The 31st Annual Meeting of the Association of Thoracic and Cardiovascular Surgeons of Asia (ATCSA) in conjunction with
The 2023 Workshop of International Society of Minimally Invasive Cardiac Surgery (ISMICS) &
The 9th Scientific Conference of Thoracic and Cardiovascular Surgery of Viet Nam (ATCSVN)

Ho Chi Minh City
16.-18. November 2023

Should Every Young Cardiac Surgeon Learn Robotic Techniques?

Martin Misfeld

University Department for Cardiac Surgery, Leipzig Heart Center
Department of Cardiothoracic Surgery, Royal Prince Alfred Hospital, Sydney

Co-Director of Research, Institute of Academic Surgery, RPAH
The Baird Institute of Applied Heart and Lung Surgical Research
Honorary Professor, Sydney Medical School, University of Sydney

Disclosures: none

Agenda

- Am I qualified to give this talk?
- Background
- Robotic cardiac surgery in the world
- Why go from 1 to 10, if 2 -9 is left out?
- „Gold Standards in Cardiac Surgery“ (3 examples)

Remark: Personal view!

First Robotic-assisted MV repair

May 27, 1998

Robotic MV Surgery

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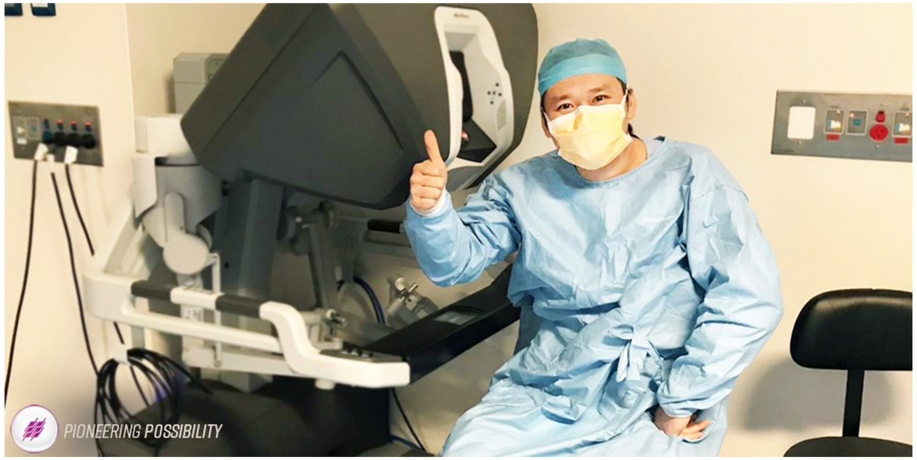
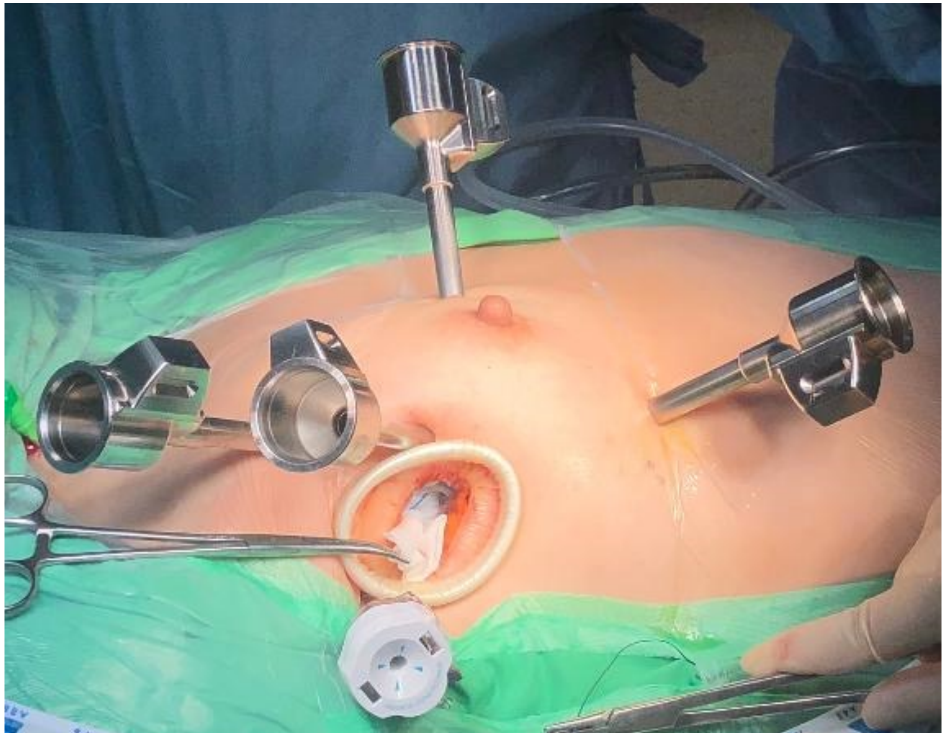
Ho Chi Minh city, Vietnam

Robotic **Assisted** MV Surgery!

Robotic MV surgery



Operative Setup



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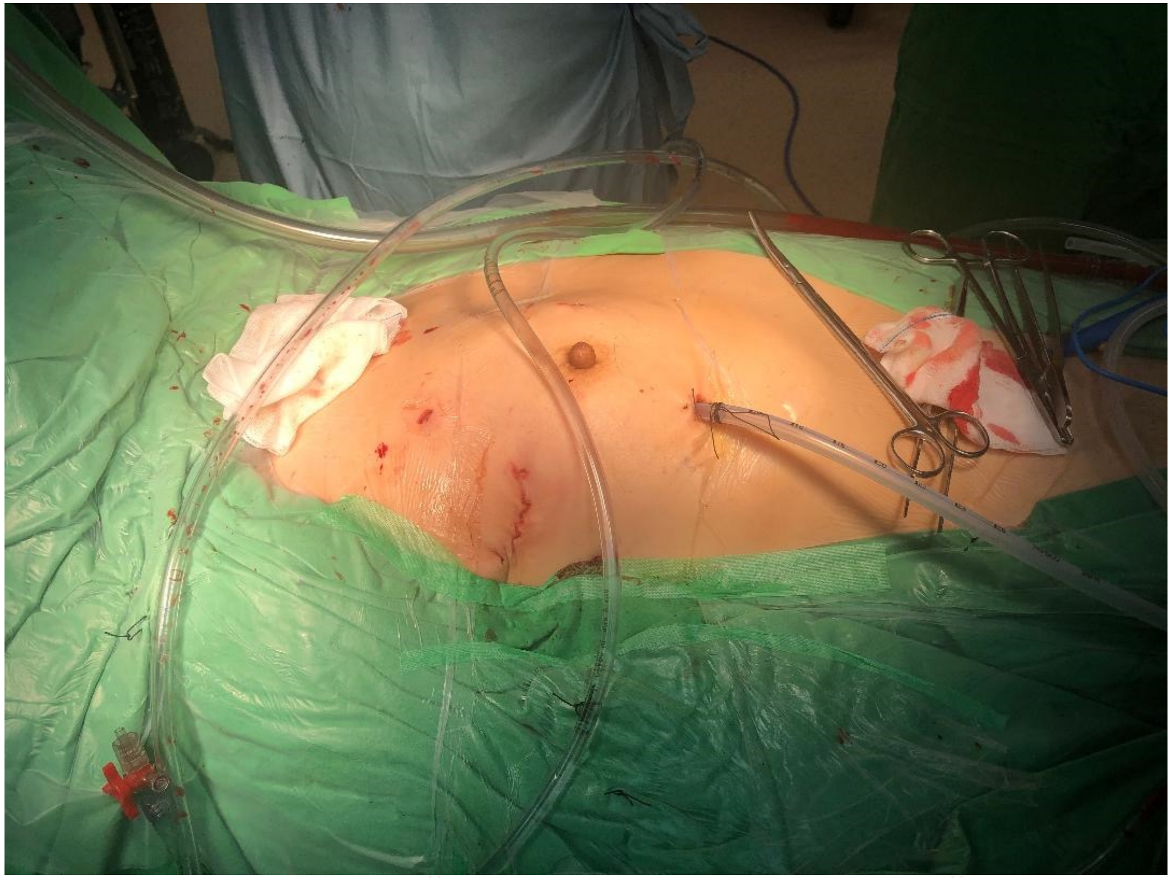
Robotic Assisted MV Surgery



Should Every Young Cardiac Surgeon Learn Robotic Techniques?

„No“

Predictions

„It is hard to make predictions, especially about the future“

Niels Bohr

1885 – 1965
Nobel Prize in physics 1921

Wrong Predictions

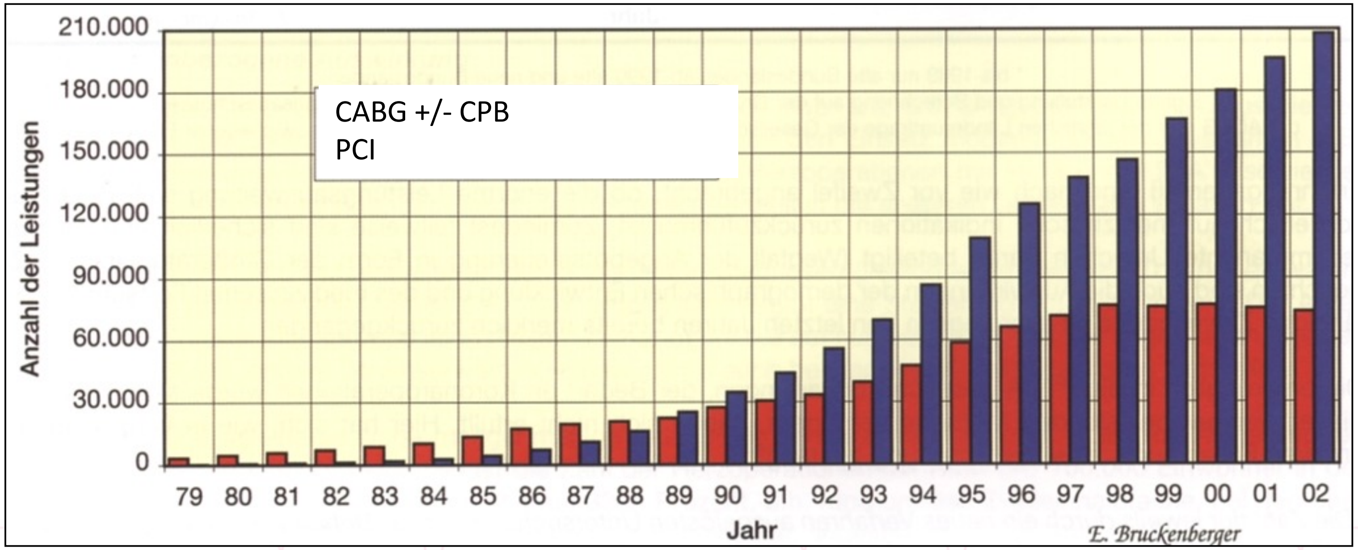
"Television won't be able to hold on to any market it captures after the first six months. People will soon get tired of staring at a playwood box every night" *- Darryl F. Zanuck, head of 20th Century-Fox, 1946*

"There is no reason for any individual to have a computer in their home" *- Kenneth Olsen, president and founder of Digital Equipment Corp, 1977*

Example of surgical misconception of the future

Quotes from surgeons:

- "dangerous"
- "ridiculous"
- "unethical"
- "a joke"
- "will never work"



ATCSA2023
Ho Chi Minh city, Vietnam
ISMICS

Cardiovascular Disease Worldwide

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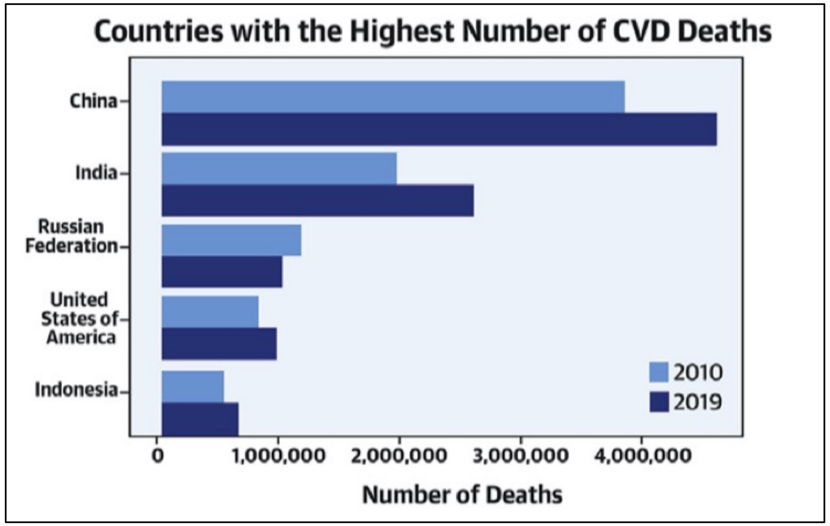
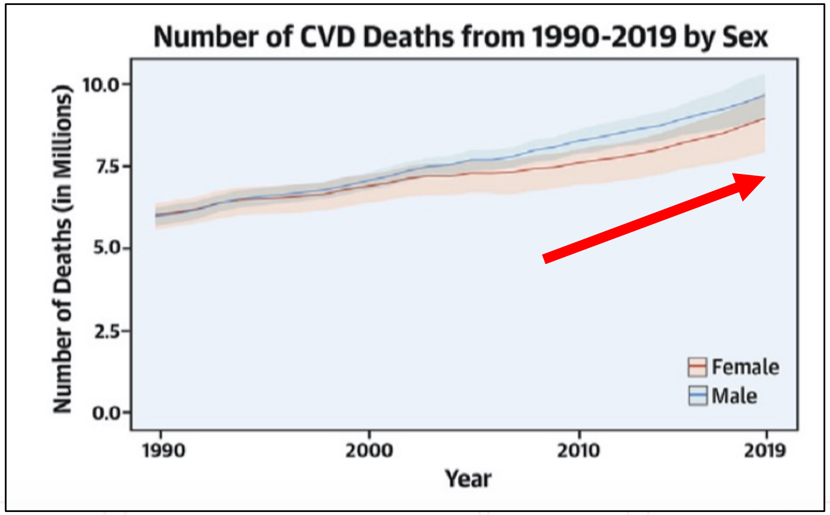
***JACC* STATE-OF-THE-ART REVIEW**

