



TURIN
October
24th-26th
2019

31 GIORNATE CARDIOLOGICHE TORINESI

*Everything you always
wanted to know about*
Cardiovascular Medicine



**The gold standard:
more than 10 years
experience in minimally
invasive mitral valve
surgery**

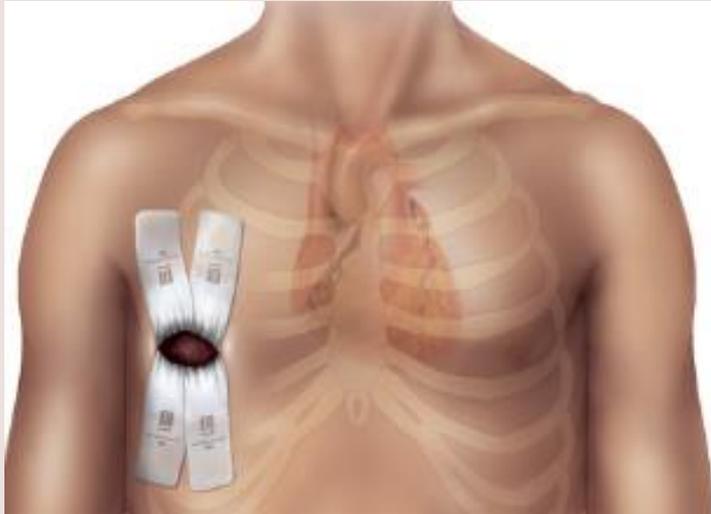
Mauro Rinaldi MD

**Division of Cardiothoracic Surgery
Citta' della Salute e della Scienza
University of Turin – Italy
Chief: Prof. Mauro Rinaldi**



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- Reduce surgical trauma
- Minimize disruption of the chest wall
- Provide a safe and reproducible approach to CPB and myocardial protection

- Be applicable to the majority of patients and procedures
- Provide same safety and efficacy as conventional cardiac surgery





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Compared to conventional Mitral Valve surgery

- Equivalent perioperative and long-term mortality rates.
- Equivalent perioperative and long-term valve function.
- **Reduced surgical trauma with less pain, less blood loss, less transfusions and reoperations for bleeding**.
- **Shorter hospital stay, faster recovery, less use of rehabilitation resources, and overall healthcare savings.**

Modi et al, JTCS. 2009;137:1481-7

Cheng et al, Innov 2011;6:66-76

Falk et al, Innov 2011;6:84-103



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A minimally invasive approach is more **cost-effective** than a traditional sternotomy approach for mitral valve surgery

Alexander Iribarne, MD, MS,^a Rachel Easterwood, BA,^a Mark J. Russo, MD, MS,^b Y. Claire Wang, MD, ScD,^c Jonathan Yang, MD,^a Kimberly N. Hong, MHSA,^a Craig R. Smith, MD,^a and Michael Argenziano, MD^a

- 217 MI vs 217 ST pts (2003 – 2008)
- Propensity matched showed no difference in morbidity and long term survival

	ST (n = 217)	MI (n = 217)	P value
Mitral valve surgery type			
Replacement	87 (40.1%)	83 (38.3%)	.768
Repair	130 (59.9%)	134 (61.8%)	
Mitral valve disease			
Mitral regurgitation	185 (85.3%)	183 (84.3%)	.424
Mitral stenosis	24 (11.1%)	30 (13.8%)	
Mitral valve disease etiology			
Degenerative	130 (59.9%)	128 (59.0%)	.594
Anterior leaflet prolapse	28 (12.9%)	16 (7.4%)	
Bileaflet prolapse	21 (9.7%)	33 (15.2%)	
Posterior leaflet prolapse	81 (37.3%)	79 (36.4%)	
Dilated cardiomyopathy	13 (6.0%)	10 (4.6%)	
Endocarditis	19 (8.8%)	14 (6.5%)	
Ischemic	9 (4.2%)	15 (6.9%)	
Rheumatic	17 (7.8%)	25 (11.5%)	
Calcific	22 (10.1%)	20 (9.2%)	
Other	7 (3.2%)	5 (2.3%)	
Concomitant procedures			
Atrial septal defect repair	14 (6.5%)	18 (8.3%)	.141
Atrial fibrillation ablation	50 (23.0%)	32 (14.7%)	
Operative times (min)			
CPB time	112.6 ± 2.2	137.3 ± 3.4	<.0001
Crossclamp time	75.8 ± 1.6	80.7 ± 2.8	.135

