it can be widely performed by all surgeons.

Delos M. Cosgrove

Minimal Invasive Surgery in Mitral Valve Surgery

	Sternotomy	Partial Sternotomy	Thoracotomy Rib Spreading	Thoracotomy Non Rib Spreading	Robotic
Incision size	12-20 cm	8cm	6-8cm	4-6cm	2-4cm
		→	→	MICS →	
Visualisation	Direct	Direct	Direct	Indirect	Indirect
					

Courtesy of Th. Aymard

Minimal Invasive Surgery in Mitral Valve Surgery

- **Minimize the surgical trauma**
- **Accelerate recovery**
- **Increase patients' satisfaction**

MICS is also …

… reducing costs

… a marketing factor

MIS MV Surgery in Germany

Leistungsstatistik DGTHG 2014

One thousand minimally invasive mitral valve operations: Early outcomes, late outcomes, and echocardiographic follow-up

R. Scott McClure, MD, SM, FRCSC, Leonidas V. Athanasopoulos, MD, PhD, Siobhan McGurk, MSc, Michael J. Davidson, MD, Gregory S. Couper, MD, and Lawrence H. Cohn, MD

Conclusions: Minimally invasive mitral valve surgery is effective, with excellent late results. The durability of minimally invasive mitral valve repair compared favorably with conventional full sternotomy methods at late follow-up. (J Thorac Cardiovasc Surg 2013;145:1199-206)

ELSEVIER

European Journal of Cardio-thoracic Surgery 34 (2008) 760–765

EUROPEAN JOURNAL OF CARDIO-THORACIC SURGERY

www.elsevier.com/locate/ejcts

Minimal invasive mitral valve repair for mitral regurgitation: results of 1339 consecutive patients☆

Joerg Seeburger*, Michael Andrew Borger, Volkmar Falk, Thomas Kuntze, Markus Czesla, Thomas Walther, Nicolas Doll, Friedrich Wilhelm Mohr

Department of Cardiac Surgery, Heartcenter, Leipzig University, Struempelstrasse 39, 04289 Leipzig, Germany

Received 3 September 2007; received in revised form 30 April 2008; accepted 7 May 2008; Available online 30 June 2008

CONCLUSIONS: Minimal invasive MV repair, along with certain concomitant procedures, can be performed in the vast majority of patients with MR. Our large series demonstrates that these procedures can be performed with low perioperative complication rates and very good durability.

Mitral valve surgery: Right lateral minithoracotomy or sternotomy? A systematic review and meta-analysis

Simon H. Sündermann, MD,[a] Juri Sromicki, MD,[a] Héctor Rodriguez Cetina Biefer, MD,[a,b] Burkhardt Seifert, MD, PhD,[c] Tomas Holubec, MD,[a] Volkmar Falk, MD, PhD,[a] and Stephan Jacobs, MD[a]

Conclusions: MIVS and conventional mitral valve surgery have a similar perioperative outcome. Mitral valve surgery via a right lateral minithoracotomy seems to be favorable with regard to resource-related outcome.
(J Thorac Cardiovasc Surg 2014;■:1-7)

Systematic Review

A meta-analysis of minimally invasive versus conventional mitral valve repair for patients with degenerative mitral disease

Christopher Cao[1], Sunil Gupta[1], David Chandrakumar[1], Thomas A. Nienaber[1], Praveen Indraratna[1], Su C. Ang[1], Kevin Phan[1,2], Tristan D. Yan[1,2]

[1]The Collaborative Research (CORE) Group, Macquarie University, Sydney, Australia; [2]The Royal Prince Alfred Hospital, Sydney University, Sydney, Australia

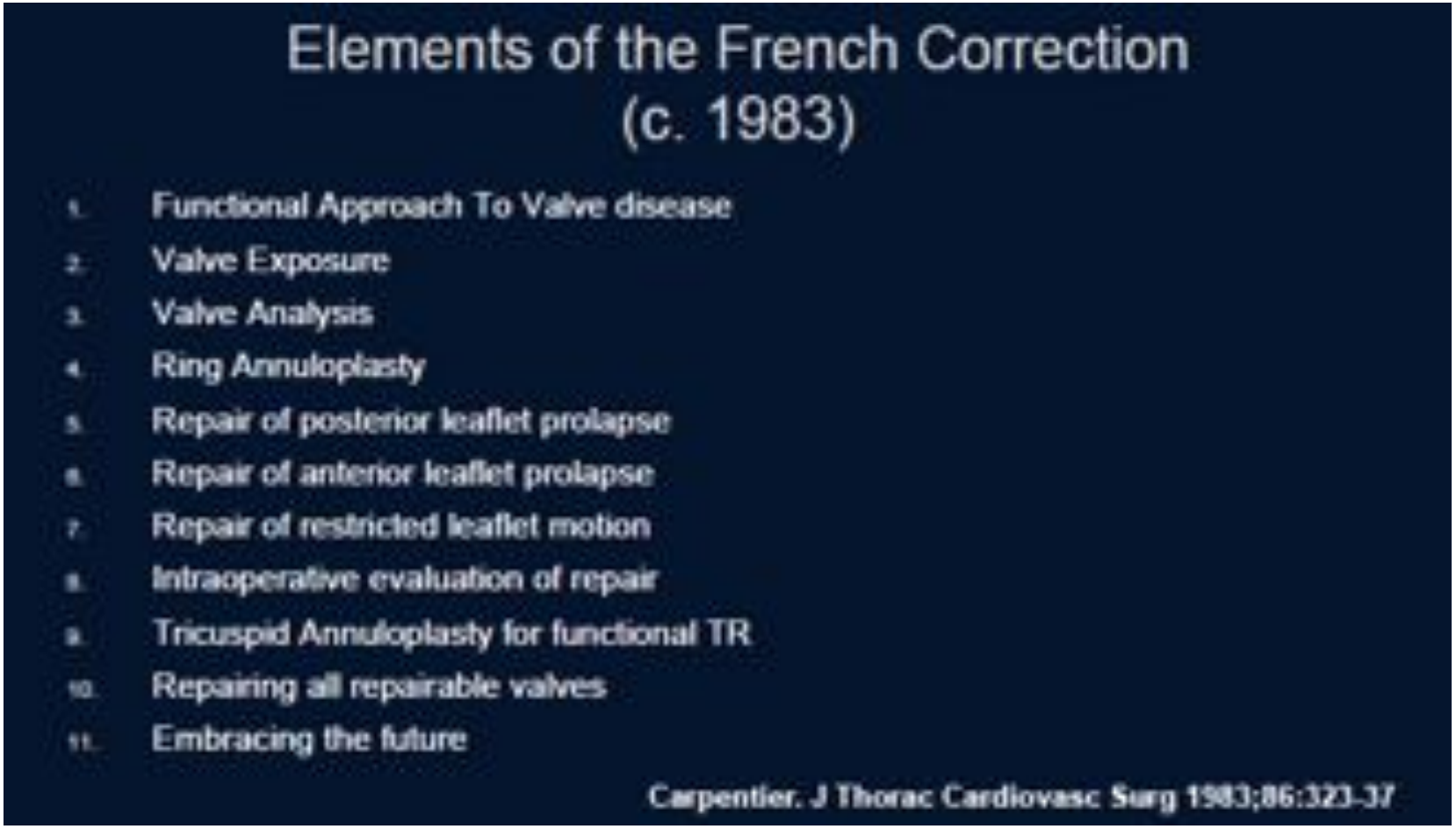
Conclusions: The existing literature has limited data on comparative outcomes after MIMVR versus conventional mitral valve repair for patients with degenerative disease. From the available evidence, there are no significant differences between the two surgical techniques in regards to clinical outcomes. Patients who underwent MIMVR required longer cardiopulmonary bypass and cross clamp times, but the duration of stay in the ICU was significantly shorter than conventional mitral valve repair.