Global Burden of Cardiovascular Diseases and Risk Factors, 1990–2019

Update From the GBD 2019 Study

Gregory A. Roth, MD, MPH,[a] George A. Mensah, MD,[b] Catherine O. Johnson, PhD, MPH,[c] Giovanni Addolorato, MD,[d] Enrico Ammirati, MD, PhD,[e] Larry M. Baddour, MD,[f] Noël C. Barengo, MD, PhD, MPH,[g] Andrea Z. Beaton, MD,[h] Emelia J. Benjamin, MD, ScM,[i] Catherine P. Benziger, MD,[j] Aimé Bonny, MD, MSc,[k] Michael Brauer, ScD,[l] Marianne Brodmann, MD,[m] Thomas J. Cahill, MBBS, DPhil,[n] Jonathan Carapetis, MBBS, PhD,[o] Alberico L. Catapano, PhD,[p] Sumeet S. Chugh, MD,[q] Leslie T. Cooper, MD,[r] Josef Coresh, MD, PhD,[s] Michael Criqui, MD, MPH,[t] Nicole DeCleene, BS,[u] Kim A. Eagle, MD,[u] Sophia Emmons-Bell, BA,[c] Valery L. Feigin, MD, MSc, PhD,[a] Joaquim Fernández-Solà, MD, PhD,[v] Gerry Fowkes, PhD,[w] Emmanuela Gakidou, MSc, PhD,[a] Scott M. Grundy, MD, PhD,[x] Feng J. He, PhD,[y] George Howard, DrPH,[z] Frank Hu, MD, PhD,[aa] Lesley Inker, MD, MS,[bb] Ganesan Karthikeyan, MD,[cc] Nicholas Kassebaum, MD,[a] Walter Koroshetz, MD,[dd] Carl Lavie, MD,[ee] Donald Lloyd-Jones, MD, ScM,[ff] Hong S. Lu, MD, PhD,[gg] Antonio Mirijello, MD,[hh] Awoke Misganaw Temesgen, PhD,[c] Ali Mokdad, PhD,[c] Andrew E. Moran, MD,[ii] Paul Muntner, PhD,[z] Jagat Narula, MD, PhD,[jj] Bruce Neal, MBChB,[kk] Mpiko Ntsekhe, MD, PhD,[ll] Glaucia Moraes de Oliveira, MSc, PhD,[mm] Catherine Otto, MD,[a] Mayowa Owolabi, MBBS, MSc, DMed,[nn] Michael Pratt, MD, MPH,[t] Sanjay Rajagopalan, MD,[oo] Marissa Reitsma, PhD,[pp] Antonio Luiz P. Ribeiro, MD,[qq] Nancy Rigotti, MD,[rr] Anthony Rodgers, MD,[ss,tt] Craig Sable, MD,[uu] Saate Shakil, MD,[a] Karen Sliwa-Hahnle, MD, PhD,[ll] Benjamin Stark, MA,[a] Johan Sundström, MD, PhD,[vv] Patrick Timpel, MSc,[ww] Imad M. Tleyjeh, MD, MSc,[xx] Marco Valgimigli, MD, PhD,[yy] Theo Vos, MD, PhD,[a] Paul K. Whelton, MD, MSc,[zz] Magdi Yacoub, MD, PhD,[tt] Liesl Zuhlke, MBChB, PhD,[ll] Christopher Murray, DPhil,[c] Valentin Fuster, MD, PhD,[jj,aaa] for the GBD-NHLBI-JACC Global Burden of Cardiovascular Diseases Writing Group*





JACC 2020;76

Cardiovascular Disease Worldwide

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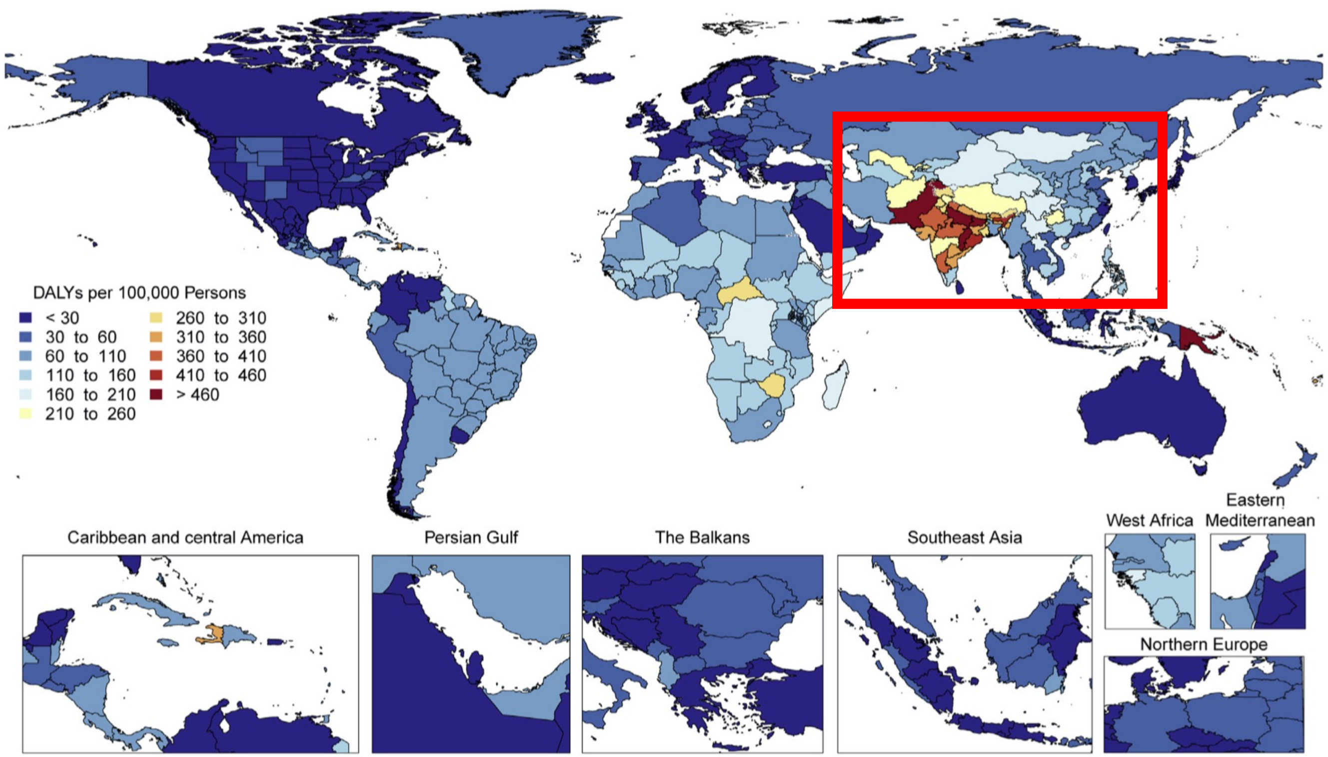
FIGURE 6 Map of Age-Standardized DALYs Due to Rheumatic Heart Disease in 2019



DALYs = disability-adjusted life years.

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Da Vinci

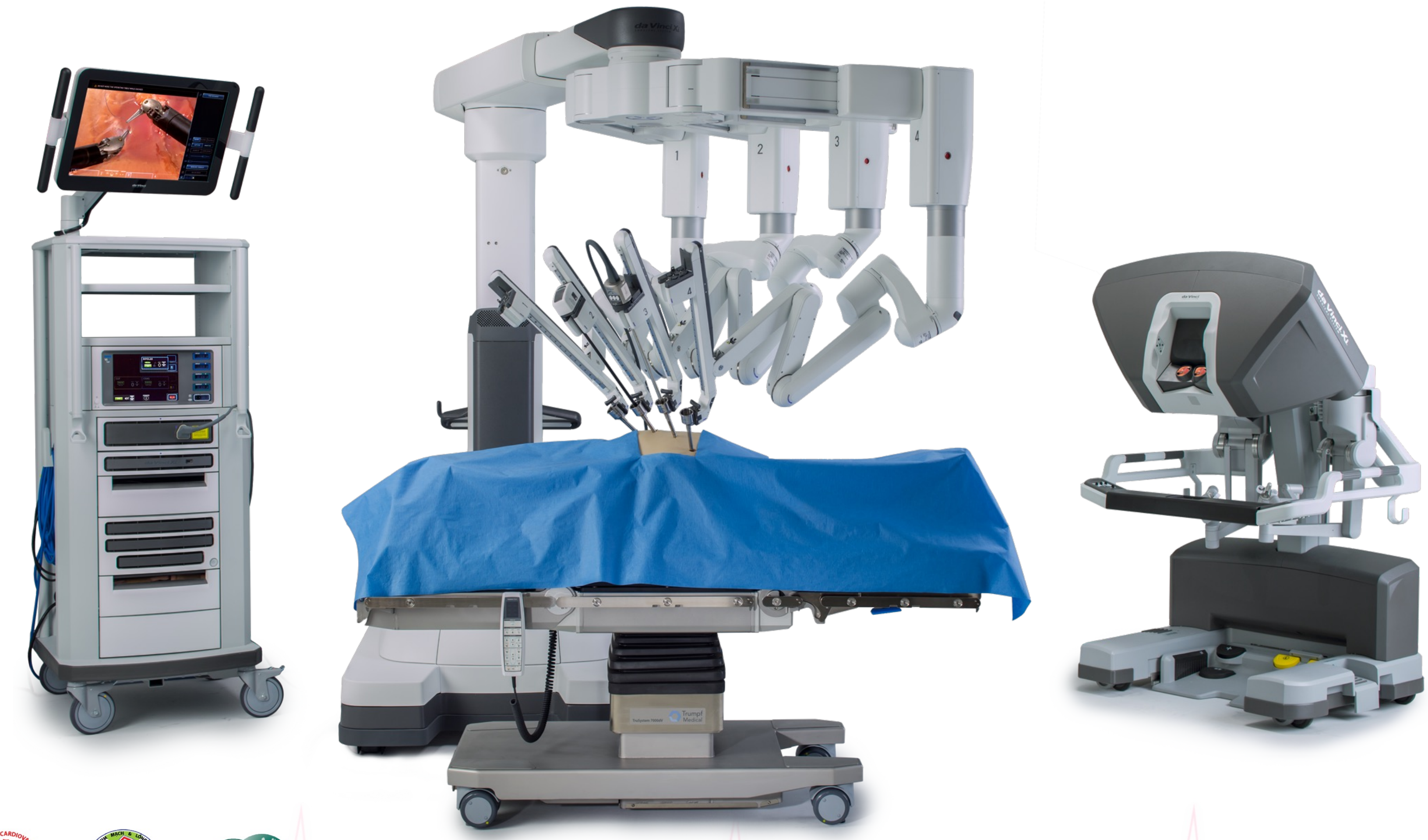


Foto: Intuitive Surgical 2019

ATCSA2023 Ho Chi Minh city, Vietnam

Modern Robotic Tools

https://isrg.intuitive,.com

Robotic Assisted Cardiac Procedures

- CABG (IMA harvesting, LIMA – LAD anastomosis)
- MV surgery
- TV surgery
- AV surgery
- ASD- /PFO-closure
- Cardiac tissue ablation
- Ductus arteriosus ligation
- Aortic ring ligation

Worldwide Procedure Trend

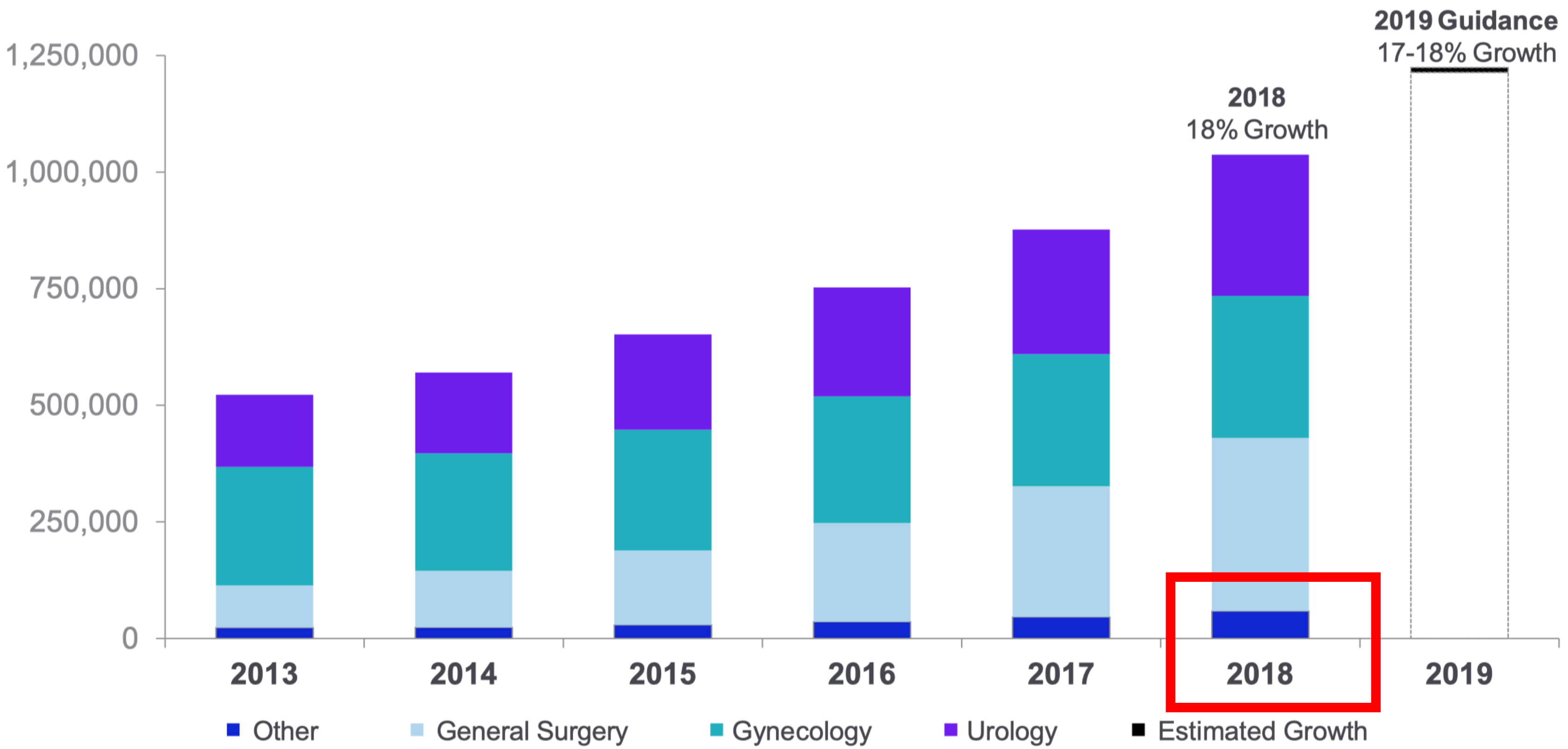
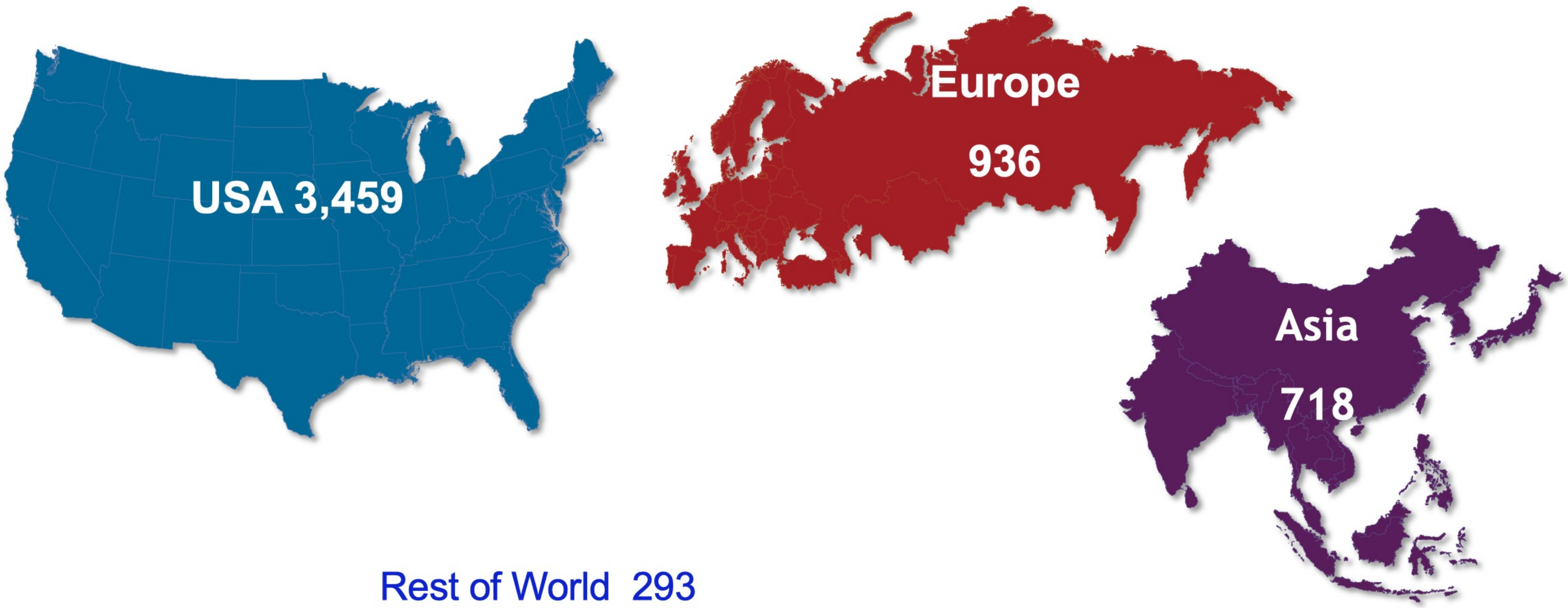