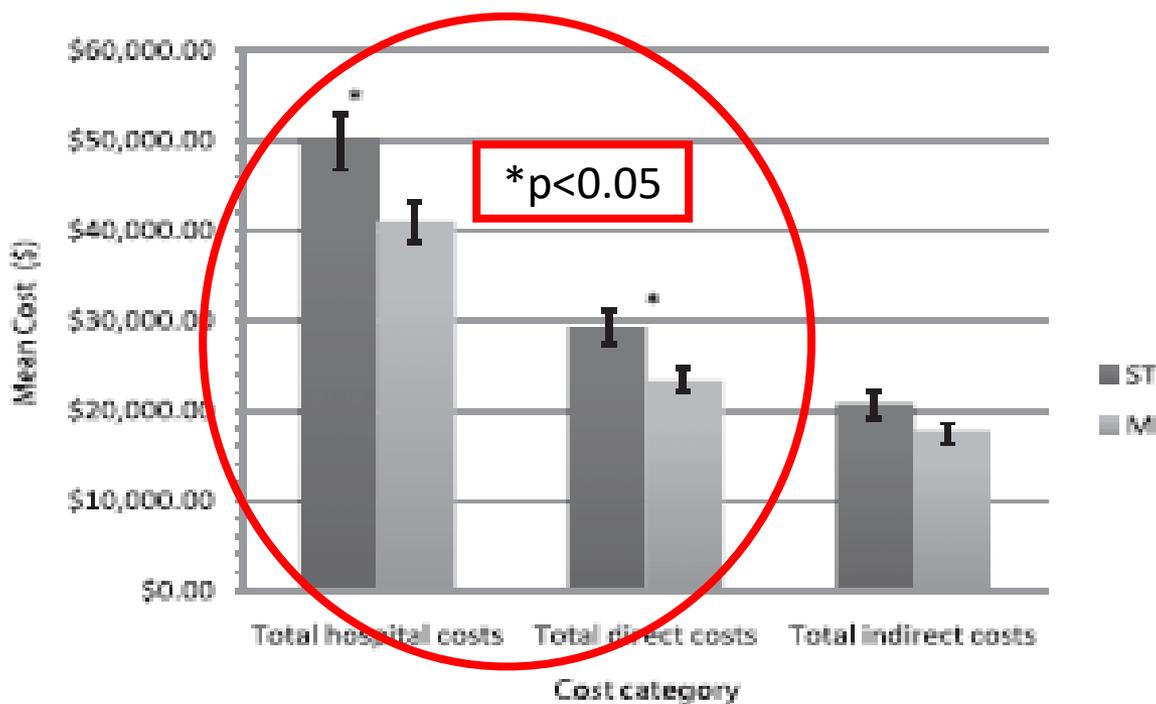


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Hospital Costs

Median ST	50060 ± 2659 \$
MINI	41006 ± 1887 \$
Difference	9054 ± 3302 \$



Reduction in:

Cardiac imaging p=0.004

Laboratory tests p=0.005

Nursing p=0.001

Radiology p=0.002

**Higher rate of home
discharge with no nursing
service in the MI group
p=0.01**



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Concerns still remain about

- Limited exposure of the mitral valve.
- Prolonged operative times.
- The risk of vascular complications and groin infections.
- The risk of neurological complication
- **Perfusion and aortic clamping technique**

Svensson et al, J Thorac Cardiovasc Surg 2007;134:677-82

Gammie et al, Ann Thorac Surg 2010;90:1401-8

Modi et al, Eur J Cardiothorac Surg 2008;34:943-52

Suri et al, Ann Thorac Surg 2009;88:1185-90

**CONCERN ESPECIALLY FOR
ENDOARTIC BALLOON
OCCLUSION**



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Less-Invasive Mitral Valve Operations: Trends and Outcomes From The Society of Thoracic Surgeons Adult Cardiac Surgery Database

James S. Gammie, MD, Yue Zhao, PhD, Eric D. Peterson, MD, MPH,
Sean M. O'Brien, PhD, J. Scott Rankin, MD, and Bartley P. Griffith, MD

Division of Cardiac Surgery, University of Maryland Medical Center, Baltimore, Maryland; Duke Clinical Research Institute, Durham, North Carolina; and Centennial Medical Center, Vanderbilt University, Nashville, Tennessee

(Ann Thorac Surg 2010;90:1401-10)

Femoral cannulation was not independently related to increased risk for stroke in the LIMV operation patients (adjusted OR for femoral versus central cannulation 1.39, 95% CI: 0.90 to 2.15, $p = 0.14$). Use of beating- or fibrillating-heart techniques compared with aortic cross-clamping with cardioplegic cardiac arrest was associated with an adjusted threefold higher risk of stroke (adjusted OR 3.03, 95% CI: 1.66 to 5.51, $p = 0.0003$). We repeated the

Femoral cannulation was not independently related to increased risk of stroke

Higher risk in case of MIS performed without aortic occlusion (beating or fibrillating heart)

Need for aortic clamping especially in case of retrograde perfusion





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Retrograde femoral arterial perfusion and stroke risk during minimally invasive mitral valve surgery: is there cause for concern?

Paul Modi¹, W. Randolph Chitwood Jr²

...for every study that reports a higher stroke risk with MIMVS, there are studies reporting no difference in this.

The only other meta-analysis on this subject published in 2008 concluded that of six eligible studies, there was no significant difference in neurological event rate

Three propensity matched studies from ***high-volume institutions*** (Cleveland, Leipzig, Mayo/UPenn) have all shown ***no difference in stroke risk with RAP compared to antegrade perfusion***



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Endoaortic Clamping Does Not Increase the Risk of Stroke in Minimal Access Mitral Valve Surgery: A Multicenter Experience

Filip Casselman, MD PhD, Jose Aramendi, MD, Mohamed Bentala, MD, Pascal Candolfi, PhD, Rudolf Coppoolse, MD, Borut Gersak, MD, PhD, Ernesto Greco, MD, PhD, Paul Herijgers, MD, PhD, Steven Hunter, MD, Ralf Krakor, MD, PhD, Mauro Rinaldi, MD, Frank Van Praet, MD, Geert Van Vaerenbergh, ECP, and Joseph Zacharias, MD

Department of Cardiovascular & Thoracic Surgery, OLV, Aalst, Belgium; Department of Cardiac Surgery, Hospital de Cruces, Bilbao, Spain; Department of Cardiothoracic Surgery, Amphia Breda Hospital, Breda, The Netherlands; Biostatistics, Edwards Lifesciences, Nyon, Switzerland; Department of Cardiac Surgery, Schüchtermann Klinik, Bad Rothenfelde, Germany; Department of Cardiovascular Surgery, University Medical Centre, Ljubljana, Slovenia; Department of Cardiac Surgery, Policlinico Umberto I, Rome, Italy; Department of Cardiac Surgery, Gasthuisberg, Leuven, Belgium; Department of Cardiac Surgery, Northern General Hospital, Sheffield, UK; Department of Cardiac Surgery, Klinikum Dortmund, Dortmund, Germany; Department of Cardiac Surgery, Azienda Ospedaliera San Giovanni Battista, Turin, Italy; and Department of Cardiac Surgery, Victoria Hospital, Blackpool, United Kingdom

Background. Some controversy exists regarding the safety of endoaortic balloon clamping in minimal access isolated mitral valve surgery (MIMVS). The aim of this European multicenter study was to analyze the results in 10 experienced centers and compare the outcomes with published data.

Methods. The most recent 50 consecutive MIMVS cases from 10 European surgeons who had performed at least 100 procedures were prospectively collected and retrospectively analyzed. All procedures were performed through right minithoracotomy with femoral cannulation and endoaortic balloon occlusion. In-hospital and 30-day outcomes were studied. Mortality and stroke rates were compared with published median sternotomy and MIMVS outcomes.