Ann Cardiothorac Surg 2013;2(6):693-703

Why so successfull?

- Mainly done in centers and taught by experts
- Never a teaching operation
- Usually started by the best surgeon in the team
- Cannot be compared to beating heart surgery
- reproduzierbarer/einfacher als OPCAB

French Correction versus «New Correction»



French Correction versus «New Correction»

What are the results of the French Correction?

Very Long-Term Results (More Than 20 Years) of Valve Repair With Carpentier's Techniques in Nonrheumatic Mitral Valve Insufficiency

E. Braunberger, MD; A. Deloche, MD; A. Berrebi, MD; F. Abdallah, MD; J.A Celestin, MD; P. Meimoun, MD; G. Chatellier, MD; S. Chauvaud, MD; J.N. Fabiani, MD; A. Carpentier, MD

Background—Mitral valve repair is considered the gold standard in surgery of degenerative mitral valve insufficiency (MVI), but the long-term results (>20 years) are unknown.

Methods and Results—We reviewed the first 162 consecutive patients who underwent mitral valve repair between 1970 and 1984 for MVI due to nonrheumatic disease. The cause of MVI was degenerative in 146 patients (90%) and bacterial endocarditis in 16 patients (10%). MVI was isolated or, in 38 cases, associated with tricuspid insufficiency. The mean age of the 162 patients (104 men and 58 women) was 56±10 years (age range 22 to 77 years). New York Heart Association functional class was I, II, III, and IV in 2%, 39%, 52%, and 7% of patients, respectively. The mean cardiothoracic ratio was 0.58±0.07 (0.4 to 0.8), and 72 (45%) patients had atrial fibrillation. Valve analysis showed that the main mechanism of MVI was type II Carpentier's functional classification in 132 patients. The leaflet prolapse involved the posterior leaflet in 93 patients, the anterior leaflet in 28 patients, and both leaflets in 10 patients. Surgical technique included a Carpentier's ring annuloplasty in all cases, a valve resection in 126 patients, and shortening or transposition of chordae in 89 patients. During the first postoperative month, there were 3 deaths (1.9%) and 3 reoperations (2 valve replacements and 1 repeat repair [1.9%]). Six patients were lost to follow-up. The remaining 151 patients with mitral valve repair were followed during a median of 17 years (range 1 to 29 years; 2273 patient-years). The 20-year Kaplan-Meier survival rate was 48% (95% CI 40% to 57%), which is similar to the survival rate for a normal population with the same age structure. The 20-year rates were 19.3% (95% CI 11% to 27%) for cardiac death and 26% (95% CI 17% to 35%) for cardiac morbidity/mortality (including death from a cardiac cause, stroke, and reoperation). During the 20 years of follow-up, 7 patients were underwent surgery at 3, 7, 7, 8, 8, 10, or 11 years after the initial operation. Valve replacement was carried out in 5 patients, and repeat repair was carried out in 2 patients. At the end of the study, 65 patients remained alive (median follow-up 19 years). Their median age was 76 years (age range 41 to 95 years). All except 1 were in New York Heart Association functional class I/II.

Conclusions—Mitral valve repair using Carpentier's technique in patients with nonrheumatic MVI provides excellent long-term results with a mortality rate similar to that of the general population and a very low incidence of reoperation. **(Circulation. 2001;104[suppl I]:I-8-I-11.)**

Key words: regurgitation ■ valves ■ mitral valve ■ heart diseases ■ surgery ■ rheumatic heart disease

Braunberger et al Circulation 2001; 104: S8-11

Long-Term (29 Years) Results of Reconstructive Surgery in Rheumatic Mitral Valve Insufficiency

Sylvain Chauvaud, MD; Jean-François Fuzellier, MD; Alain Berrebi, MD; Alain Deloche, MD; Jean-Noël Fabiani, MD; Alain Carpentier, MD, PhD

Background—Results of conservative surgery are well established in degenerative mitral valve (MV) insufficiency. However, there are controversies in rheumatic disease. This study is the evaluation of one center for rheumatic MV insufficiency based on a functional approach.