Foto: Intuitive Surgical 2019

Da Vinci System Installed Base

5,406 Worldwide as of September 30, 2019

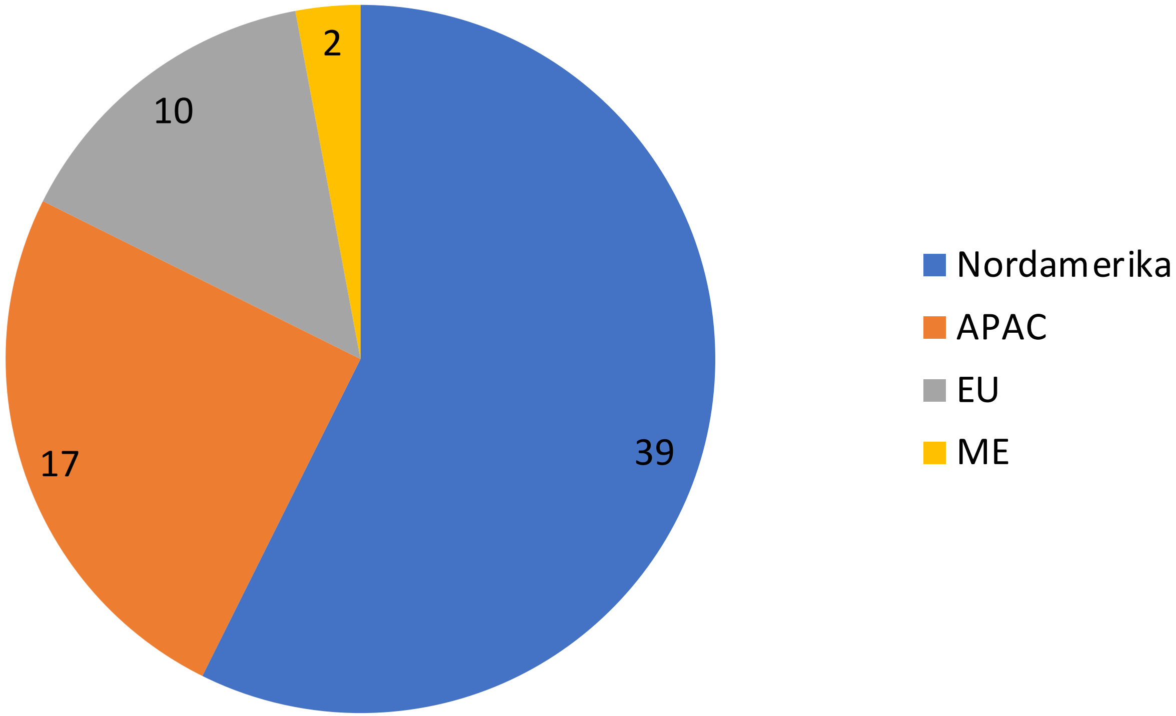


Rest of World 293

560 of 5,406 installed systems under operating lease.

Foto: Intuitive Surgical 2019

Numbers of Centers Performing Robotic Assisted Cardiac Procedures



Definition:
Min. 30 cardiac procedures with a robot within the last two years

Nordamerika: USA 35, Kanada 4
APAC (Asian Pacific Countries): China 6, Taiwan 5, Japan 4, Australien 1, Südkorea 1
EU (Europäische Union): Türkei 3, Belgien 3: Niederlande 2, Tschechische Republik 2
ME (Middle East): Saudi Arabien 1, Kuweit 1

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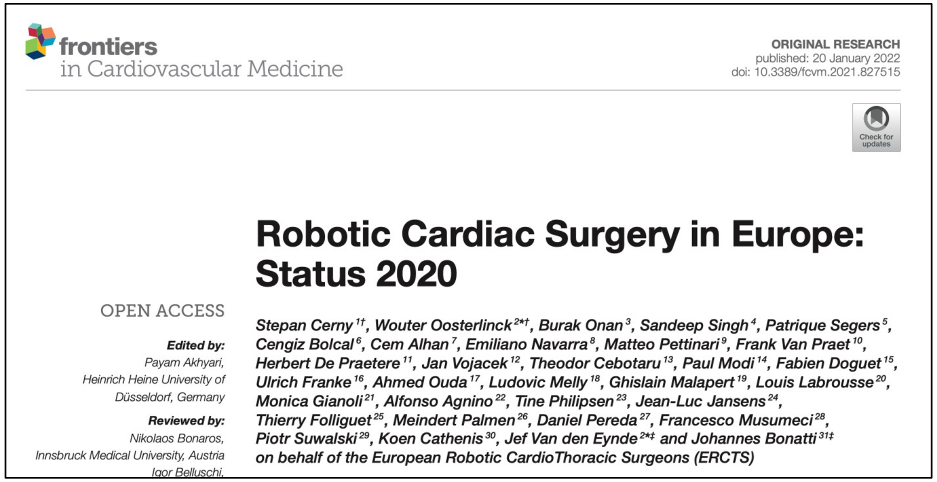
Europe


frontiers in Cardiovascular Medicine
ORIGINAL RESEARCH
published: 20 January 2022
doi: 10.3389/fcvm.2021.827515

Check for updates

Robotic Cardiac Surgery in Europe: Status 2020

OPEN ACCESS

Edited by:
Payam Akhyari,
Heinrich Heine University of Düsseldorf, Germany

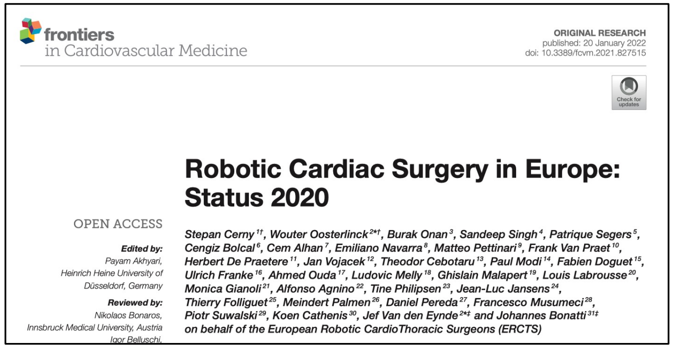
Reviewed by:
Nikolaos Bonaros,
Innsbruck Medical University, Austria
Igor Belluschi,

Stepan Cerny[1†], Wouter Oosterlinck[2†], Burak Onan[3], Sandeep Singh[4], Patrique Segers[5], Cengiz Bolcal[6], Cem Alhan[7], Emiliano Navarra[8], Matteo Pettinari[9], Frank Van Praet[10], Herbert De Praetere[11], Jan Vojacek[12], Theodor Cebotaru[13], Paul Modi[14], Fabien Doguet[15], Ulrich Franke[16], Ahmed Ouda[17], Ludovic Melly[18], Ghislain Malapert[19], Louis Labrousse[20], Monica Gianoli[21], Alfonso Agnino[22], Tine Philipsen[23], Jean-Luc Jansens[24], Thierry Folliguet[25], Meindert Palmen[26], Daniel Pereda[27], Francesco Musumeci[28], Piotr Suwalski[29], Koen Cathenis[30], Jef Van den Eynde[2*‡] and Johannes Bonatti[31‡] on behalf of the European Robotic CardioThoracic Surgeons (ERCTS)*

- 4 year period
- 2,563 procedures
  - CABG 49.4%
  - MV or TV surgery 36.9%
  - ASD closure 8.8%
  - Atrial myxoma resection 2.1%
  - other 2.8%
- Bleeding 2.2%
- Stroke 0.2%
- Mortality 1.1%

Frontiers Cardiovasc Med 2022;8, article 827515

Europe



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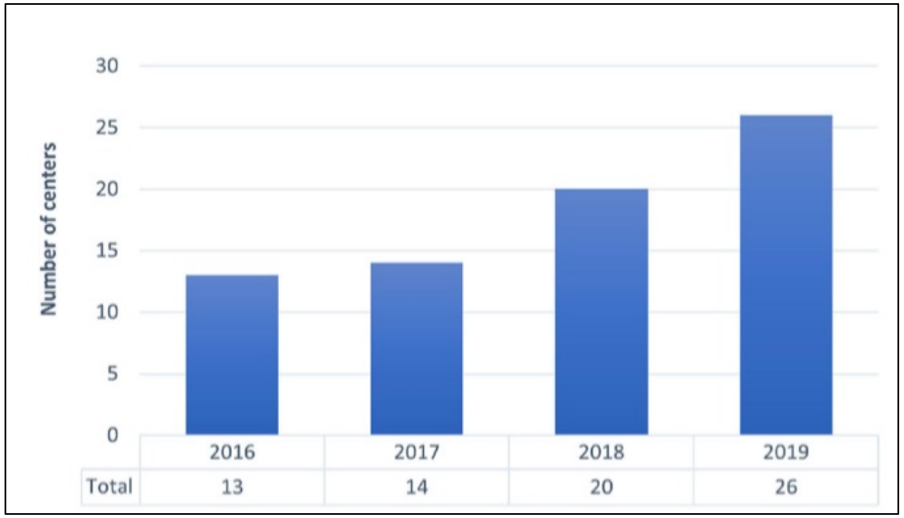
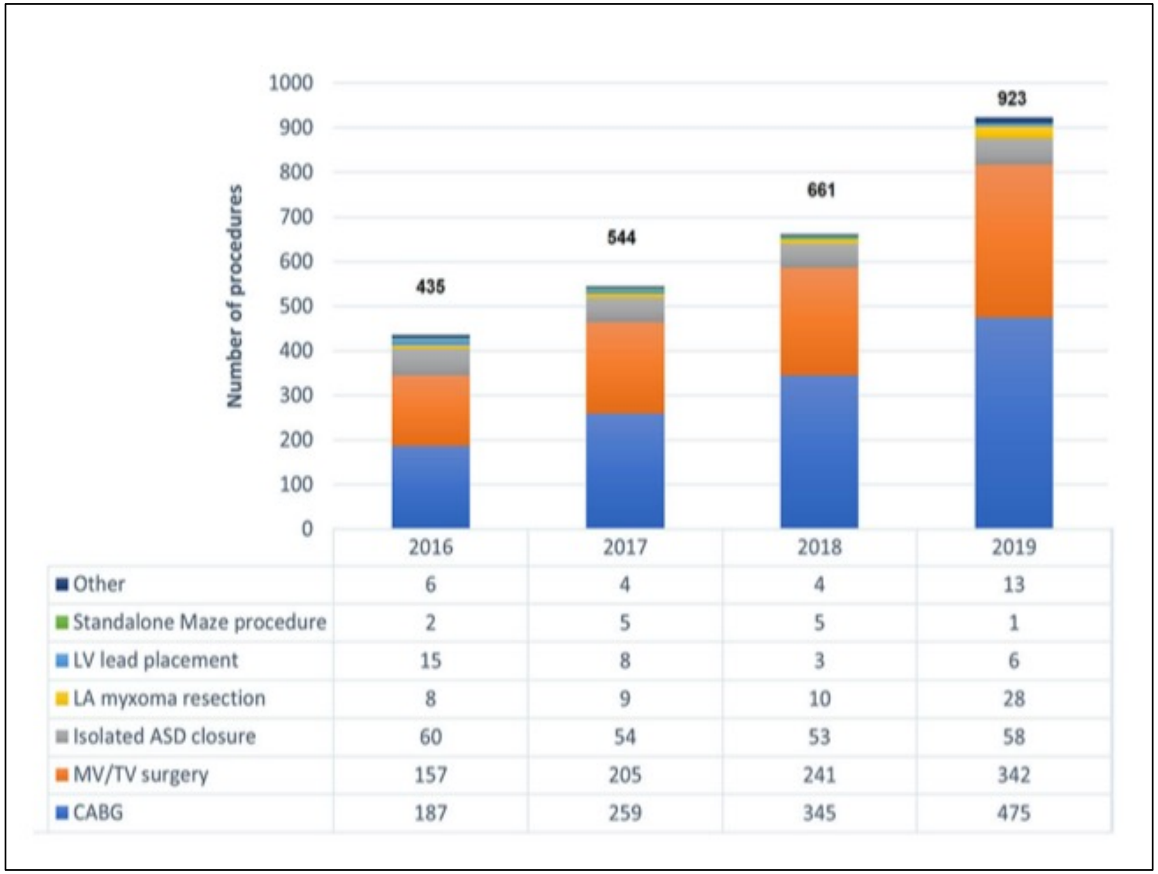


	2016	2017	2018	2019
Total	13	14	20	26



	2016	2017	2018	2019
Other	6	4	4	13
Standalone Maze procedure	2	5	5	1
LV lead placement	15	8	3	6
LA myxoma resection	8	9	10	28
Isolated ASD closure	60	54	53	58
MV/TV surgery	157	205	241	342
CABG	187	259	345	475

Frontiers Cardiovasc Med 2022;8, article 827515

Europe

frontiers in Cardiovascular Medicine

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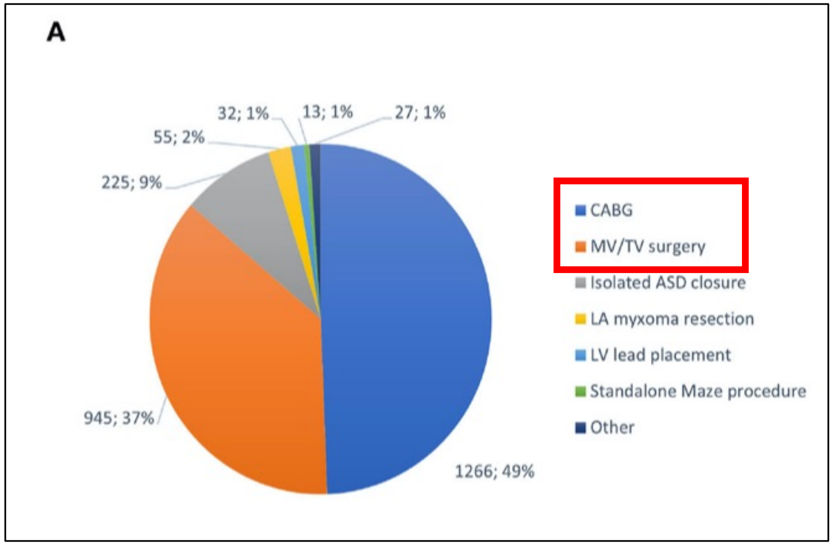

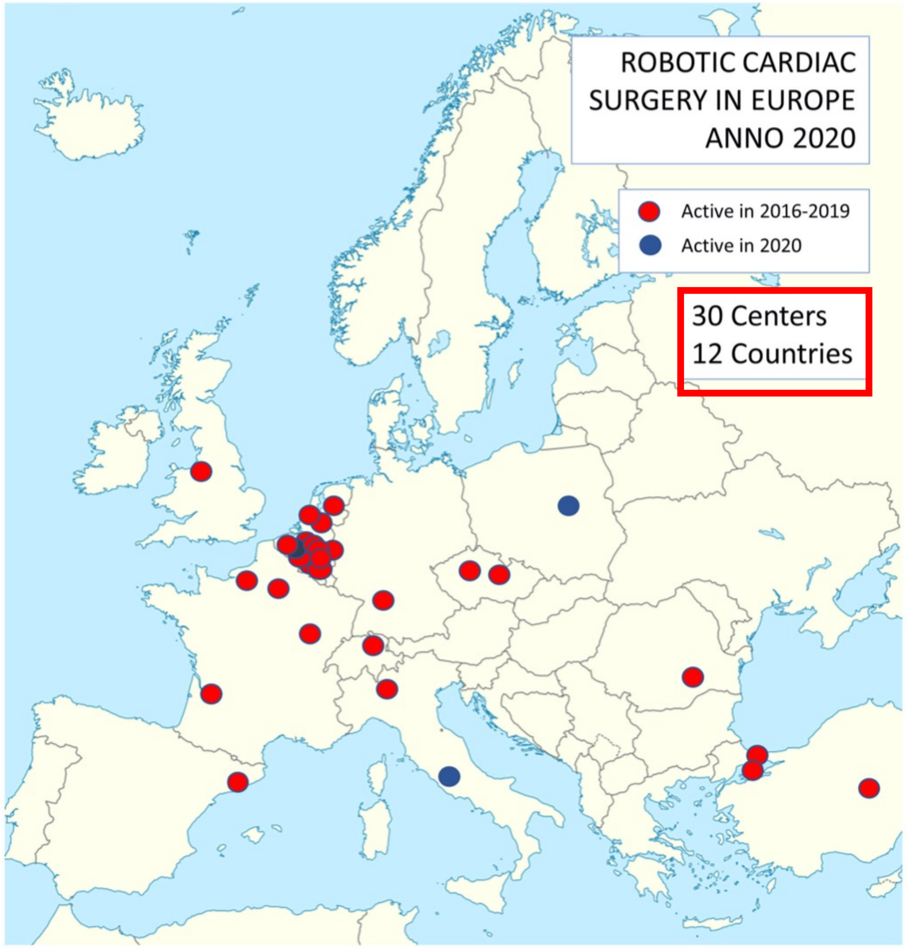

FIGURE 1 | Distribution of centers performing robotic cardiac surgery in Europe. Note a concentration of activities in Belgium and the Netherlands.