Results. Mean age was 63.2 ± 12.5 years, 289 (57.8%) were male, mean logistic European system for cardiac operative risk evaluation was 6.1 ± 6.2 , and 53 (10.6%) procedures had cardiac reoperations. Concomitant procedures were performed in 126 (25.9%) cases. Three patients (0.6%) required conversion to full sternotomy.

re-exploration for bleeding was necessary in 24 (4.8%) cases. Mean aortic cross-clamp and cardiopulmonary bypass times were 85.6 ± 30.1 and 129.5 ± 40.2 min, respectively, and were significantly longer for concomitant procedures ($p < 0.001$). There were no aortic dissections and no deep venous thromboses. Operative mortality (none neurologic) and major stroke occurred in 7 (1.4%) and 4 (0.8%) patients, respectively. These rates compared favorably with the published literature on isolated primary mitral valve surgery (MVS) through sternotomy or minithoracotomy (mortality rates 0.2% to 11.6%, stroke rates 0.6% to 4.4%).

Conclusions. Once procedural proficiency is acquired, endoaortic balloon clamping in MIMVS is a safe and effective technique. Despite the fact that this patient cohort also includes combined and redo procedures, the observed mortality and stroke rate compared favorably with the existing literature on primary isolated mitral valve surgery irrespective of the approach.



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Table 4: Major postoperative-events

	MIMVS 500 pts (%)
Mortality	7/500 (1.4 %)
Aortic dissection	0/500
Reoperation for bleeding	24/500 (4.8 %)
Deep venous thrombosis	0/500
Major stroke	4/500 (0.8 %)
Renal Failure	13/500 (2.6 %)
Groin lymphocoele	7/500 (1.4 %)
Myocardial infarction	5/500 (1%)



European Journal of Cardio-thoracic Surgery 37 (2010) 920–927

EUROPEAN JOURNAL OF
CARDIO-THORACIC
SURGERY

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Port-access surgery as elective approach for mitral valve operation in re-do procedures

Davide Ricci^{b,*}, Carlo Pellegrini^a, Marco Aiello^a, Alessia Alloni^a, Barbara Cattadori^a, Andrea M. D'Armini^a, Mauro Rinaldi^b, Mario Viganò^a

Minimally invasive tricuspid valve surgery in patients at high risk

Davide Ricci, MD,^{a,b} Massimo Boffini, MD,^a Cristina Barbero, MD,^a Suad El Qarra, MD,^a Giovanni Marchetto, MD,^a and Mauro Rinaldi, MD^c

The Journal of Thoracic and Cardiovascular Surgery • March 2014

Port-access redo mitral valve surgery in a 15-year-old child

Davide Ricci, MD,^{a,b} Cristina Barbero, MD,^a Massimo Boffini, MD,^a Suad El Qarra, MD,^a Francesca Ivaldi, MD,^a Luca Deorsola, MD,^c Carlo Pace, MD,^c and Mauro Rinaldi, MD,^a Turin and Pavia, Italy
The Journal of Thoracic and Cardiovascular Surgery • Volume 146, Number 4

Right Minithoracotomy for Mitral Valve Surgery: Impact of Tailored Strategies on Early Outcome

(Ann Thorac Surg 2016;102:1989–95)

Cristina Barbero, MD, Giovanni Marchetto, MD, Davide Ricci, MD, Suad El Qarra, MD, Matteo Attisani, MD, Claudia Filippini, PhD, Massimo Boffini, MD, and Mauro Rinaldi, MD



1d Critical Care, University of Turin, Torino, Italy

Preoperative vascular screening: a novel breakthrough in minimally invasive mitral valve surg

STUDY PROTOCOL

Open Access



Magnetic resonance imaging for cerebral lesions during minimal invasive mitral valve surgery: study protocol for a randomized controlled trial

Trials (2017) 18:76

Cristina Barbero^{1*}, Davide Ricci¹, Erik Cura Stura¹, Augusto Pellegrini¹, Giovanni Marchetto¹, Suad ElQarra¹, Massimo Boffini¹, Roberto Passera², Maria Consuelo Valentini³ and Mauro Rinaldi¹

Cristina Barbero, MD, Mauro Rinaldi, MD



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Right Minithoracotomy for Mitral Valve Surgery: Impact of Tailored Strategies on Early Outcome



Ann Thorac Surg
2016;102:1989-95

Cristina Barbero, MD, Giovanni Marchetto, MD, Davide Ricci, MD, Suad El Qarra, MD, Matteo Attisani, MD, Claudia Filippini, PhD, Massimo Boffini, MD, and Mauro Rinaldi, MD

Department of Cardiovascular and Thoracic Surgery, and Department of Anesthesia and Critical Care, University of Turin, Torino, Italy

Conclusions. Right minithoracotomy MVS can routinely be performed with favorable outcomes in all comers when perfusion strategies and clamping techniques are carefully selected after proper evaluation of the patient's preoperative characteristics.



INVITED COMMENTARY



The article by Barbero and associates [1] helps to dispel the notion that minimally invasive mitral valve operations performed through a right mini-thoracotomy are consonant with a higher risk of neurologic and vascular complications, compared with conventional sternotomy methods. The authors' hypothesis suggests that by

defining preoperatively the presence of significant vascular atherosclerosis and tortuosity by detailed angiographic or computed tomographic studies, the safest perfusion and aortic clamping methods can be selected. This makes perfect sense, as no doubt atheroma-emboli are the stroke culprits in most patients

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events went undefined. This article should redirect surgeons away from this earlier notion and implore them to vascular screen patients undergoing a mini-thoracotomy minimally invasive mitral valve operation. This is especially important for patients in whom femoral arterial perfusion or retrograde endoballoon deployment will be used. This article sends the strong message that radiologic and echocardiographic studies will become even more important in guiding future operations, and that they have become pivotal in reducing operative risks.

CO₂ insufflation.

In the past, many surgeons believed and some data showed that retrograde perfusion, especially with endoballoon insertion, created a higher risk of neurologic

1. Barbero C, Marchetto G, Ricci D, et al. Right mini-thoracotomy for mitral valve surgery: impact of tailored strategies on early outcome. *Ann Thorac Surg* 2016;102:1989-95.



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- Strategies for cannulation and clamping are essential for the success of the procedure
- Strategies should be planned well in advance

**“FAILURE TO PREPARE IS PREPARE
TO FAIL”**

ONLY ONE WAY IS NOT THE WAY !!!