Methods and Results—From 1970 to 1984, 951 patients with rheumatic MV insufficiency were operated on with the reconstructive techniques elaborated by Alain Carpentier. Aortic valve diseases were excluded. Mean age was 25.8 years (4 to 73), and sinus rhythm was present in 63%. The functional classification used was type I, normal leaflet motion, 71 patients (7%); type II, prolapsed leaflet, 313 patients (33%); and type IIIb, restricted leaflet motion, 345 patients (36%). The combined lesion of prolapse of the anterior leaflet and restriction of the posterior was present in 224 patients (24%). Surgical techniques used were implantation of a prosthetic ring in 95%, shortening of the chords and leaflet enlargement with autologous pericardium, and commissurotomy. Hospital mortality rate was 2%. The mean follow-up was 12 years (maximum, 29 years); 80.18 patients per year. Actuarial survival was 89±19% at 10 years and 62±18% at 20 years. The rate of thromboembolic events was 0.4% patients per year (33 events), with 3 deaths. Freedom from reoperation was 82±19% at 10 years and 55±25% at 20 years. The main cause (83%) of reoperation was progressive fibrosis of the MV. The actuarial rate of reoperation was 2% patients per year and was correlated to the degree of preoperative fibrosis.

Conclusions—Conservative surgery of rheumatic MV insufficiency has a low hospital mortality rate and an acceptable rate of reoperation. The results are excellent regarding the minimal risk of thromboembolic events. **(Circulation. 2001; 104[suppl I]:I-12-I-15.)**

Chauvaud et al Circulation 2001; 104: S12-15

French Correction versus «New Correction»

The 'New' Correction

- In general aims to simplify mitral valve repair
- Simplification often used to facilitate minimal access surgery
- Rarely is the object to improve quality or durability of repair

Hellenic J Cardiol 2008; 49: 329-334

Original Research

Mitral Valve Repair: Beyond the French Correction

Christopheros Kotoulas[1,2], Savvas Osorios[1], Ali Sarrai[1], Kostas Patris[1,2], Ragheb Hasan[1]

[1]Manchester Heart Centre, Manchester, UK; [2]"Iasis" General Hospital of Athens, Greece

In this series of mitral valve repair we used three main means of reconstruction. They included Alfieri's E2E technique, triangular exclusion, and ring annuloplasty. We did not use quadrangular resections, slid-

Conclusions: Our study demonstrates that the techniques beyond the "French correction" simplify the repair, especially when combined with other cardiac procedures. These techniques were applied with no mortality in the isolated mitral valve repair group.

Kotoulas et al. Hellenic J Cardiol 2008; 49:329-34

Endoscopic placement of multiple artificial chordae with robotic assistance and nitinol clip fixation

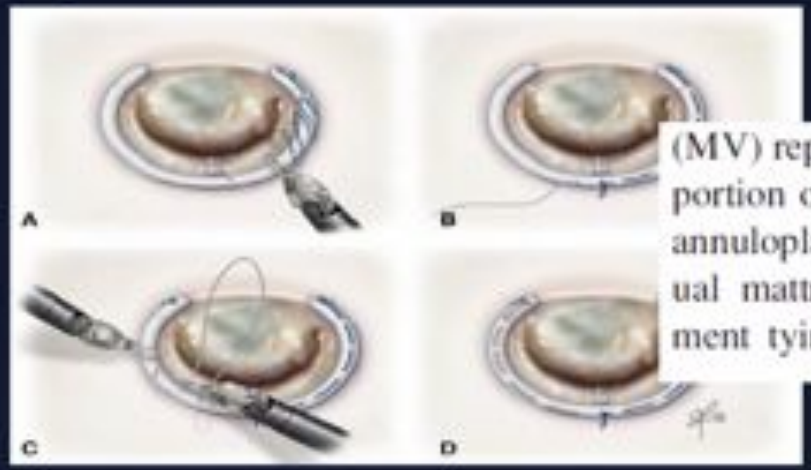
J. Michael Smith, MD,[a] and Hubert Stein, BSc, BME[b]

and limited degrees of freedom of standard thoracoscopic instrumentation, anchoring the neochordae precisely in the papillary muscle and securing the sutures through the leaflets are often challenging.

Smith and Stein JTCVS 2008; 135:610-4

A novel running annuloplasty suture technique for robotically assisted mitral valve repair

Tomislav Mihaljevic, MD,[a] Craig M. Jarrett, MD, MBA,[a] A. Marc Gillinov, MD,[a] and Eugene H. Blackstone, MD,[a,b] Cleveland, Ohio



(MV) repair have in part slowed its adoption. A significant portion of operative time is dedicated to placement of the annuloplasty ring, which is usually anchored with individual mattress sutures that require time-consuming instrument tying. We have developed an alternative technique

Mihaljevic et al. The Journal of Thoracic and Cardiovascular Surgery, Volume 139, Issue 5, 2010, 1343 - 1344

European Journal of Cardio-Thoracic Surgery 44 (2013) 485–489
doi:10.1093/ejcts/ezt092 Advance Access publication 28 February 2013

ORIGINAL ARTICLE

Posterior ventricular anchoring neochordal repair of degenerative mitral regurgitation efficiently remodels and repositions posterior leaflet prolapse*

Y. Joseph Woo* and John W. MacArthur, Jr.

Department

* Correspor
19104, US

Received 13

terior leaflet. This repair facilitated the right chest minimally invasive approach. As this is a newly developed procedure, long-

Woo and MacArthur EJCTS 2013;44:485-89


POSTER ABSTRACTS
P21
An Analysis of Acute Changes in Mitral Valve Geometry Following Standalone Surgical Annuloplasty for Bileaflet Prolapse in Barlow's Disease
D. Maselli, A. Salica, L. Weltert, R. Scaffa, S. Nardella, A. Belluzzo, R. De Paulis
European Hospital, Rome, Italy
A simple annuloplasty alone was effective in restoring competence in Barlow's Disease …avoids complex and time consuming reparative surgery
STS 2013

- French Correction defines a philosophical approach to Valve Repair that predictably yields good long-term durability
- New Corrective Approaches should be driven by long-term durability
- and not short-term ease of surgery

Is minimal invasive mitral valve surgery dumbing down repair techniques?