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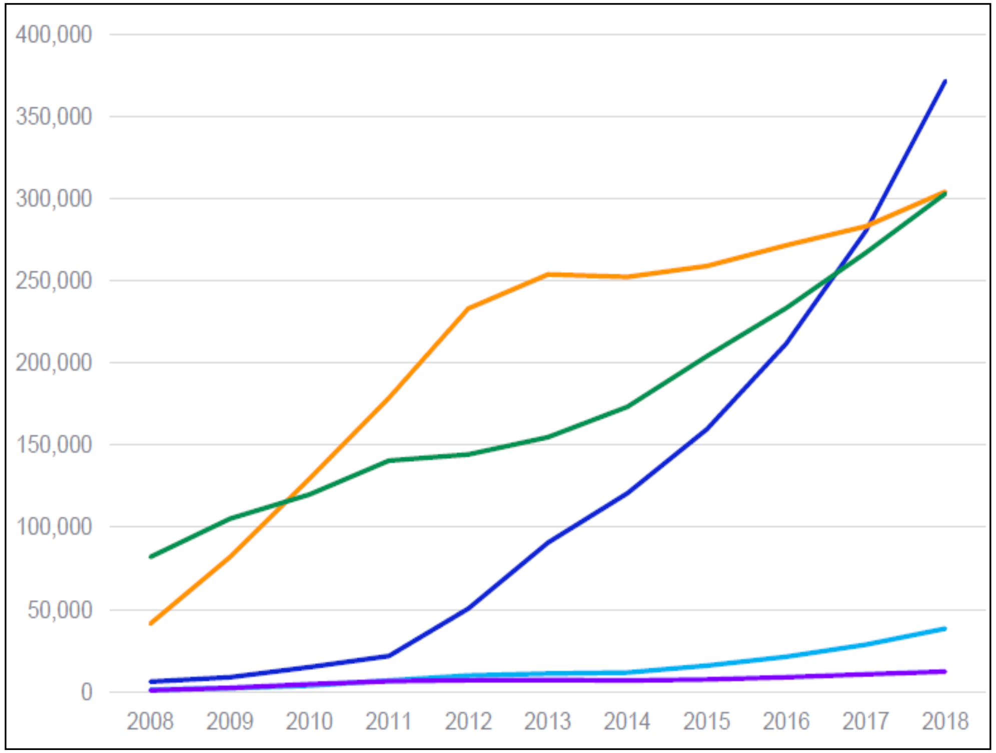
Evolution of Robotic Surgery



General surgery

Gynecology

Urology

Thoracic surgery

TORS = transoral robotic assisted surgery

https://isrg.intuitive,.com

Robotic Cardiac Surgery

Journal of *Cardiovascular Development and Disease*

MDPI

Review

Is There a Future for Minimal Access and Robots in Cardiac Surgery?

Gloria Faerber, Murat Mukharyamov and Torsten Doenst *

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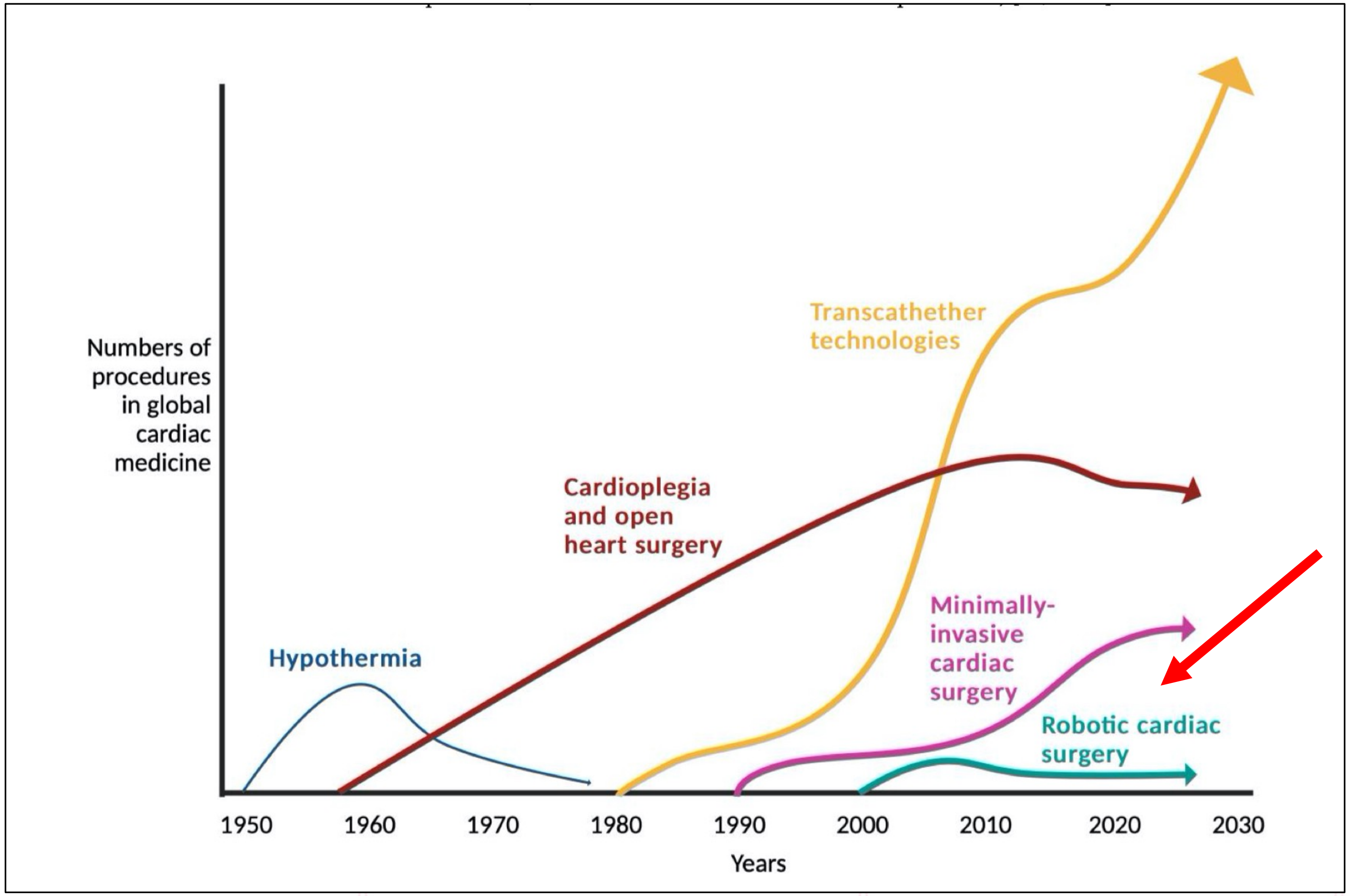
Abstract: Minimally invasive techniques in cardiac surgery have found increasing use in recent years. Both patients and physicians often associate smaller incisions with improved outcomes (i.e., less risk, shorter hospital stay, and a faster recovery). Videoscopic and robotic assistance has been introduced, but their routine use requires specialized training and is associated with potentially longer operating times and higher costs. Randomized evidence is scarce and transcatheter treatment alternatives are increasing rapidly. As a result, the concept of minimally invasive cardiac surgery may be viewed with skepticism. In this review, we examine the current status and potential future perspectives of minimally invasive and robotic cardiac surgery.



J Cardiovasc Dev Dis 2023;10:380

Mitral Valve Surgery

Review Article

Innovations
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Minimally Invasive and Robotic Mitral Valve Surgery: Methods and Outcomes in a 20-Year Review

Johannes Bonatti[1,2], MD, Ingo Crailsheim[1,2], MD, Martin Grabenwöger[1,2,3], MD, and Bernhard Winkler[1,2,4], MD

Abstract

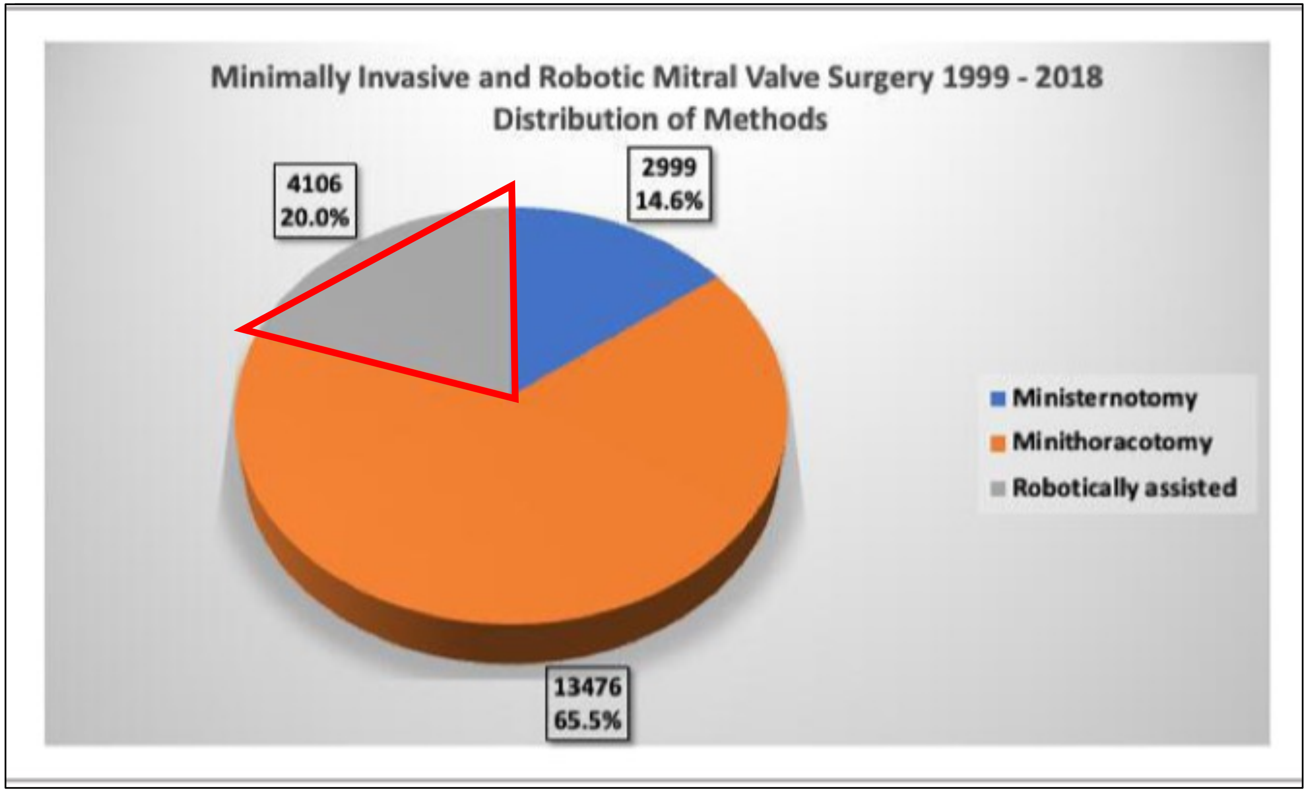
In the mid- to late-1990s the cardiac surgery community began to apply limited incisions in mitral valve surgery. Ministernotomies and right-sided minithoracotomies were placed instead of the classic midline sternotomy. Adjunct technology such as videoscopy, advanced peripheral cannulation techniques, procedure specific long shafted surgical instruments, as well as surgical robots became available, and the procedures were refined in a stepwise fashion. In 2021, minimally invasive mitral valve repair is routine at many centers around the globe. We reviewed a total of 50 consecutive patient series published on the topic between 1999 and 2019. Three main versions of minimally invasive mitral valve surgery were applied in 20,539 patients. The surgical methods, their specific results, and the cumulative outcome of less invasive mitral valve surgery published over more than 20 years are reported and an integrated view on what less invasive mitral valve surgery can offer is presented.

Keywords

mitral valve repair, minimally invasive, minithoracotomy, videoscopy, robotic surgery, totally endoscopic mitral valve repair

Central Message

Our review of 50 consecutive series published on minimally invasive and robotic mitral valve surgery, demonstrates that this type of intervention can be performed with very satisfactory intra-operative and post-operative outcome while surgical trauma is significantly reduced.



Innovations, DOI: 10.1177/15569845211012389

Mitral Valve Surgery

Keynote Lecture Series

Robotic mitral valve surgery: overview, methodology, results, and perspective

W. Randolph Chitwood Jr[1,2,3]

[1]Emeritus Chairman, Department of Surgery, Brody School of Medicine, Greenville, NC, USA; [2]Founding Director, East Carolina Heart Institute, East Carolina University, Greenville, NC, USA; [3]Visting Professor, University of Virginia, Charlottesville, VA, USA

Correspondence to: W. Randolph Chitwood Jr, MD, (D.Sc.-Hon), FACS, FACC, FRCS (England). 146 East Longmeadow Road, Greenville, North Carolina 27858, USA. Email: chitwoodw@ecu.edu.

Table 4 Technique toolbox used for robotic mitral valve repairs

Posterior leaflet prolapse		Anterior leaflet prolapse	Bileaflet prolapse (barlow)	Commissure prolapse
Small segment	Large segment			
Triangular resection	Trapezoid resection	Triangular resection (small segment)	AL = PTFE neochords PL = multiple triangular resections	Commissure closure Alfieri stitch or "magic stitch"
PTFE neochords	PTFE neochords	PTFE neochords (large segment)	AL = PTFE neochords PL = multiple folding-plasties	PTFE neochords
Native chord transfer	"Haircut" Edge resection + native chord transfer or PTFE neochords	Papillary Folding-plasty For multiple chords	AL = PTFE neochords PL = leaflet sliding-plasty	PL = sliding-plasty + PTFE neochords
Leaflet folding-plasty	Leaflet folding-plasty	Combined techniques	Combined techniques	Papillary folding-plasty (elongated or multi papillary: PL and AL Chords)
Inter-scallop cleft closure	Inter-scallop cleft closure	–	–	–

AL, anterior leaflet; PL, posterior leaflet; PTFE, polytetrafluoroethylene.