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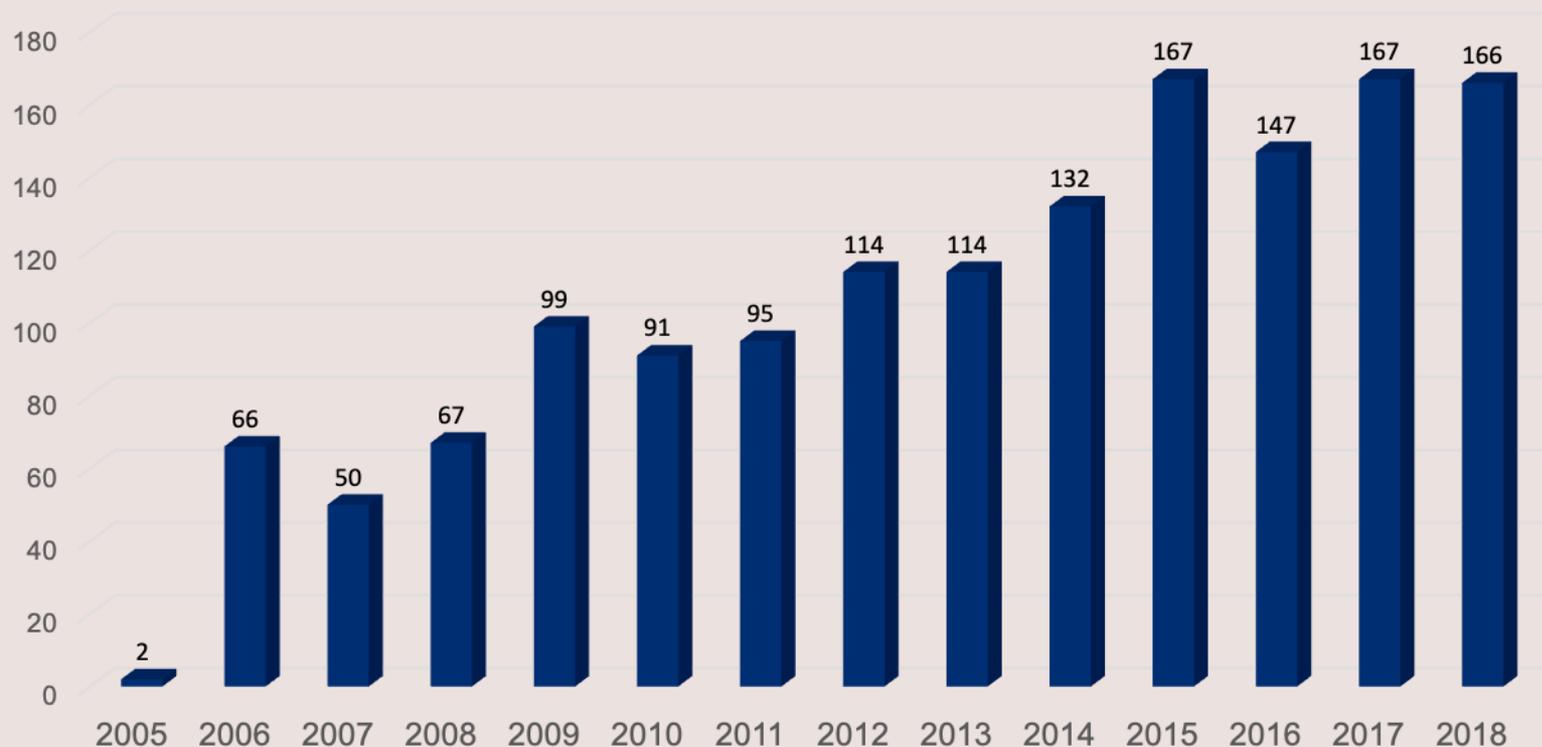
Cannulation	Clamping	Flow	Invasiveness
Endoreturn® - Femoral artery	Endoclamp	Retrograde	+---, “keyhole surgery”, no rib retraction, “no touch” on the aorta
Transthoracic clamp - Femoral artery - Axillary artery	External	-Retrograde -Antegrade	++--, some rib retraction, aortic “cracking”, single aortic purse string
Endodirect® - Aortic	Endoclamp	Antegrade	+++-, rib retraction and lifting, single aortic purse-string
Direct aortic cannulation	External	Antegrade	++++, larger incision, rib retraction or resection, two aortic purse-string
Femoral, Axillary artery	No clamp - Beating - VF	Retrograde Antegrade	++++, larger incision, rib retraction, bad mitral exposure, STROKES