Aortic valve surgery

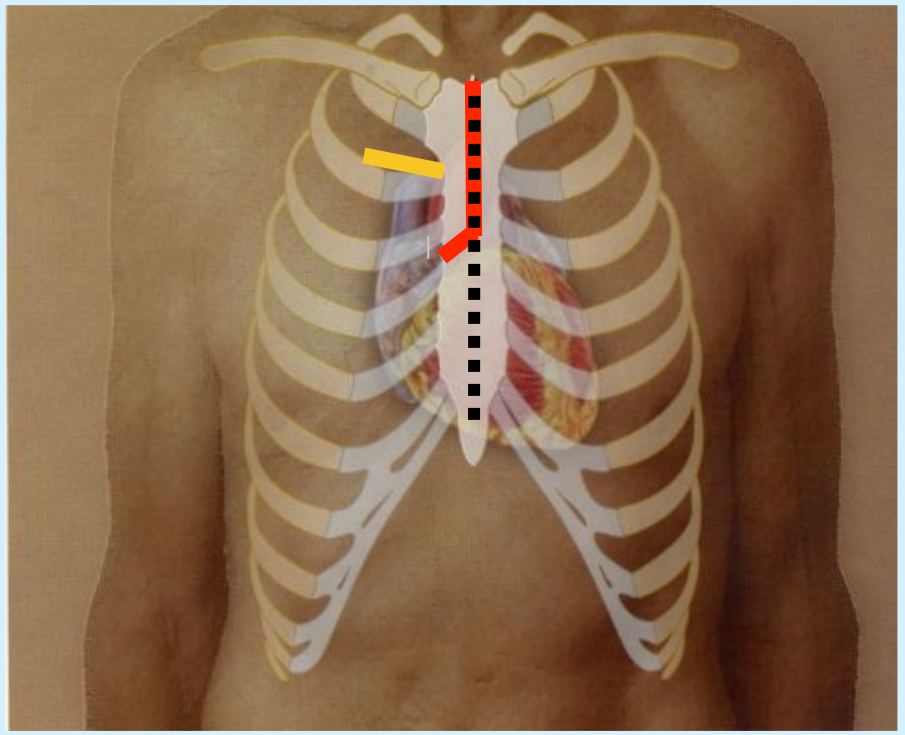
Minimally invasive surgery

- Less trauma
- Less pain
- Better cosmetic result

Moustafa A et al. Asian Cardiovasc Thorac Ann 2007;15:472-475

Candaele S et al. Acta Cardiol. 2003 Feb;58(1):17-21

by Lange R.



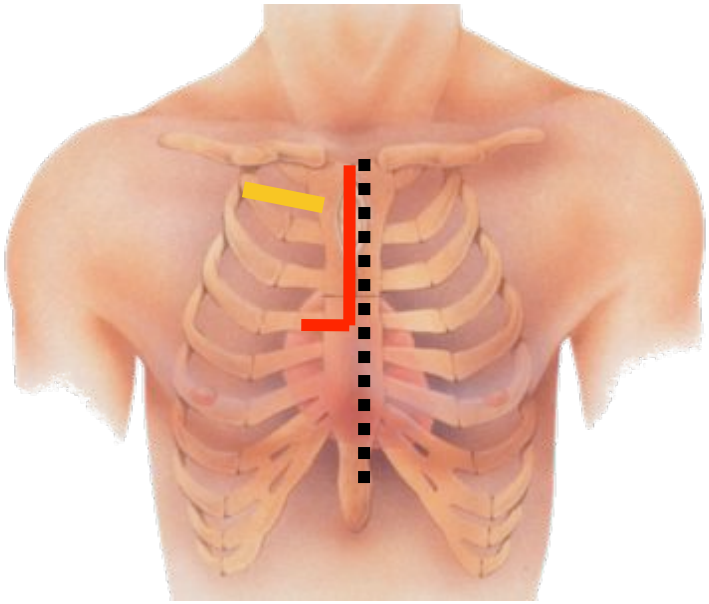
ctsnet.org

Complicated and not recommended:

- Right mini-thoracotomy
- Right parasternal approach
- Transversal sternotomy

Surgical access in AVR

Minimally invasiveness should not



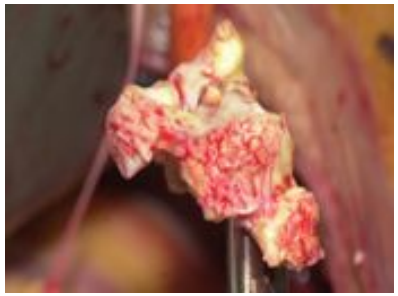
- increase the risk
- prolong operation

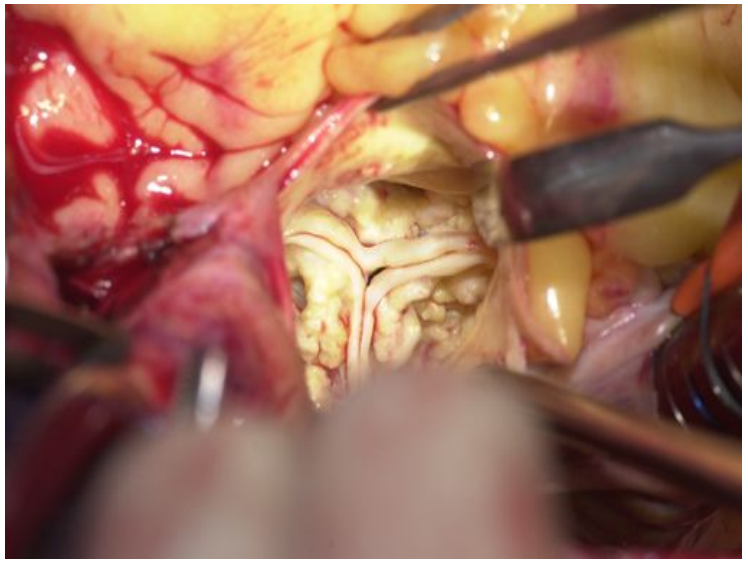
  AVR

  clamp time < 40-45 min **(20-25 min)**

  perfusion < 50-60 min **(30-35 min)**
- complicate a simple intervention

Alternatives have to make sense and should not endager the patient!