Ann Cardiothorac Surg 2016;5:544

Cardiac Surgical Training

Global Differences in the Training, Practice, and Interrelationship of Cardiac and Thoracic Surgeons

Douglas E. Wood, MD, and Farhood Farjah, MD, MPH

Section of General Thoracic Surgery, Division of Cardiothoracic Surgery, and Department of Surgery, University of Washington, Seattle, Washington

Background. Training and certification for general thoracic surgeons varies enormously between countries. There is little knowledge about training and certification for general thoracic surgeons, and the relationship between thoracic surgery and cardiac surgery around the world.

Methods. A 38-item survey was designed to assess training, practice, demographics, and relationships of general thoracic and cardiac surgeons. Eighteen cardiothoracic societies representing surgeons on six continents were contacted, and 15 submitted the survey to their membership. The survey was advertised through CTSnet, and 928 surgeons from 105 countries were contacted directly in regions not covered by the professional societies.

Results. In all, 1,520 survey respondents were tabulated, representing 95 separate countries. Non-US respondents were younger, more commonly had practices exclusively in cardiac or thoracic surgery, less commonly obtained general surgery certification, less commonly performed esophageal surgery, and had shorter overall surgical training but longer specialized training in cardiothoracic surgery, although US respondents received greater length of cardiac surgery specific training (all $p < 0.05$). The US respondents thought that cardiac surgery training was more important for the practice of general thoracic surgery than did non-US respondents, and that it was important for thoracic surgeons and cardiac surgeons to be aligned in public policy and specialty advocacy.

Conclusions. Marked differences in training and certification across the world result in discrepancies in clinical practice, levels of collaboration between cardiac and thoracic surgeons, and culture and attitude differences that are relevant to the feasibility of alliances relating to public policy. These findings also provide important data to inform any decisions about changes in US cardiothoracic training. Greater international cooperation may diminish these differences in order to propagate improvements in cardiothoracic education, and improve patient access and outcomes through shared specialty advocacy.

(Ann Thorac Surg 2009;88:515–22)

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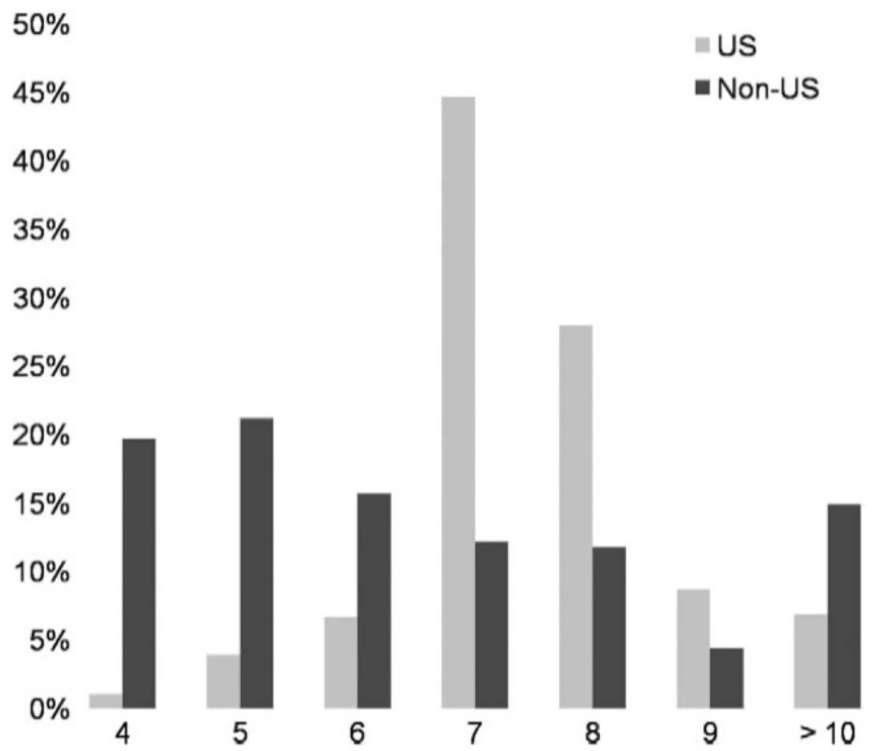

Fig 1. Total duration of post–medical school clinical training of US surgeons (light gray bars) and non-US surgeons (dark gray bars), in years.

Ann Thorac Surg 2009;88:515

„Gold Standards in Cardiac Surgery“

- Minimally invasive MV-, TV-surgery (ASD, PFO, tumor surgery, ablation therapy)
- Aortic valve sparing procedures in aortic root aneurysm +/- AR
- anOPCAB

Minimally Invasive Mitral Valve Surgery

Minimally Invasive MV Surgery

Cardiovascular Surgery

Learning Minimally Invasive Mitral Valve Surgery

A Cumulative Sum Sequential Probability Analysis of 3895 Operations From a Single High-Volume Center

David M. Holzhey, MD, PhD; Joerg Seeburger, MD; Martin Misfeld, MD, PhD;
Michael A. Borger, MD, PhD; Friedrich W. Mohr, MD, PhD

Background—Learning curves are vigorously discussed and viewed as a negative aspect of adopting new procedures. However, very few publications have methodically examined learning curves in cardiac surgery, which could lead to a better understanding and a more meaningful discussion of their consequences. The purpose of this study was to assess the learning process involved in the performance of minimally invasive surgery of the mitral valve using data from a large, single-center experience.

Methods and Results—All mitral (including tricuspid, or atrial fibrillation ablation) operations performed over a 17-year period through a right lateral mini-thoracotomy with peripheral cannulation for cardiopulmonary bypass (n=3907) were analyzed. Data were obtained from a prospective database. Individual learning curves for operation time and complication rates (using sequential probability cumulative sum failure analysis) and average results were calculated. A total of 3895 operations by 17 surgeons performing their first minimally invasive surgery of the mitral valve operation at our institution could be evaluated. The typical number of operations to overcome the learning curve was between 75 and 125. Furthermore, >1 such operation per week was necessary to maintain good results. Individual learning curves varied markedly, proving the need for good monitoring or mentoring in the initial phase.

Conclusions—A true learning curve exists for minimally invasive surgery of the mitral valve. Although the number of operations required to overcome the learning curve is substantial, marked variation exists between individual surgeons. Such information could be very helpful in structuring future training and maintenance of competence programs for this kind of surgery. (***Circulation*. 2013;128:483–491.**)

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Circulation 2013;128:483

Typical CUSUM Graph

Cardiovascular Surgery

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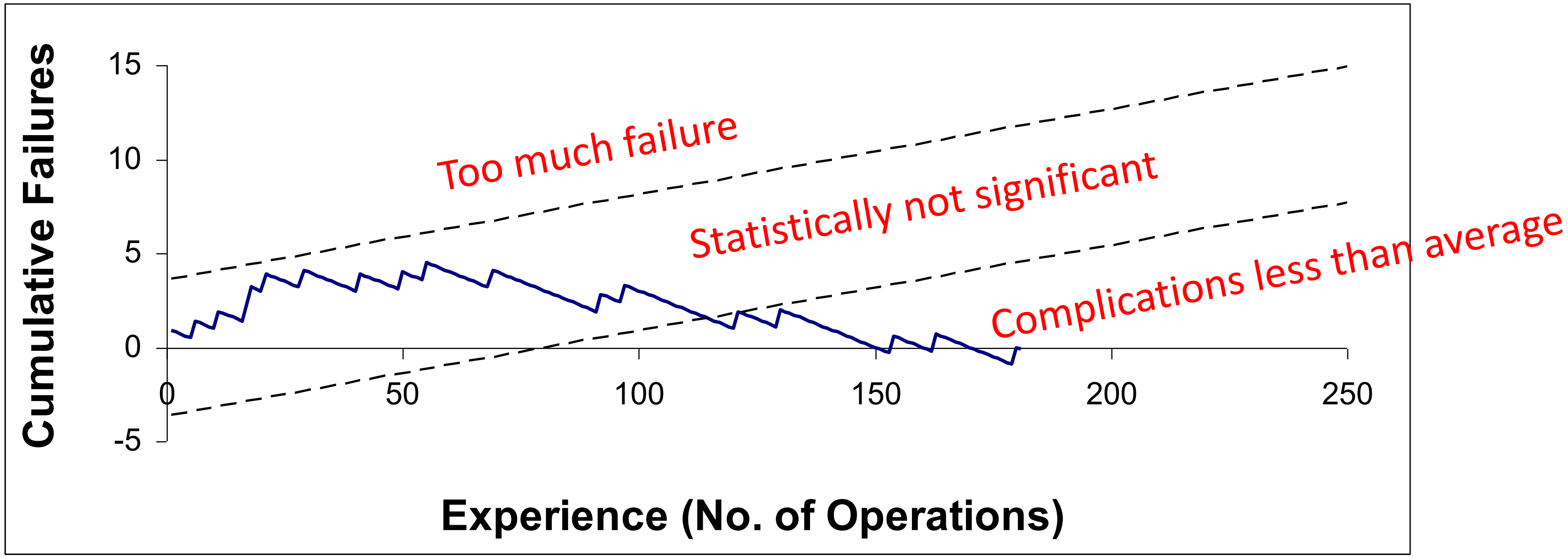
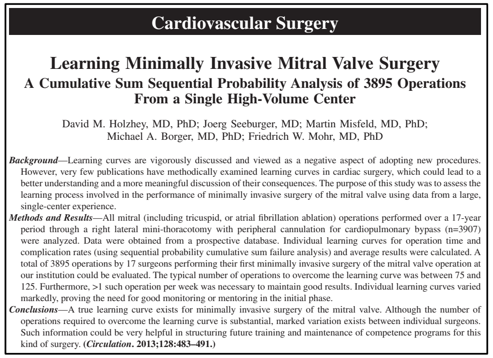
>>>> Observed minus expected failures



Circulation 2013;128:483

Minimally Invasive MV Surgery



Cardiovascular Surgery

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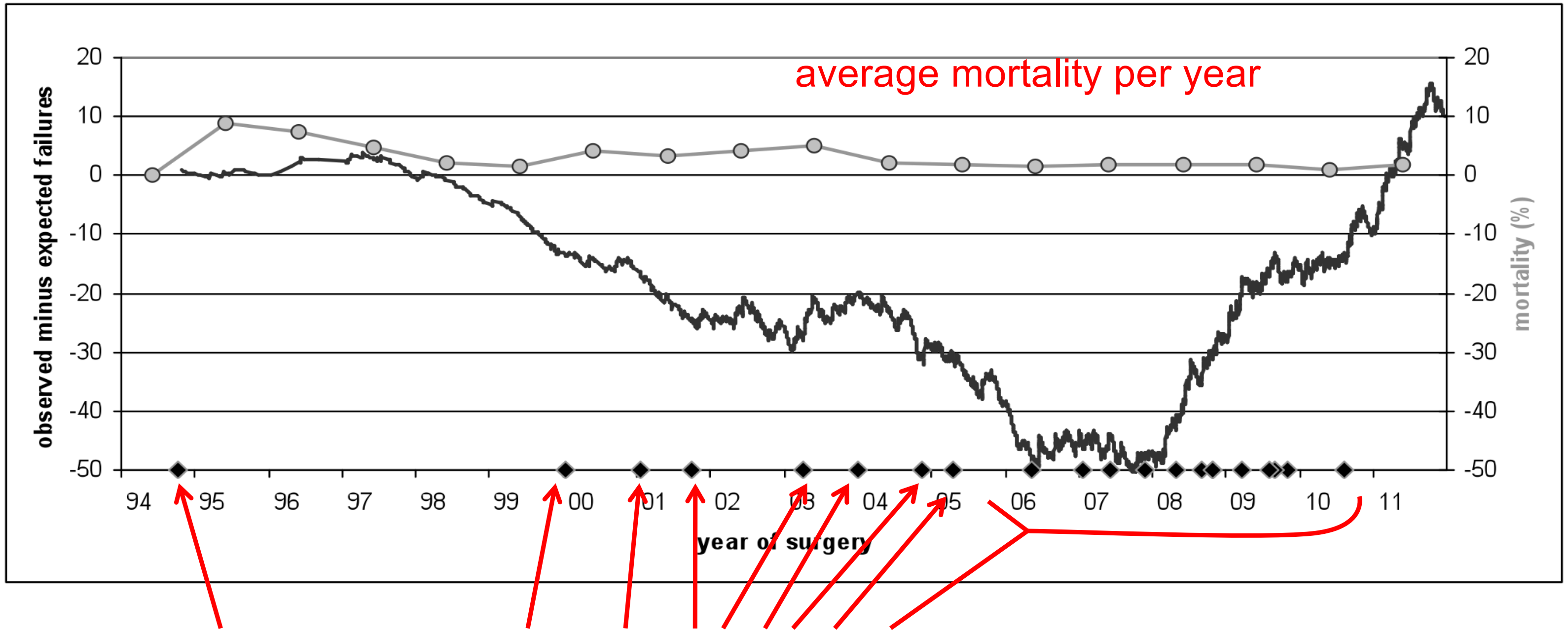

first operation of each new surgeon

Circulation 2013;128:483

Individual Learning Curve Patterns

Cardiovascular Surgery

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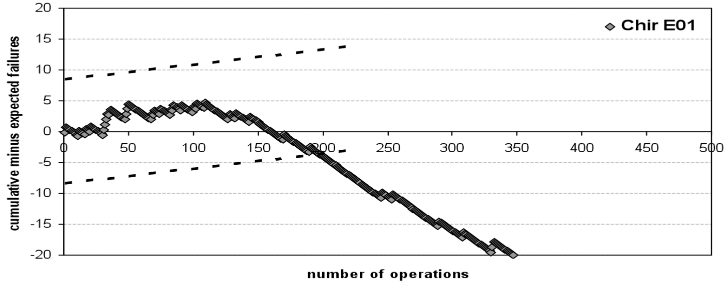
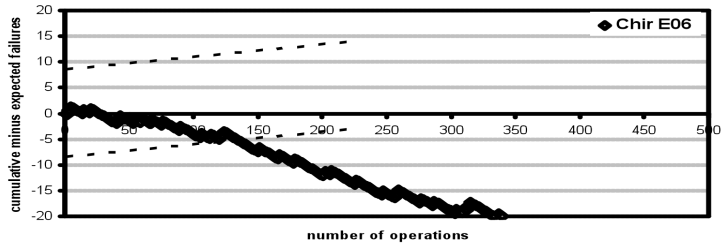
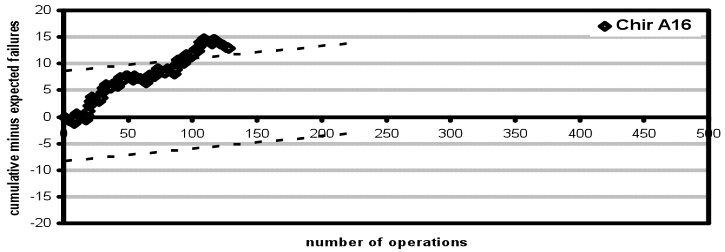
Examples of learning curve patterns