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2006-2018: 1477 MIS surgery



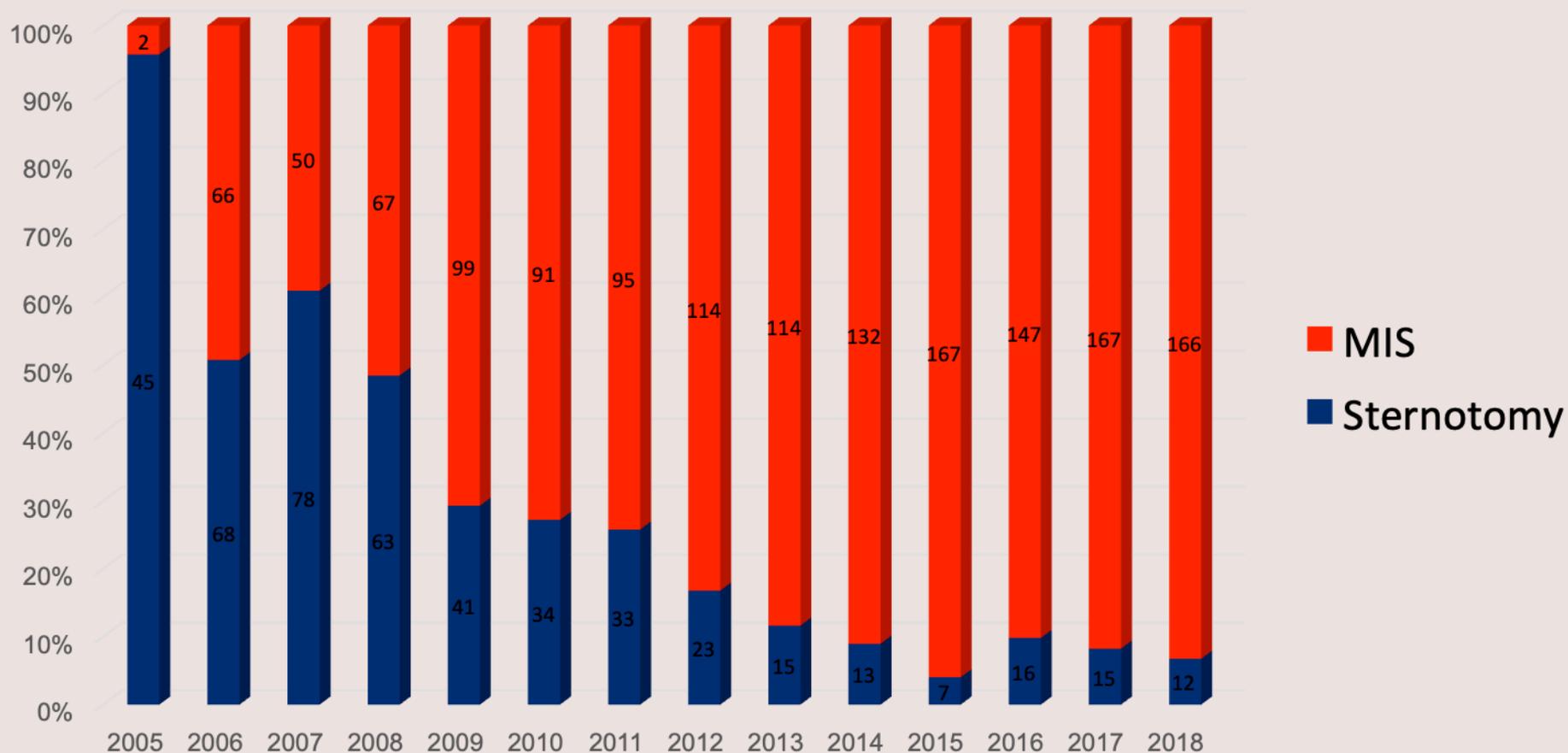
MIS Consecutive unselected patients



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MIS vs Sternotomy



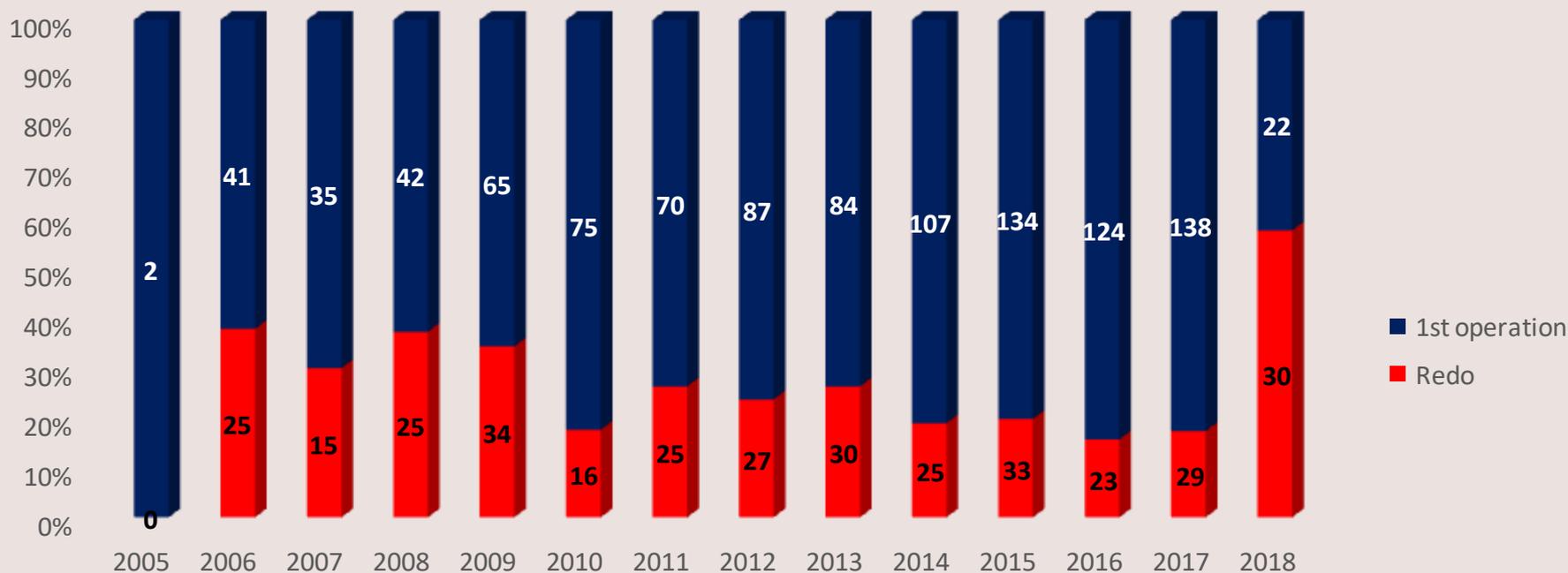


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**Redo surgery: 335/1477
(22.7%)**

- 1st redo 234 (15.8%)
 - 2nd redo 61 (4.2%)
 - 3rd redo 31 (2.1%)
 - 4th redo 7 (0.5%)
- } **99
(6.7%)**