Sutureless AVR

(1) is suitable for all patients with

biological valves, conventional access & ministernotomy

(2) is also especially indicated for

small roots, calcified roots, pts at risk

AVR

clamp time < 40-45 min **(20-25 min)**

perfusion < 50-60 min **(30-35 min)**

	n	Logistic ES	Mortality
Heidelberg (Osswald et al.)	**833**	**14.8 %**	**3.5 %**
Bern conventional 2007-2014	**370**	**> 10 %**	**3.2 %**
Perceval Study (multicenter)	**180**	**13.1 %**	**2.8 %**

What else...

- Minimal invasive

- perfusion
- cardioplegia
- taylor made solutions for every patient

Perfusion (conventional ECC)

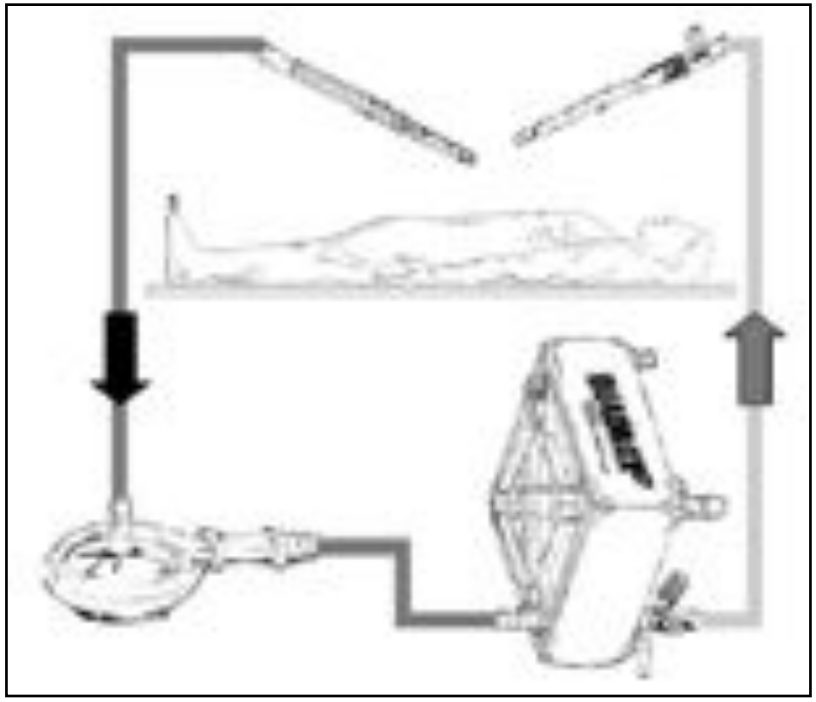
- 400iU/kg heparine (ACT 700)
- perfusion with a reservoir
- priming Volumen: 1800ml
- Buckberg cardioplegia
  (Repeated every 20 minutes)

Perfusion (minimized ECC)

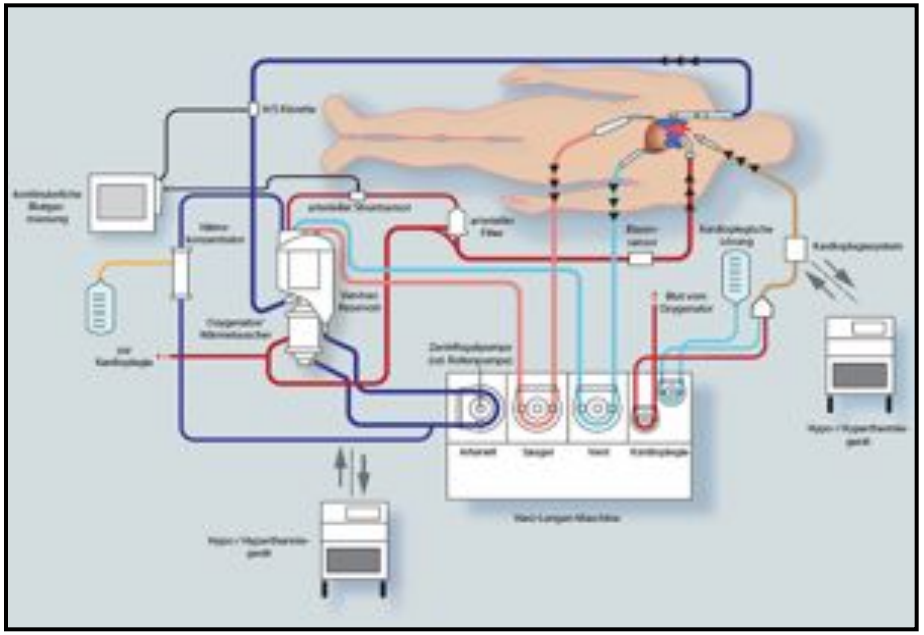
- 200iU/kg heparine (ACT 480s)
- 100ml cristalloide cardioplegia no repitition
- constant volume perfusion
- less tubing, surface
- priming volume: 400-600ml

Convincingly simple!