Lower complication rate after ≈ 125 operations



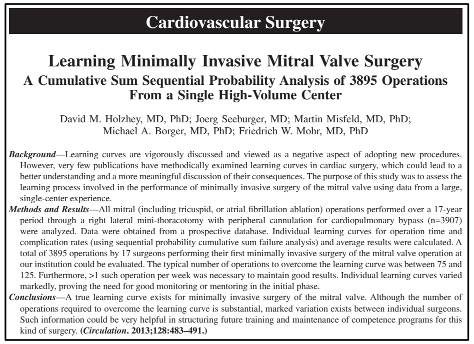
„Outperformer“



Too many complications

Circulation 2013;128:483

Dependency of Adverse Events on Operation Frequency



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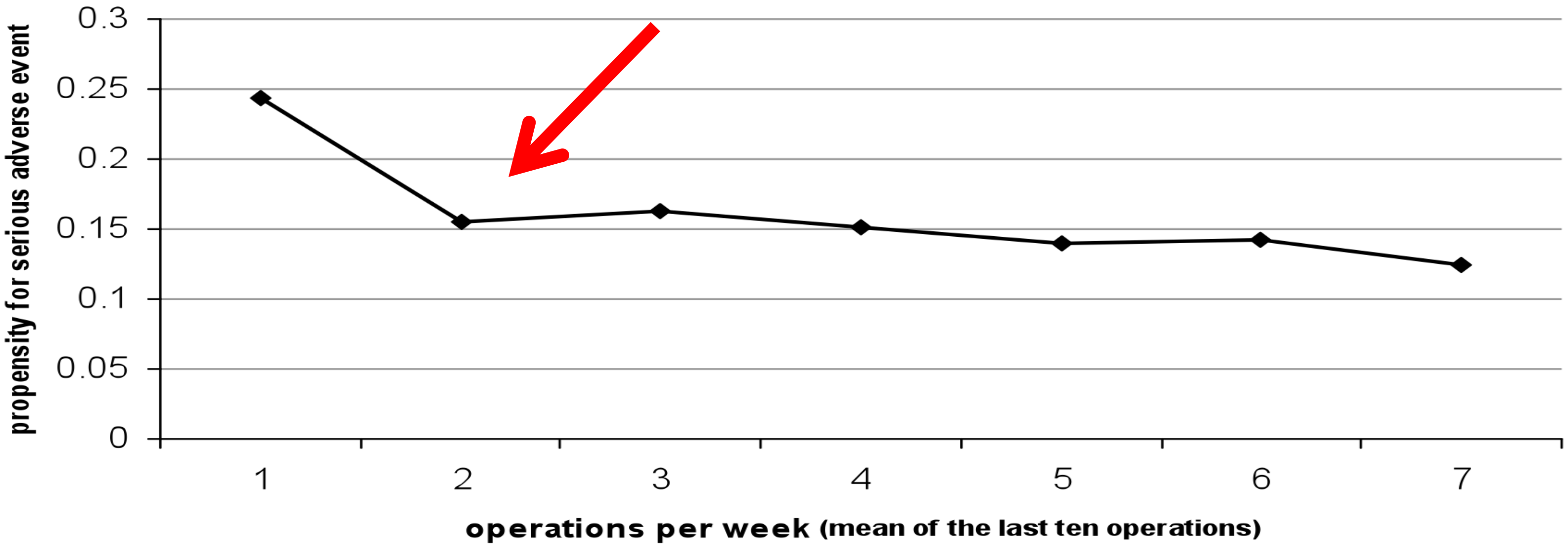

Circulation 2013;128:483

Mitral Valve Surgery

Mitral valve repair rates correlate with surgeon and institutional experience

Damien J. LaPar, MD, MSc,[a] Gorav Ailawadi, MD,[a] James M. Isbell, MD, MSCI,[a] Ivan K. Crosby, MD,[a] John A. Kern, MD,[a] Jeffrey B. Rich, MD,[b] Alan M. Speir, MD,[c] and Irving L. Kron, MD,[a] Investigators for the Virginia Cardiac Surgery Quality Initiative

Objectives: Mitral valve (MV) repair rates have lagged despite reported superior outcomes in patients with mitral regurgitation. The purpose of the present study was to evaluate the relationship between procedure volume and the propensity for MV repair in a multi-institution, regional patient cohort.

Methods: Society of Thoracic Surgeons–certified patient records of those undergoing MV repair or MV replacement (MVR) for moderate or severe mitral regurgitation were evaluated from 17 different centers (2001-2011). The relationship between the annual hospital and surgeon volume and the propensity for MV repair over MVR was analyzed using multivariable, mortality risk-adjusted models with restricted cubic splines.

Results: A total of 4194 patients were evaluated (MV repair, 2516; MVR, 1662). The median annual mitral procedure volume was 54 operations for hospitals and 13 operations for surgeons. The overall MV repair rate was 60%, with significant variations among hospitals (range, 35%-70%) and surgeons (range, 0%-90%). The MVR patients presented with higher Society of Thoracic Surgeons Predicted Risk of Mortality scores (6% vs 2%, $P < .001$). After adjustment for Predicted Risk of Mortality score, both annual hospital ($P = .04$) and surgeon ($P < .0001$) procedure volume were associated with the probability of MV repair. The likelihood for MV repair correlated with an operative volume of ≥20 procedures annually. Among surgeons and hospitals performing ≥20 mitral operations annually, MV repair rates were greater (73% vs 26% and 62% vs 37%, respectively, $P < .001$ for both).

Conclusions: Significant variation in the performance of MV repair over MVR for mitral regurgitation persists in the modern surgical era. Average annual surgeon volume was more significantly associated with MV repair rate than institutional volume, with an increased likelihood for performance of MV repair among surgeons performing >20 procedures annually. In the upcoming era of percutaneous MV repair, surgeon volume and expertise as a gatekeeper should dictate access to this technology and the decisions for the best approach to MV repair. (J Thorac Cardiovasc Surg 2014;148:995-1004)

- STS database analysis
- MV repair/replacement for MV regurgitation
- 4,194 pts (2,516 repair vs 1,662 replacement)
- Median annual MV procedure volume:
  - 54 operations / hospital!
  - **13 operations / surgeon!**
- Overall repair rate 60% (0-90%)!

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J Thorac Cardiovasc Surg 2014;148:995

Mitral Valve Surgery

Robotic mitral valve surgery: A United States multicenter trial

L. Wiley Nifong, MD,[a] W. R. Chitwood, MD,[a] P. S. Pappas, MD,[b] C. R. Smith, MD,[c] M. Argenziano, MD,[c] V. A. Starnes, MD,[d] and P. M. Shah, MD,[e] for the Multi-center Robotic Mitral Repair Group[f]

Objective: In a prospective phase II Food and Drug Administration trial, robotic mitral valve repairs were performed in 112 patients at 10 centers by using the da Vinci surgical system. The safety of performing valve repairs with computerized telemanipulation was studied.

Methods: After institutional review board approval, informed consent was obtained. Patients had moderate to severe mitral regurgitation. Operative technique included peripheral cardiopulmonary bypass, a 4- to 5-cm right minithoracotomy, a transthoracic aortic crossclamp, and antegrade cardioplegia. The successful study end point was grade 0 or 1 mitral regurgitation by transthoracic echocardiography at 1 month after surgery.

Results: Valve repairs included quadrangular resections, sliding plasties, edge-to-edge approximations, and both chordal transfers and replacements. The average age was 56.4 ± 0.09 years (mean ± SEM). There were 77 (68.8%) men and 35 (31.2%) women. Valve pathology was myxomatous degeneration in 105 (91.1%), and 103 (92.0%) had type II leaflet prolapse. Leaflet repair times averaged 36.7 ± 0.2 minutes, with annuloplasty times of 39.6 ± 0.1 minutes. Total robot, aortic cross-clamp, and cardiopulmonary bypass times were 77.9 ± 0.3 minutes, 2.1 ± 0.1 hours, and 2.8 ± 0.1 hours, respectively. On 1-month transthoracic echocardiography, 9 (8.0%) had grade 2 mitral regurgitation, and 6 (5.4%) of these had reoperations (5 replacements and 1 repair). There were no deaths, strokes, or device-related complications.

Conclusions: Multiple surgical teams performed robotic mitral valve repairs safely early in development of this procedure, with a reoperation rate of 5.4%. Advancements in robotic design and adjunctive technologies may help in the evolution of this minimally invasive technique by decreasing operative times.

From the Brody School of Medicine at East Carolina University, Pitt County Memorial Hospital, Greenville, NC,[a] Advocate Christ Medical Center, Oak Lawn, Ill,[b] Columbia Presbyterian Hospital, New York, NY,[c] University of Southern California, Los Angeles, Calif,[d] and Hoag Heart and Vascular Institute, Hoag Memorial Hospital, Newport Beach, Calif[e] (see Table 1 for a complete listing of participants and institutions[f]).

Supported in part by an Innovation in Clinical Research Award (Grant 1059) from the

TABLE 1. Institutions and investigators

Site	Investigators	No.
East Carolina University	CS: W. Randolph Chitwood Jr	22
Greenville, NC	PSS: L. Wiley Nifong	
Advocate Christ Hospital	CS: Pat Pappas	20
Oak Lawn, Ill	PSS: Anthony Tatooles	
Columbia Presbyterian Hospital	CS: Craig Smith	15
New York, NY	PSS: Michael Argenziano	
University of Southern California	CS: Vaughn Starnes	13
Los Angeles, Calif	PSS: Daniel Schwarz	
St Vincent's Hospital	CS: Jeffrey Swanson	11
Portland, Ore	PSS: Michael Savitt	
Carillon Roanoke Memorial Hospital	CS: Joseph Baker	9
Roanoke, Va	PSS: Paul Frantz	
INNOVA Fairfax Hospital	CS: Paul Massimiano	9
Fairfax, Va	PSS: Edward Lefrak	
Ohio State University	CS: Robert Michler	7
Columbus, Ohio	PSS: David Brown	
Brigham & Women's Hospital	CS: Lawrence Cohn	4
Boston, Mass	PSS: Lishan Aklog	
Baylor Healthcare System	CS: Robert Hebeler	3
Dallas, Tex	PSS: Richard Wood	

CS, Console surgeon; *PSS*, patient side surgeon.

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J Thorac Cardiovasc Surg 2005;129:1395

Mitral Valve Surgery

Research

JAMA Cardiology | Original Investigation

Volume-Outcome Association of Mitral Valve Surgery in the United States

Vinay Badhwar, MD; Sreekanth Vemulapalli, MD; Michael A. Mack, MD; A. Marc Gillinov, MD; Joanna Chikwe, MD; Joseph A. Dearani, MD;

Table 1. Patient Characteristics of Isolated MVRR for Primary Mitral Regurgitation by Quartiles of MVRR Volume[a] (continued)

Variable	Overall (N = 55 311)	Annual volume quartile: Quartile 1 (0.80-10.80) (n = 1485)	Quartile 2 (10.88-23.27) (n = 4198)	Quartile 3 (23.45-46.36) (n = 10 247)	Quartile 4 (>46.55) (n = 39 381)	*P* value
Mitral valve procedure						
Replacement	10 619 (19.2)	537 (36.2)	1255 (29.9)	2725 (26.6)	6102 (15.5)	<.001
Repair	44 692 (80.8)	948 (63.8)	2943 (70.1)	7522 (73.4)	33 279 (84.5)	
Operative approach						
Minimally invasive thoracotomy	16 199 (29.3)	109 (7.3)	539 (12.8)	1965 (19.2)	13 586 (34.5)	<.001
Sternotomy						
Partial	1228 (2.2)	8 (0.5)	73 (1.7)	216 (2.1)	931 (2.4)	
Full	37 804 (68.3)	1366 (92.0)	3580 (85.3)	8054 (78.6)	24 804 (63.0)	
Robotic technology assisted						
Yes	5756 (10.4)	7 (0.5)	96 (2.3)	580 (5.7)	5073 (12.9)	<.001
No	49 300 (89.1)	1474 (99.3)	4097 (97.6)	9660 (94.3)	34 069 (86.5)	

ATCSA2023 Ho Chi Minh city, Vietnam

JAMA Cardiol. DOI:10.1001/jamacardio.2020.2221

Aortic Valve Sparing Procedure for Aortic Root Aneurysm +/- AR

Aortic Valve Preserving Operations (BAV)

Aortic root replacement with bicuspid valve reimplantation: Are outcomes and valve durability comparable to those of tricuspid valve reimplantation?

Check for updates

Suyog A. Mokashi, MD,[a] Brad F. Rosinski, BS,[a] Milind Y. Desai, MD,[b,c] Brian P. Griffin, MD,[b,c] Donald F. Hammer, MD,[b,c] Vidyasagar Kalahasti, MD,[b] Douglas R. Johnston, MD,[a,c] Jeevanantham Rajeswaran, PhD,[d] Eric E. Roselli, MD,[a,c] Eugene H. Blackstone, MD,[a,c,d] and Lars G. Svensson, MD, PhD[a,c]

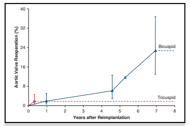
ABSTRACT

Objectives: To assess intermediate-term outcomes of aortic root replacement with valve-sparing reimplantation of bicuspid aortic valves (BAV), compared with tricuspid aortic valves (TAV).

Methods: From January 2002 to July 2017, 92 adults underwent aortic root replacement with BAV reimplantation and 515 with TAV reimplantation at the Cleveland Clinic. Balancing-score matching based on 28 preoperative variables yielded 71 well-matched BAV and TAV pairs (77% of possible pairs) for comparison of postoperative mortality and morbidity, longitudinal echocardiogram data, aortic valve reoperation, and survival.

Results: In the BAV group, 1 hospital death occurred (1.1%); mortality among all reimplantations was 0.2%. Among matched patients, procedural morbidity was low and similar between BAV and TAV groups (1 stroke in TAV group; renal failure requiring dialysis, 1 patient each; red cell transfusion, 25% each). Five-year results: Severe aortic regurgitation was present in 7.4% of the BAV group and 2.9% of the TAV group ($P = .7$); 39% of BAV and 65% of TAV patients had none. Higher mean gradients (10 vs 7.4 mm Hg; $P = .001$) and left ventricular mass index (111 vs 101 g/m^2; $P = .5$) were present in BAV patients. Freedom from aortic valve reoperation was 94% in the BAV group and 98% in the TAV group ($P = .10$), and survival was 100% and 95%, respectively ($P = .07$).

Conclusions: Both BAV and TAV reimplantations can be performed with equal safety and good midterm outcomes; however, the constellation of higher gradients, less ventricular reverse remodeling, and more aortic valve reoperations with BAV reimplantations raises concerns requiring continued long-term surveillance. (J Thorac Cardiovasc Surg 2022;163:51-63)



Reoperation after root replacement and reimplantation of a bicuspid or tricuspid valve.

CENTRAL MESSAGE

Bicuspid aortic valve preservation during aortic root replacement by the implantation technique has excellent early results similar to those for tricuspid valves, but may become inferior on long-term surveillance.

PERSPECTIVE

Bicuspid aortic valve preservation during aortic root replacement by the implantation technique has excellent early results, comparable to those with reimplantation of tricuspid aortic valves. However, there may be a divergence of outcomes over time that requires long-term surveillance. This raises concern over routine use of reimplantation in patients with a bicuspid valve.

See Commentaries on pages 64, 66, and 67.

From the Departments of [a]Thoracic and Cardiovascular Surgery and [b]Cardiovascular Medicine, and [c]The Aorta Center, Heart, Vascular, and Thoracic Institute, and [d]Department of Quantitative Health Sciences, Research Institute, Cleveland Clinic, Cleveland, Ohio.

Supported in part by the Drs Sidney and Becca Fleischer Heart and Vascular Education Chair; the Burdett, Margaret and Eugene Larson Endowed Fund in Cardiovascular Innovation; the David Whitmire Hearst, Jr. Foundation; the Marty and Michelle Weinberg and Family Fund; the Friends of the Cleveland Clinic Foundation; the Delos M. Cosgrove, MD, Chair for Heart Disease Research; the Stephens Family Endowed Chair in Cardiothoracic Surgery; the Dana A. Hamel Family Foundation; and the Gus P. Karos Registry Fund.

Read at the 99th Annual Meeting of The American Association for Thoracic Surgery, Toronto, Ontario, Canada, May 4-7, 2019.