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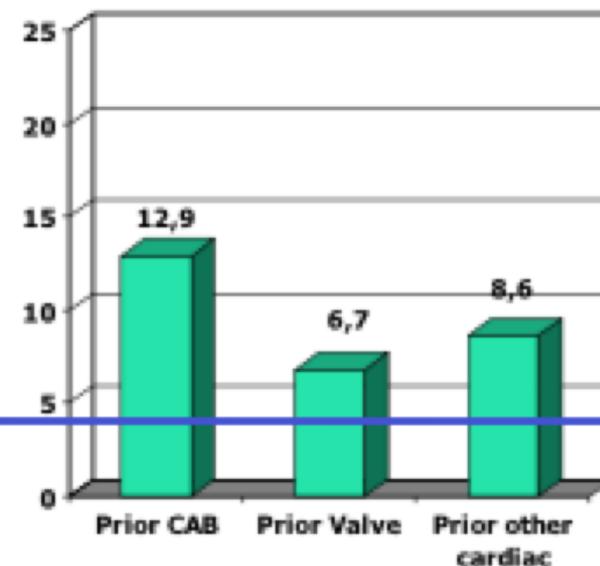
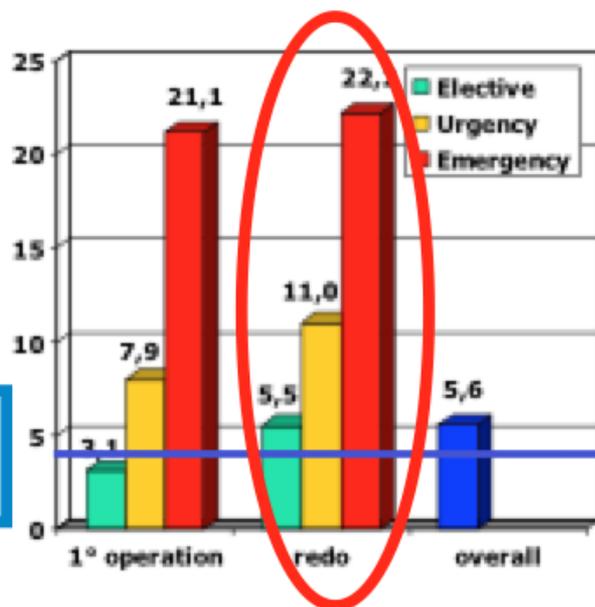
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Barbara Cattadori^a, Andrea M. D'Armini^a, Mauro Rinaldi^b, Mario Viganò^a

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**Mortality
4.9%**

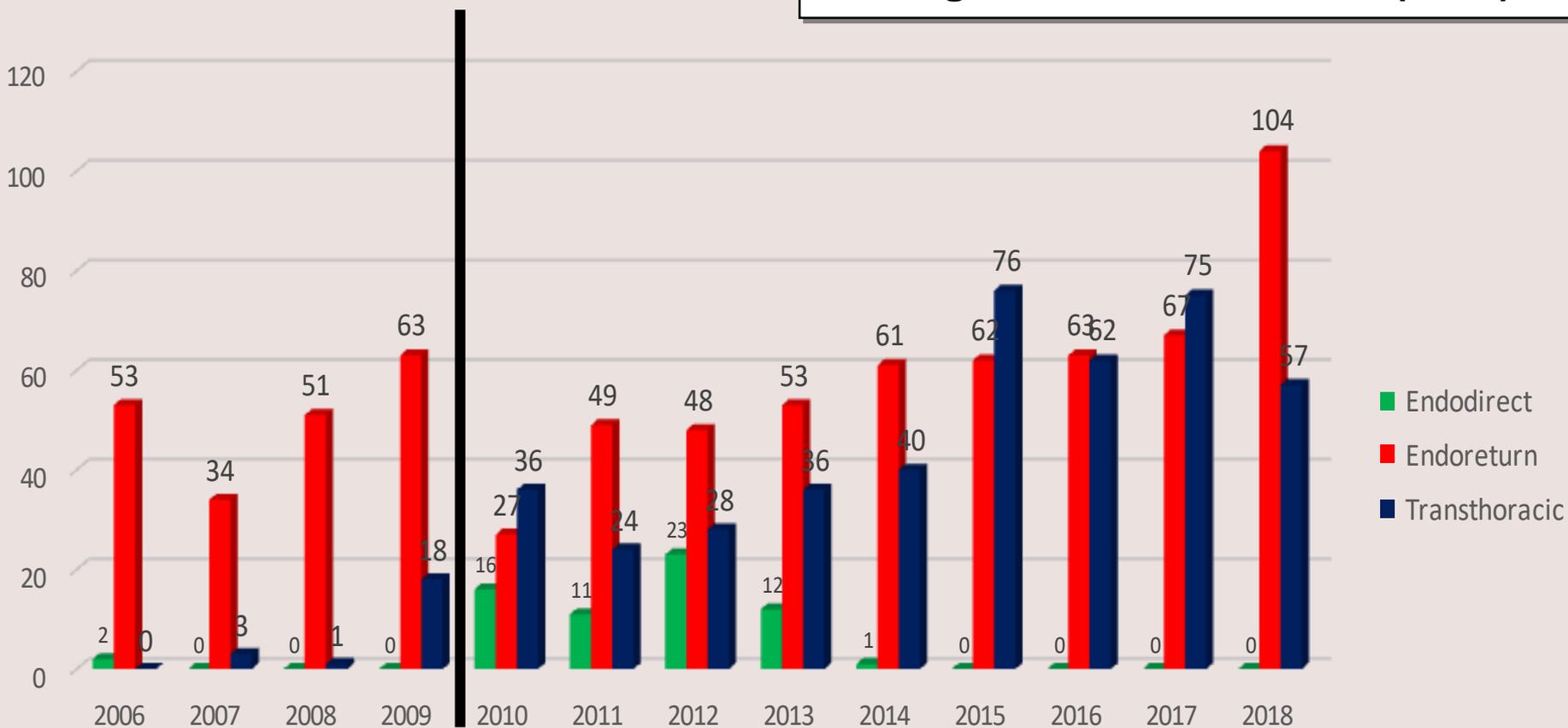


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**Conversion to sternotomy
Before the procedure
23cases (1.6%)**