MECC

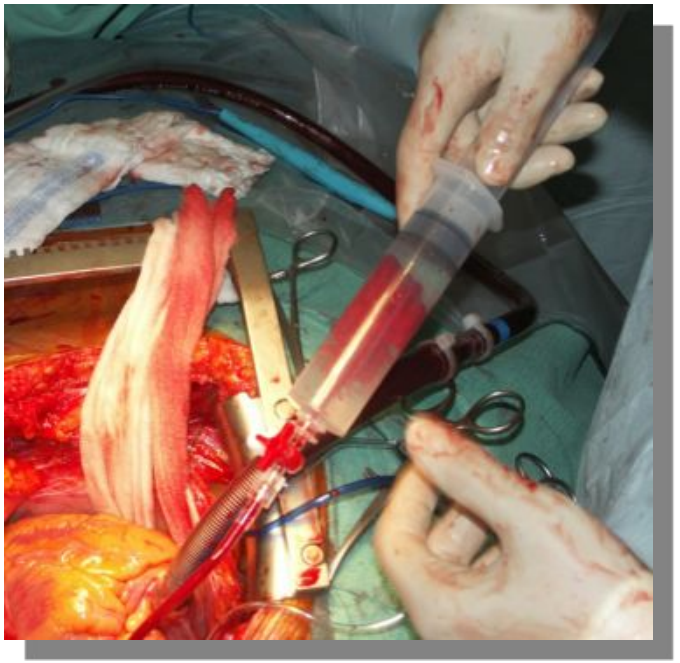


ECC



Cardioplegia

Cristalloid Cardioplegia
- Single shot 100 ml
- No repetition



Total volume of 100 ml allows…:

- prevention of hemodilution
- higher/normal hematocrit during the procedure
- reduced/eliminated need for ultrafiltration
- reduced exposure of endothelium to prolonged crystalloid perfusion

Reassuring results

January 2006 - January 2014

> 6000 interventions with M-ECC and Cardioplexol

- inflammatory response
- volume shift
- transfusion
- atrial fibrillation

↓

- myocardial protection
- outcome in high-risk patients
- quality of life
- cognitive function

↑

Reineke et al. ICVTS 2014

Jenni et al. Eur J Cardiothorac Surg. 2011

Immer et al. Ann Thorac Surg 2007

Minimized extracorporeal circulation does not impair cognitive brain function after coronary artery bypass grafting†

David Reineke[a,*], Bernhard Winkler[a,*], Tobias König[a], Katharina Meszaros[a], Gottfried Sodeck[b], Florian Schönhoff[a], Gabor Erdoes[c], Martin Czerny[a] and Thierry Carrel[a]

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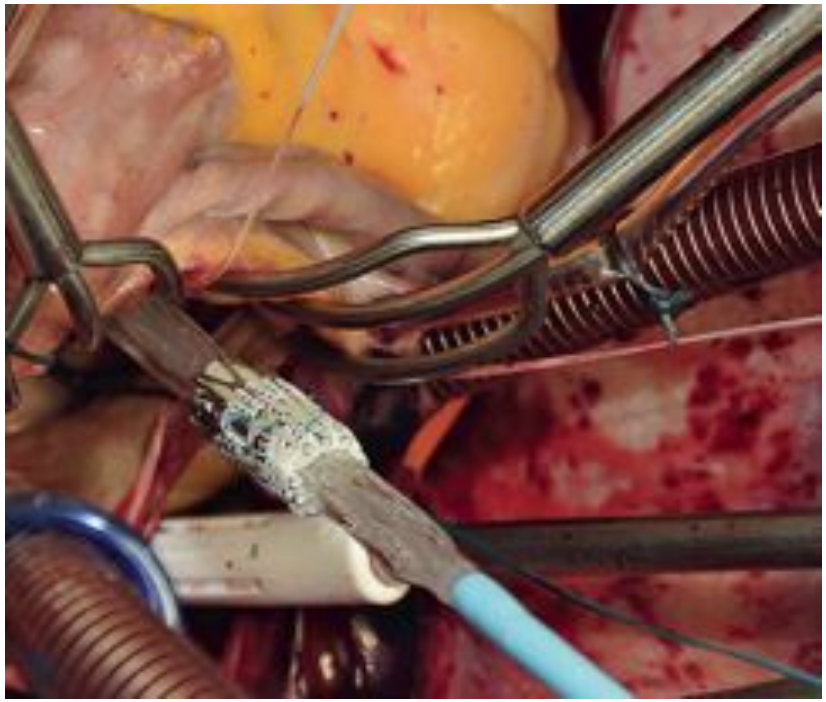
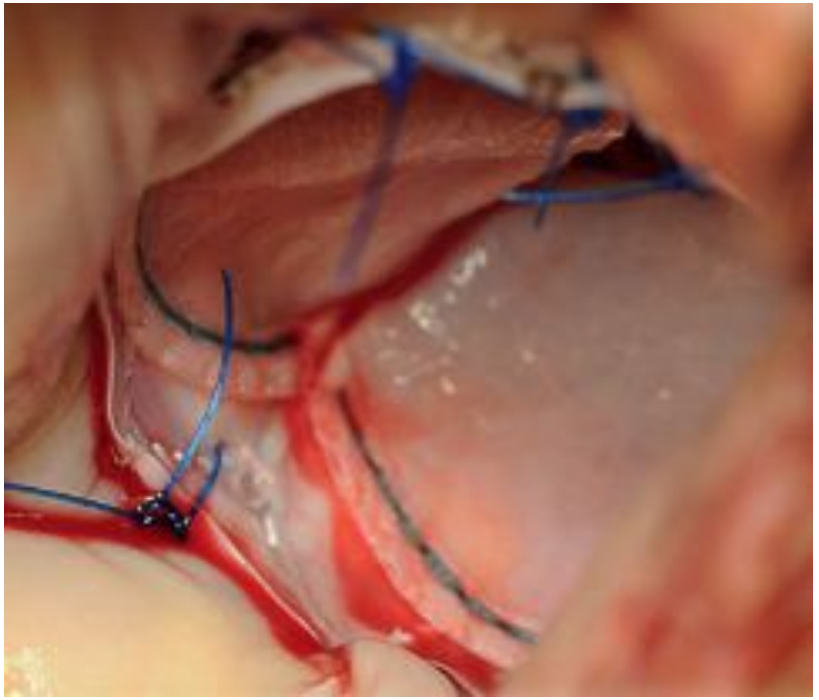
[c] Department of Anesthesiology, University Hospital Berne, Berne, Switzerland

Reineke et al. ICVTS 2014

Worldwide first surgical implantation of a transcatheter valved stent in mitral position