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Dr Lars G. Svensson *(Cleveland, Ohio).* If I can add a bit to Dr Mokashi's comments and presentation, regarding what we are doing differently: I think this study adds caution to what was already presented by Tirone David about patients with bicuspid valves and reimplantation. The question is whether you can do a reimplantation and get the patient into older age category and then later look at a biological valve for these patients. The other question that came up

„… The outcomes both in survival and reoperation with mechanical valves was actually excellent and that to me is the ***gold standard***.“

J Thorac Cardiovasc Surg 2022;63:51

Aortic Valve Preserving Operations (BAV)

The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

REIMPLANTATION SHOULD BE THE GOLD STANDARD TO TREAT THE REGURGITANT BICUSPID AORTIC VALVE

To the Editor:

Mokashi and associates[1] have recently shared the Cleveland Clinic's intermediate-term experience with reimplantation of tricuspid aortic valves (TAV) and bicuspid aortic valves (BAV). In a propensity score–matched analysis, the authors demonstrated excellent 5-year outcomes with 100% survival in the BAV and 98% survival in the TAV group. Freedom from reoperation in the BAV and TAV cohort was 94% and 98%, respectively. Although both procedures were done with equal safety and short-term outcomes, the authors were concerned due to greater transvalvular gradients and less ventricular reverse remodeling in the BAV cohort, as well as less freedom from reoperations in the BAV cohort at 8 years (77%). These concerns reached an extent that during the 2019 Annual Meeting of The American Association for Thoracic Surgery, where this manuscript was presented and discussed, the senior author Dr Svensson mentioned that mechanical aortic valves should be the gold standard in patients with BAV,[1] a sentiment that we don't necessarily share.

Although there is considerable variability within the spectrum of BAVs, they generally have one normal (nonfused) and one abnormal (fused) cusp.[2,3] The fused cusp is typically prolapsing in cases of aortic regurgitation (AR), but it can also be restricted in the presence of a fibrous raphe. In addition, the cumulative free margin length is shorter than in TAVs. Consequently, these last 2 factors contribute to greater transvalvular gradients in BAV.

When repairing BAVs, one of the key maneuvers is to improve the mobility of the fused cusp, to increase valve opening area and alleviate the transvalvular gradient as much as possible. Our 180° reimplantation technique accomplishes these goals, through increasing the relative free margin length of the fused cusp (and hence increased fused cusp mobility), and through relatively increasing the valve orifice area, which is covered by the normal and more mobile nonfused cusp.[2] In addition to this, we often perform raphe detachment from the aortic wall and thinning of the raphe, thinning of free margins, commissurotomies, etc, to further increase the mobility of the fused cusp, as well central cusp plications to close the line of fusion and to treat the prolapse. Our learning curve has taught us to avoid patch material and free margin resuspension with polytetrafluoroethylene, due to the accelerated valve degeneration.

Following these principles, we have been able to achieve excellent long-term results. Until 2018, we had performed 340 BAV repairs, of which 190 were performed with our 180° reimplantation technique,[4] which is a modification of the David 1 procedure, with reimplantation of the commissures at 180° and a selective annuloplasty.[2] At 12 years, survival was 94% and freedom from reoperation and AR>2+ were 91% and 97%, respectively.

Nonetheless, we also do observe a slow increase of gradients over time in some patients (up to 2.6%), which ultimately leads to late valve stenosis.[4] However, considering the excellent outcomes of the Cleveland Clinic with TAV reimplantation, the decreased freedom from reoperation in the BAV cohort is somewhat puzzling and not consistent with our experience (77% at 8 years vs 91% at 12 years, respectively). Although it's not entirely clear from the Cleveland Clinic data, it appears to be mainly driven by greater recurrence of AR in the BAV cohort. As we are trying to learn from everyone's experience, the question naturally arises whether this was driven by recurrent cusp prolapse or annular dilatation.

Even so, outcomes of aortic valve repair irrespective of phenotype are superior to prosthetic valve replacements. Long-term survival curves are superimposed on survival curves of the general population,[4] results that to date have not been achieved with any of the valve replacement therapies, except for the pulmonary autograft.[5] We therefore recommend repairing any BAV, whenever feasible. The reimplantation technique has yielded excellent long-term results in our experience and should therefore be the gold standard. The question is not if we should use mechanical valves instead, but how we can teach cardiac surgeons the necessary skills to achieve consistent repair results, regardless of BAV phenotype.

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Original Cardiovascular

German Heart Surgery Report 2021: The Annual Updated Registry of the German Society for Thoracic and Cardiovascular Surgery

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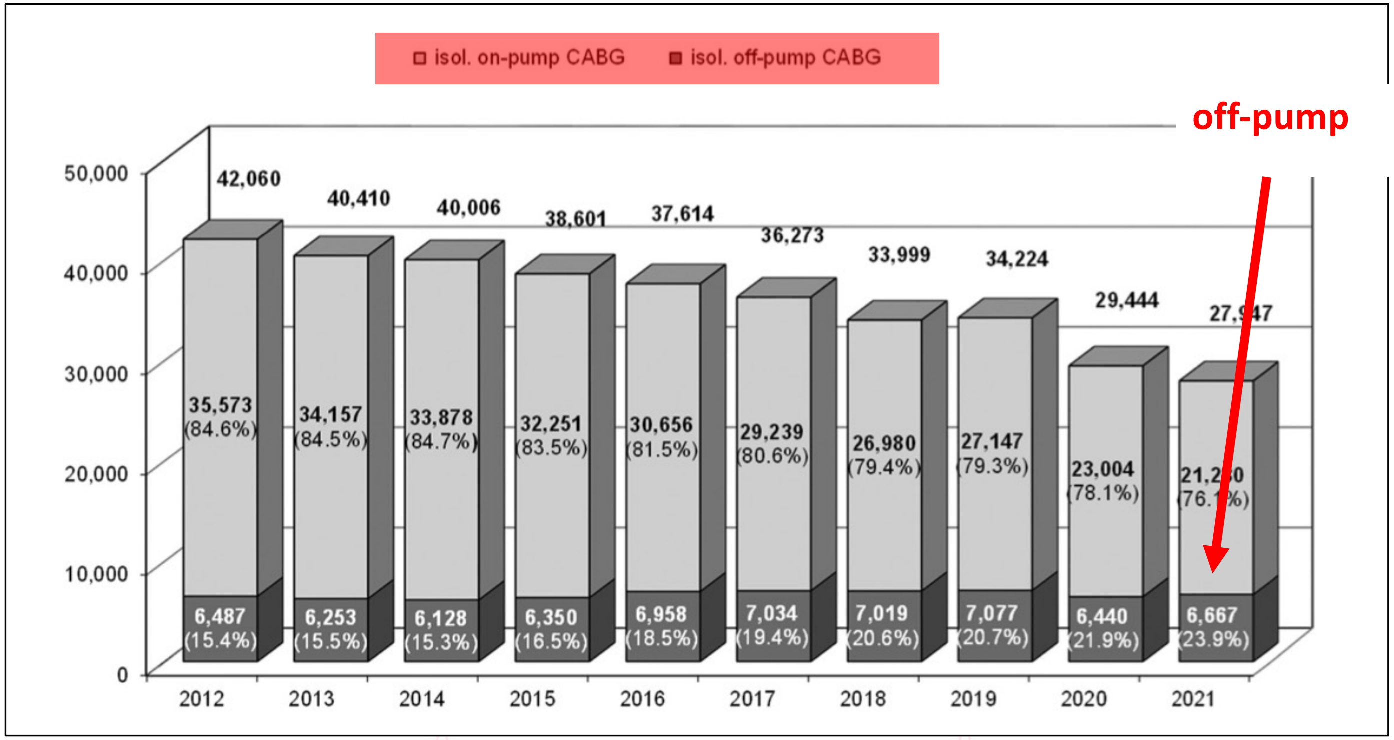
Thorac Cardiovasc Surg 2022;70:362–376.



Thorac Cardiovasc Surg 2022;70:362

SIMA versus BIMA

Volume 117 Number 5 May 1999

The Journal of
THORACIC AND CARDIOVASCULAR SURGERY

SURGERY FOR ADULT CARDIOVASCULAR DISEASE

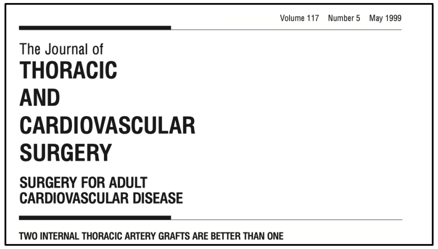
TWO INTERNAL THORACIC ARTERY GRAFTS ARE BETTER THAN ONE

- Retrospective study
- SIMA = 8,123 vs BIMA = 2,001
- In-hospital mortality 0,7%

- Wound infections SIMA 1,4% vs BIMA 2,5%

J Thorac Cardiovasc Surg 1999;17:855

SIMA versus BIMA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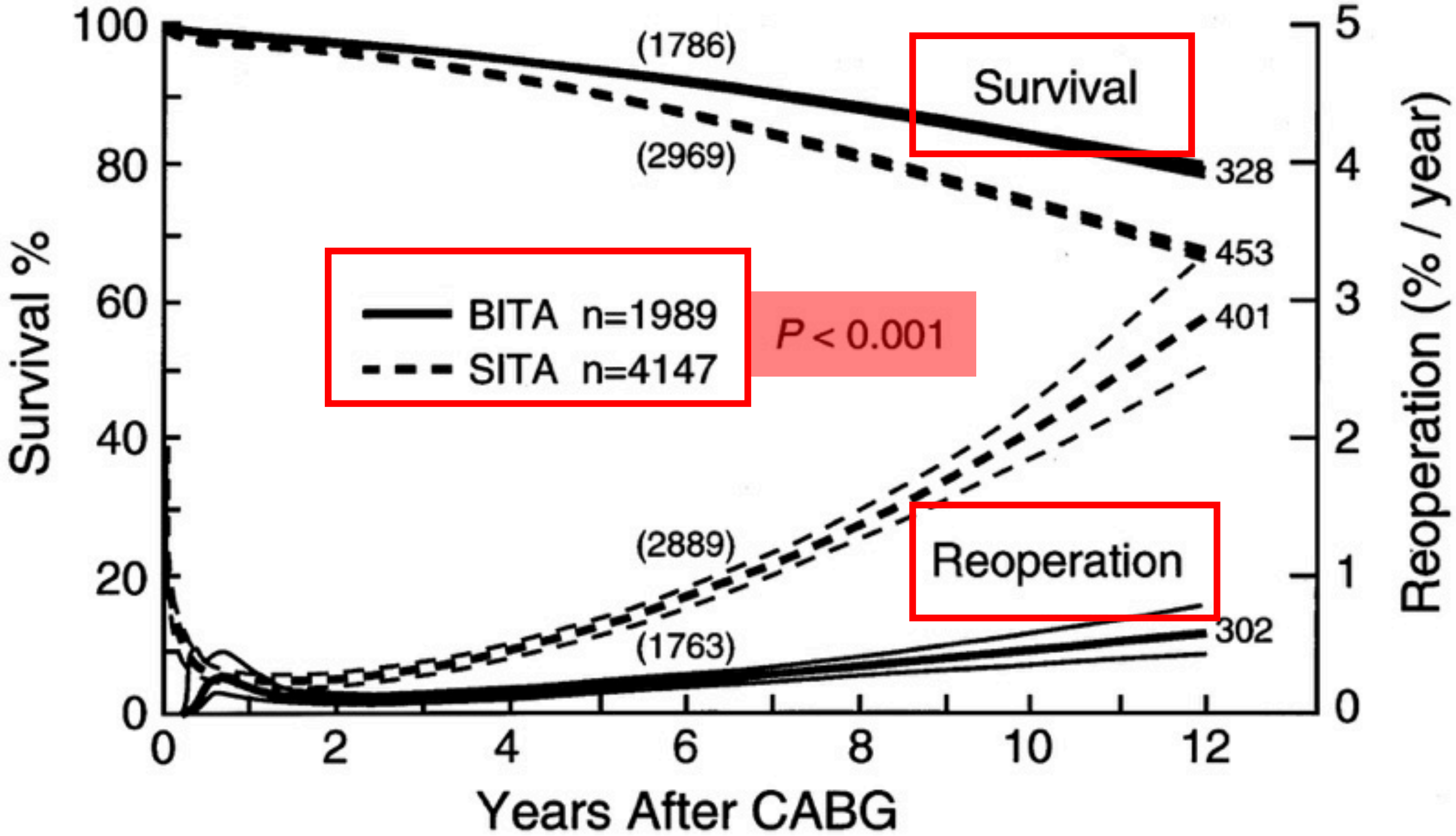
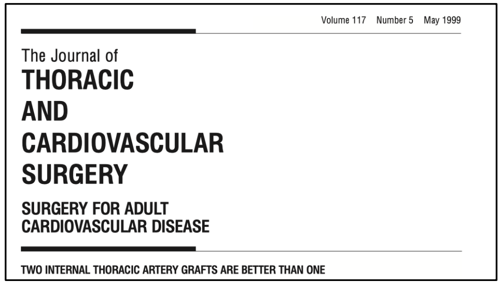


J Thorac Cardiovasc Surg 1999;17:855

SIMA versus BIMA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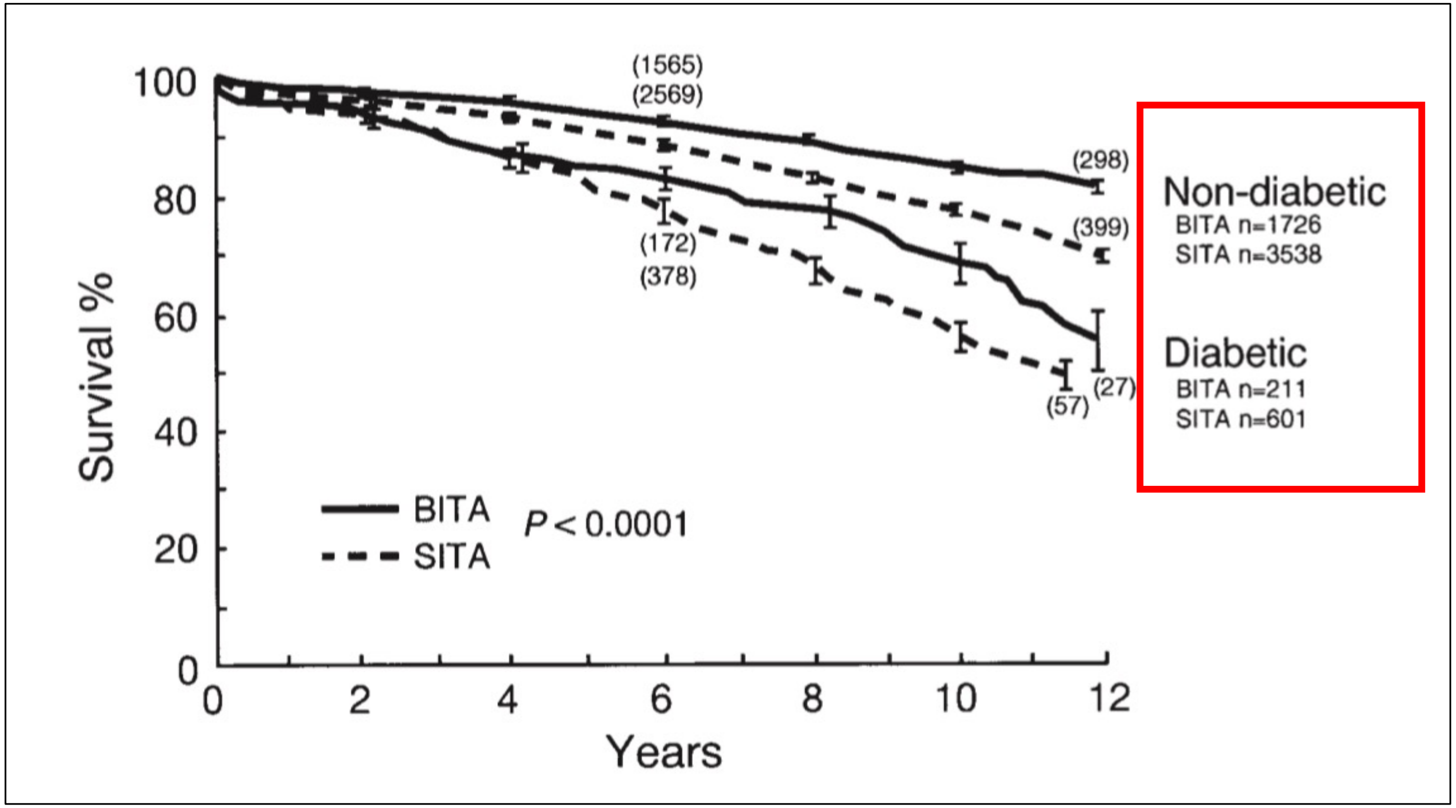

Non-risk adjusted

J Thorac Cardiovasc Surg 1999;17:855

SIMA versus BIMA

The Effect of Bilateral Internal Thoracic Artery Grafting on Survival During 20 Postoperative Years

Bruce W. Lytle, MD, Eugene H. Blackstone, MD, Joseph F. Sabik, MD,
Penny Houghtaling, MS, Floyd D. Loop, MD, and Delos M. Cosgrove, MD

Departments of Thoracic and Cardiovascular Surgery, and Biostatistics and Epidemiology, The Cleveland Clinic Foundation, Cleveland, Ohio

Background. To compare survival of patients receiving bilateral internal thoracic artery grafts and single internal thoracic artery grafts more than 20 postoperative years, assess magnitude of benefit, and identify predictors of benefit.