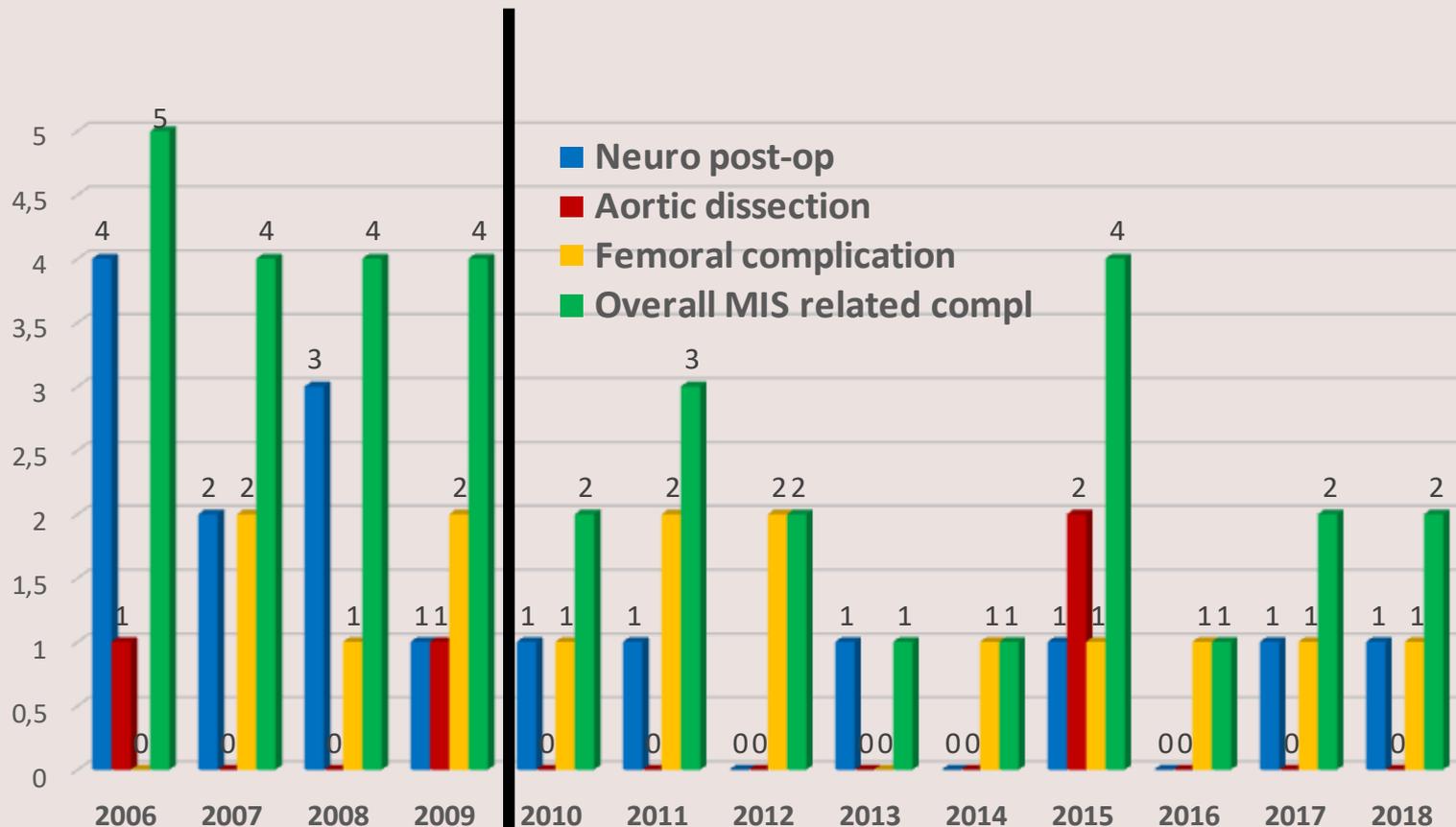
EndoDirect: 65/1477 cases (4.4%)
EndoReturn: 823/1477 cases (55.7%)
Transthoracic : 500/1477 cases (33.9%)
Beating heart: 62/1477 cases (4.2%)





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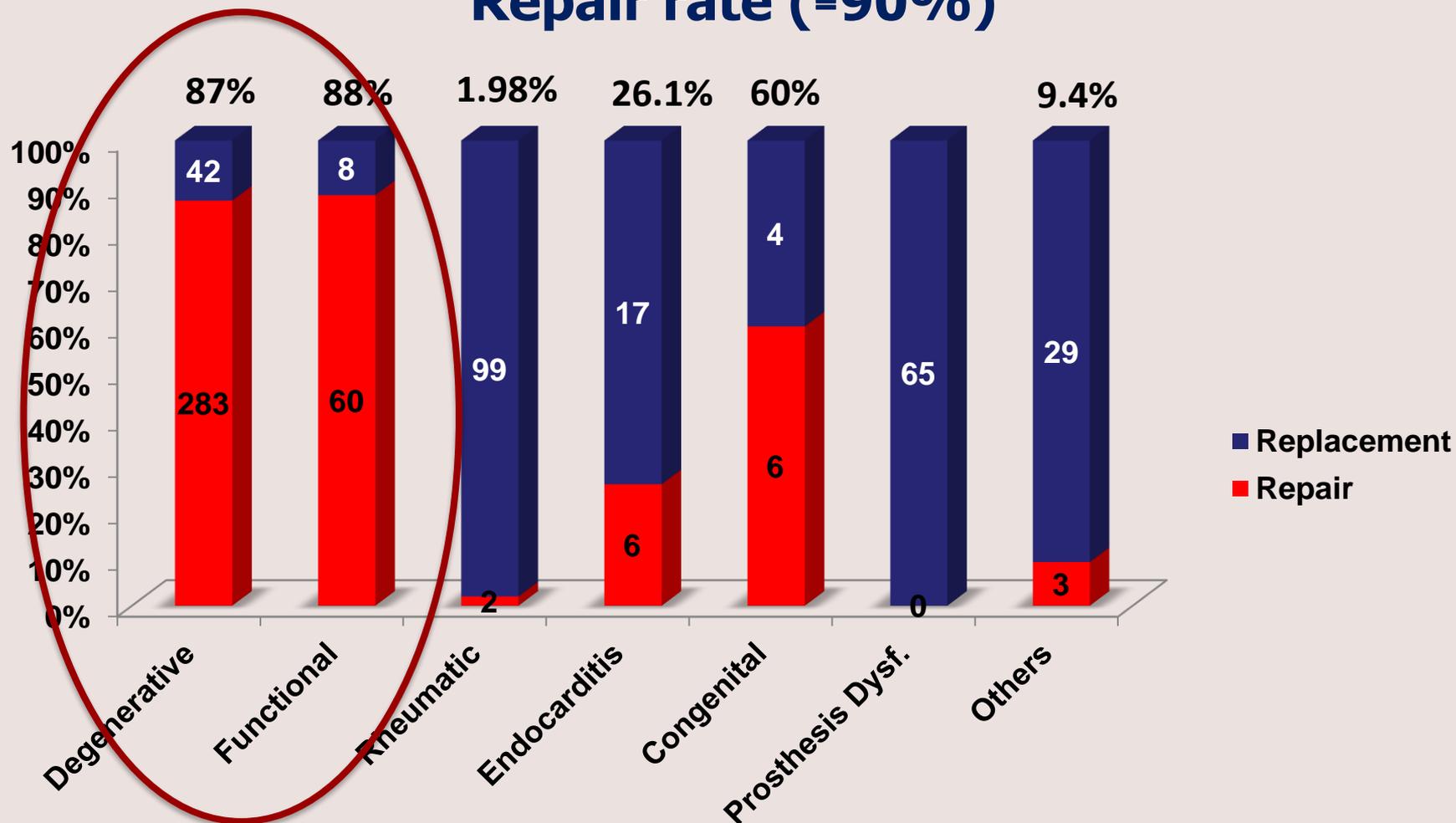