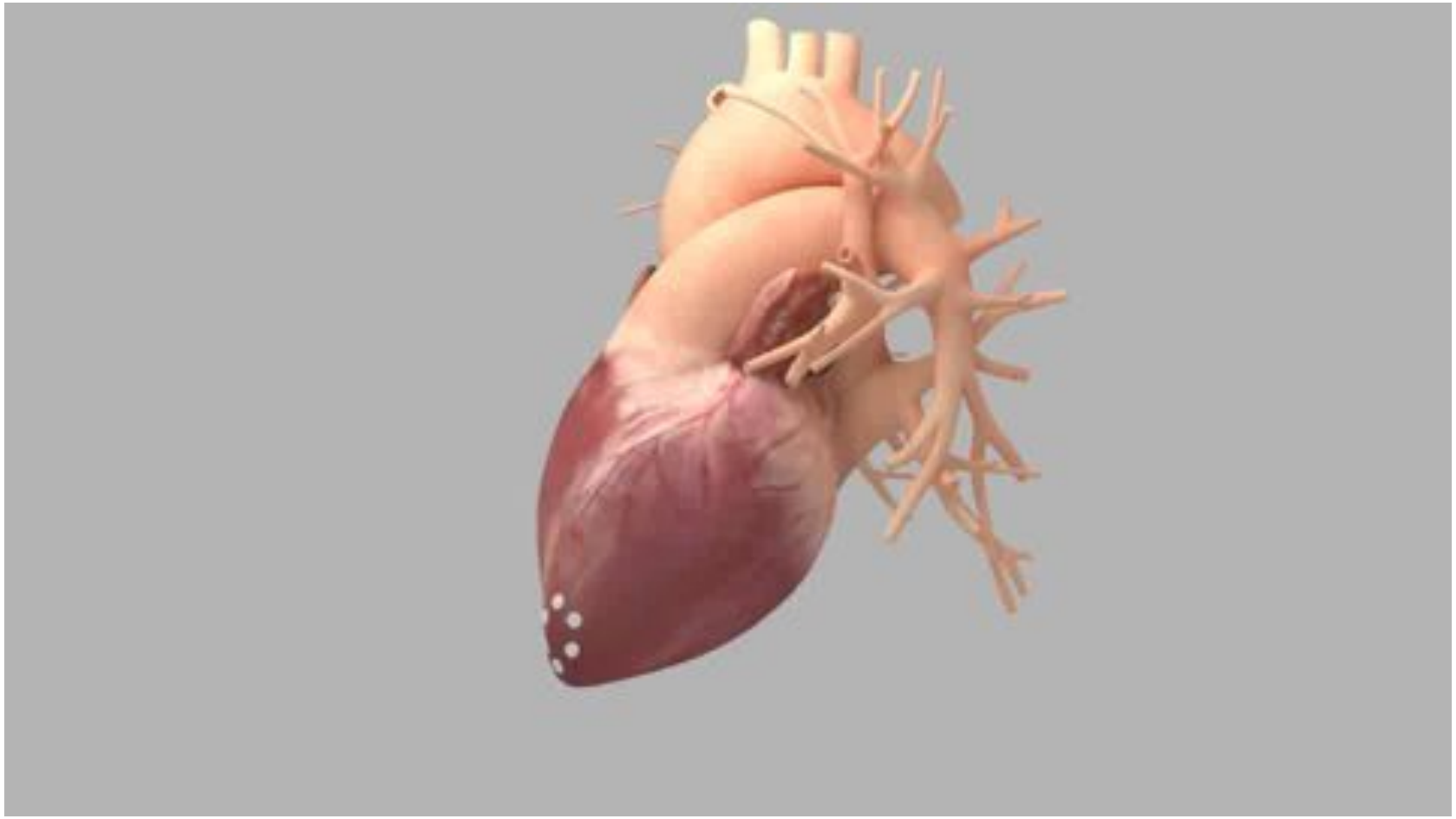
Thierry Carrel[a], Peter Wenaweser[b], Sylvia Reineke[a], René Simon[c], Balthasar Eberle[d], Stephan Windecker[b], Christoph Huber[a]