Methods. From cohorts of 8123 patients receiving single internal thoracic artery grafts and 2001 receiving bilateral internal thoracic artery grafts during primary isolated bypass operations for multivessel coronary disease between 1971 and 1989, we identified 1152 propensity-matched pairs. Mean follow-up of survivors was 16.5 years, with 51 patients followed for 20 years or more. Hazard function methodology was used to identify risk factors for mortality, compare survival, and assess magnitude of benefit.

Results. Comparison of the matched pairs showed survival of the bilateral internal thoracic artery and single internal thoracic artery groups at 7, 10, 15, and 20 years was 89% versus 87%, 81% versus 78%, 67% versus 58%, and 50% versus 37%, respectively ($p < 0.0001$). Divergence of bilateral internal thoracic artery and single internal thoracic artery hazard function curves continued to widen through 20 postoperative years. At 20 years, bilateral internal thoracic artery grafting was predicted to produce worse survival in 2.8% of patients, a survival advantage of less than 5% in 12.9%, greater than 10% in 52%, and greater than 15% in 7.6%. Combinations of cardiac and noncardiac descriptors were used to define higher and lower risk patient subsets. Advanced age, abnormal left ventricular function and noncardiac risk factors decreased overall survival but the incremental benefit of bilateral internal thoracic artery grafting persisted.

Conclusions. Bilateral internal thoracic artery grafting produces improved survival compared with single internal thoracic artery grafting during the second postoperative decade, and the magnitude of that benefit increases through 20 postoperative years.

(Ann Thorac Surg 2004;78:2005–14)
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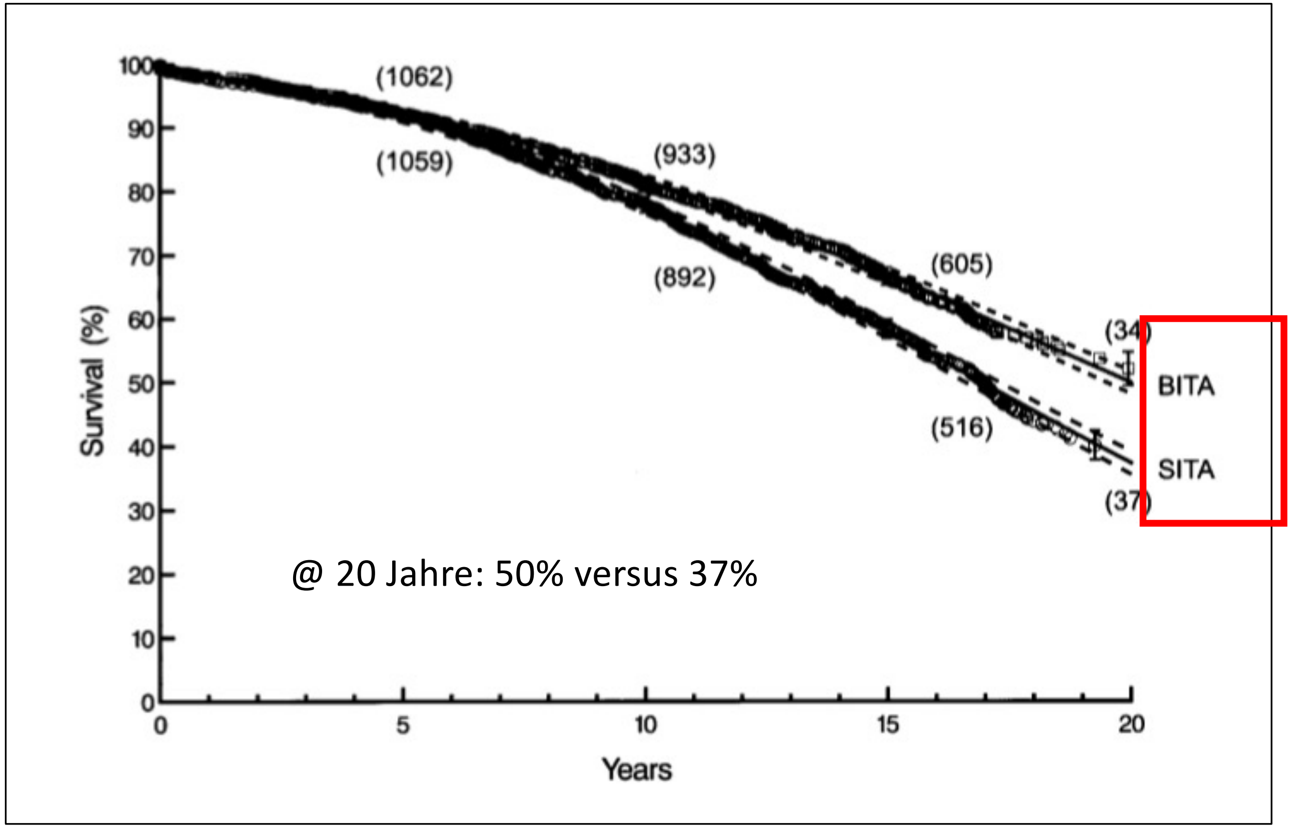

Ann Thorac Surg 2004;78:2005

Multiple Arterial Grafting

Ann Thorac Surg. 2023 Jun;115(6):1411-1419. doi: 10.1016/j.athoracsur.2022.12.014. Epub 2022 Dec 14.

FULL TEXT LINKS

ELSEVIER FULL-TEXT ARTICLE

Multiarterial Coronary Artery Bypass Grafting Practice Patterns in the United States: Analysis of The Society of Thoracic Surgeons Adult Cardiac Surgery Database

ACTIONS

Cite

Collections

Siavash Saadat[1], Robert Habib[2], Milo Engoren[3], Graciela Mentz[3], Mario Gaudino[4] ...

„**Conclusions:** Multiarterial bypass grafting remains underused and limited to selected centers. Worse outcomes at low-volume BITA and radial institutions documents a case-volume outcomes effect…“

Additional studies are warranted to improve multiarterial outcomes at low-volume institutions.

Ann Thorac Surg 2023;115:1411

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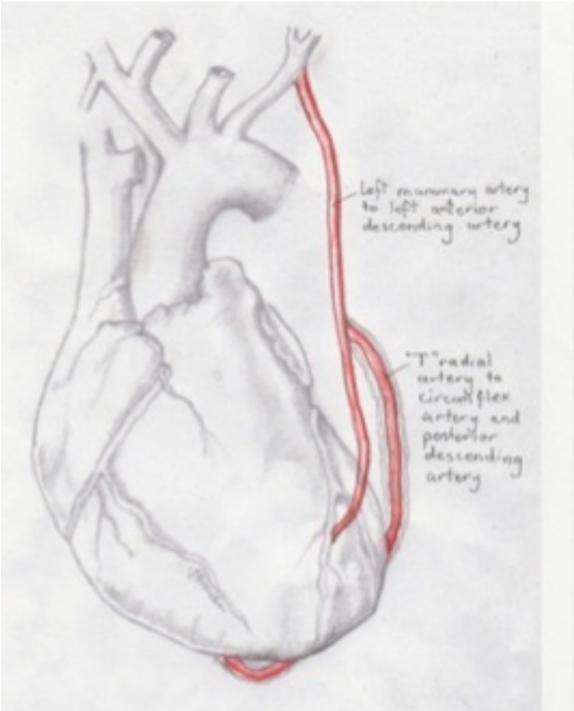
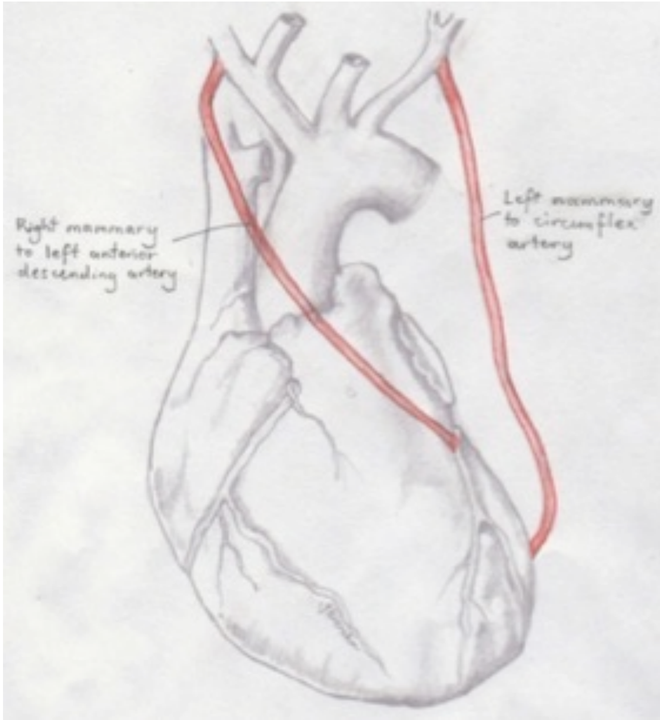
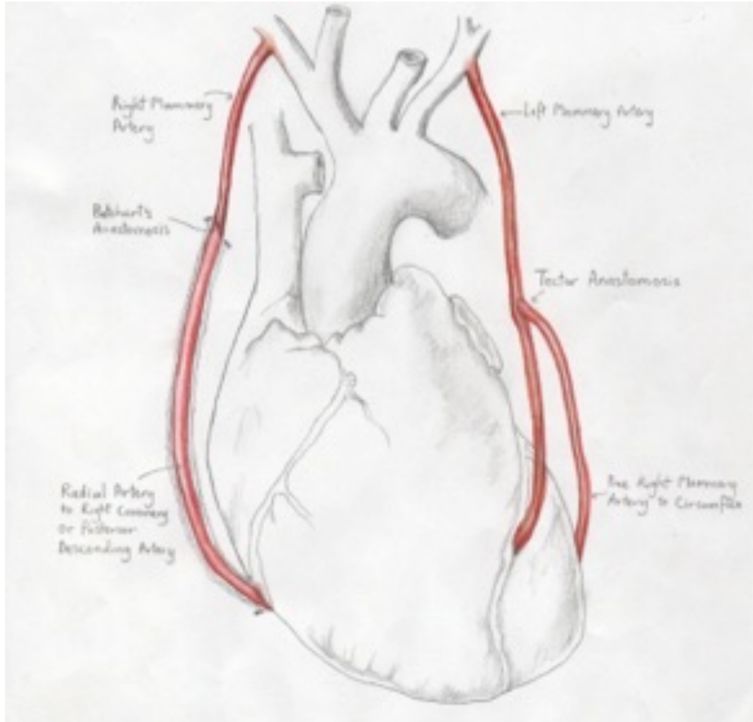
Complete Arterial Revascularization





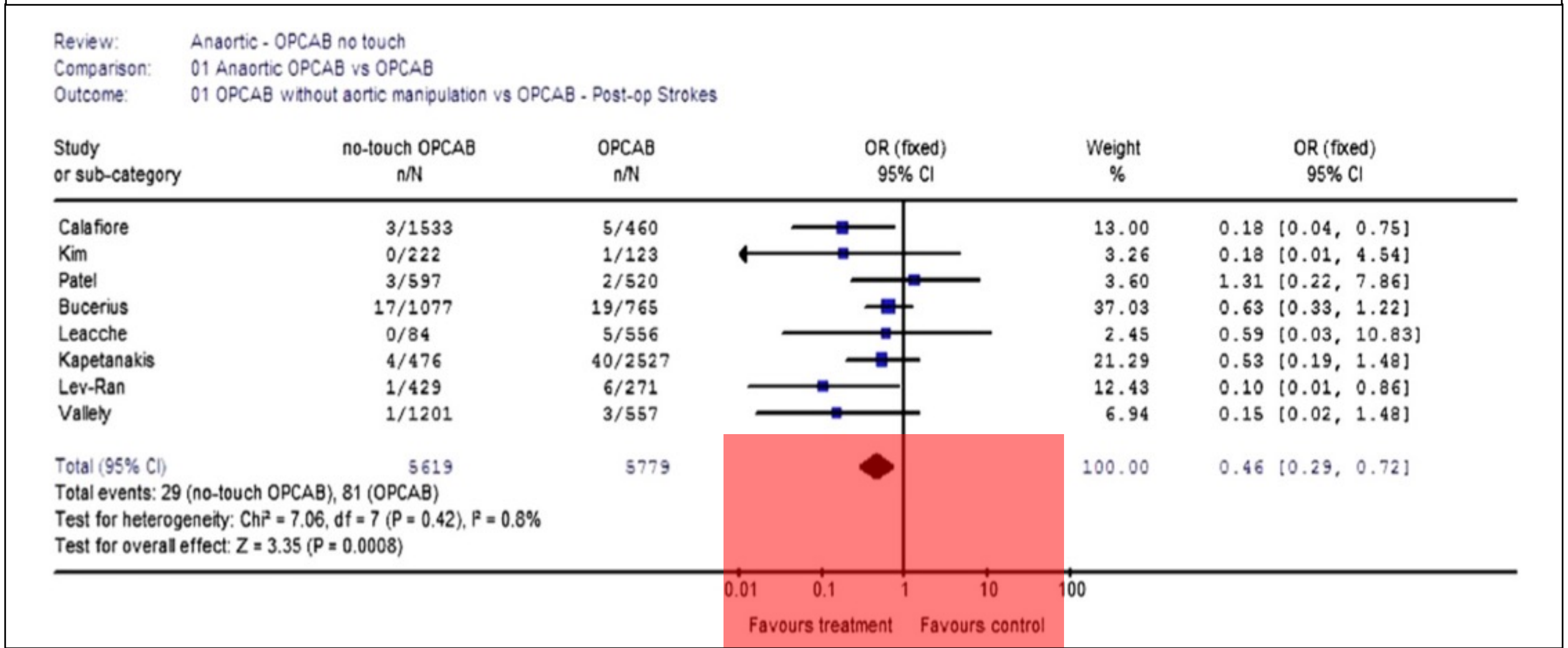


Anaortic Off-pump Coronary Artery Bypass Grafting **(anOPCAB)**

Misfeld et al — **Acquired Cardiovascular Disease**

Neurologic complications after off-pump coronary artery bypass grafting with and without aortic manipulation: Meta-analysis of 11,398 cases from 8 studies

Stroke



J Thorac Cardiovasc Surg 2011;142:e11

Conclusions

- Robotic cardiac surgery remains to be selective, exclusive and a not widely performed procedure
- We are far away of performing the most beneficial cardiac procedures as a standard of care
- Future robotic tools, centralization and specialization of cardiac services may change this picture

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