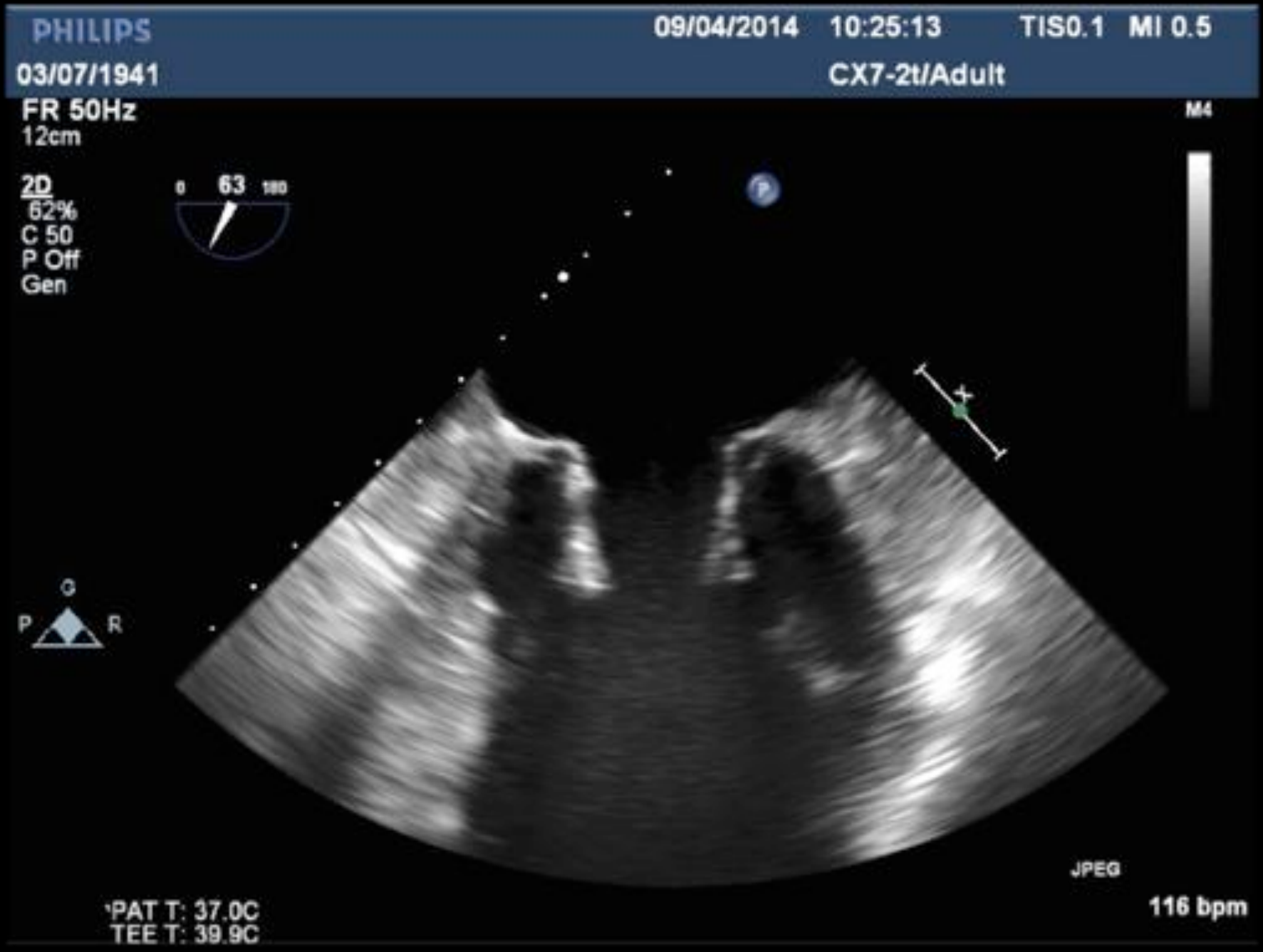




Cardiovascular Medicine 2012;15(6):202–205

Fortis Valve Animation

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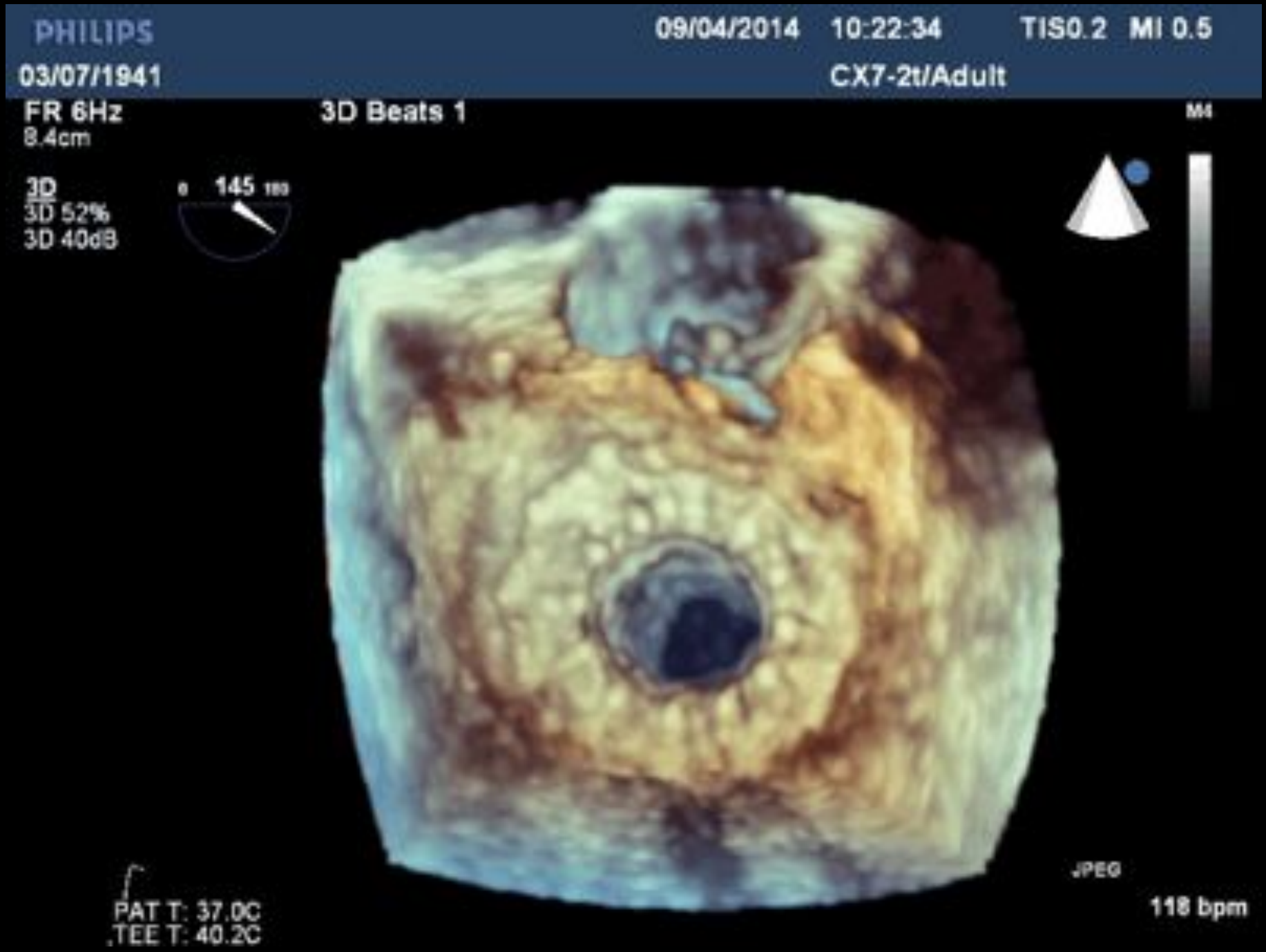
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TEE T: 40.2C
118 bpm

Take home message

OPCAP	Good results in experienced hands
MICS	Simplification should not be the center of attention – do not dumb it down.
AVR	Do not complicate a simple intervention.
Perfusion/ Cardioplegia	A good pump is not so bad after all

Taylor made solutions are the least invasive!

Thank you for your attention!