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Overall MV surgeries: 1100 procedures
Repair rate ($\approx 90\%$)

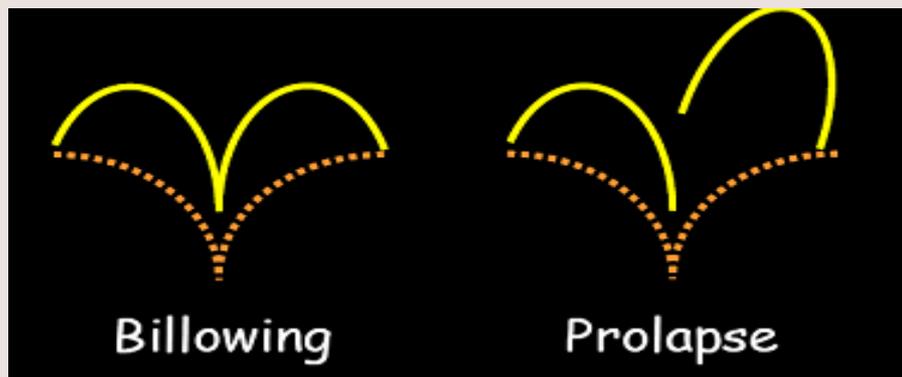




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Simple MV repair



- ***P2 quadrangular resection***
- ***Sliding/folding***
- ***Anular ring positioning***

Complex MV repair



- ***Chordal transpositioning***
- ***Gore-tex neochordal appositioning***
- ***AL patch positioning***



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Mitral valve repair techniques

Technique	(n=586)	%
Simple MV repair	325	55.5
Ring annuloplasty	325	100
Quadrang/Triang resection \pm folding/sliding	230	70.8
Complex MV repair	261	44.5
Ring annuloplasty	261	100
Quadrang/Triang resection \pm folding/sliding	137	52.5
Chordal transposition	37	14.2
Gore-tex neochordae	253	93.9
Papillary muscle splitting	6	2.3
Anterior leaflet triangular resection	1	0.4
Anterior leaflet patch	4	1.5
Edge-to-edge	1	0.4



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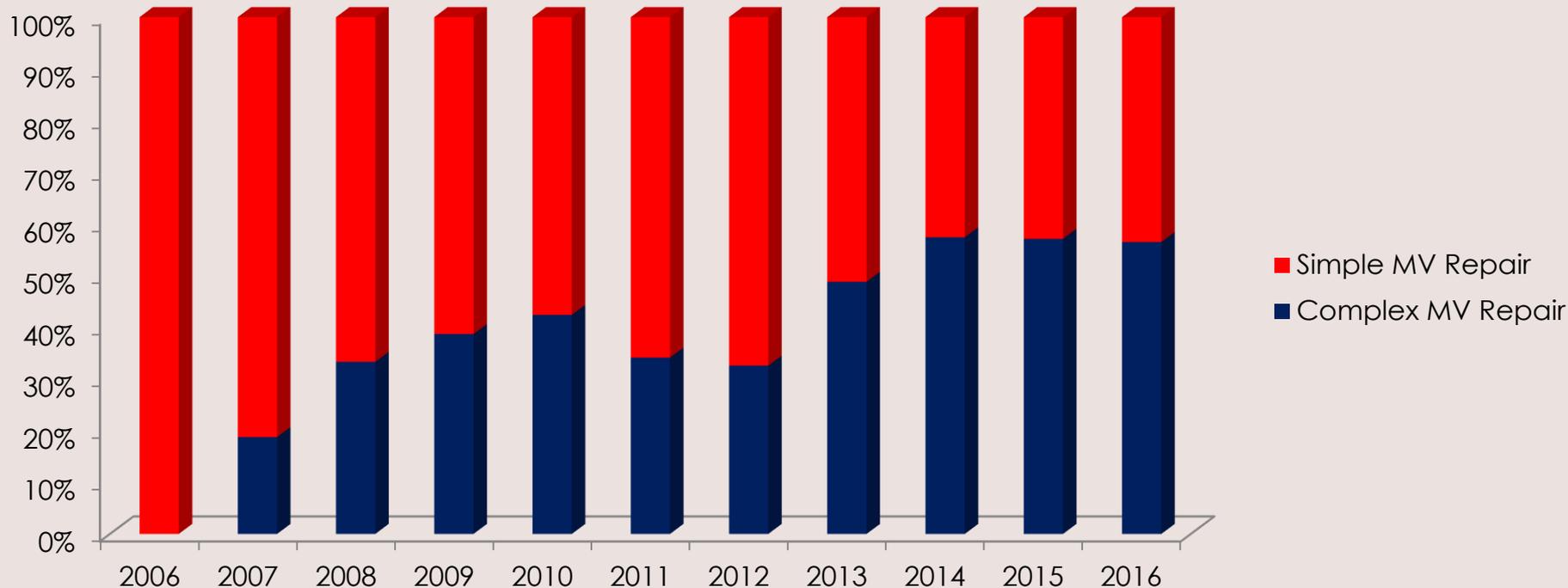
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Overall MV surgeries: 1100/1477 (74.4%)

Degenerative MV: 586/1100 (53.3%)

MV repair rate: 563/586 (96.6%)

Previous MV repair 23/586





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Preoperative clinical and echocardiographic characteristics

Variable	(n= 586)	
Age (mean, SD)	62.2	12.4
Female sex (n,%)	194	33.1
Diabetes (n,%)	23	3.9
Renal failure (n,%)	20	3.4
Hypertension (n,%)	312	53.2
COPD (n,%)	34	5.8
Peripheral vascular disease (n,%)	24	4.1
Pulmonary hypertension (≥ 50 mmHG) (n,%)	91	15.5
Atrial fibrillation (n,%)	123	21.0
EURO Score add (mean, SD)	4.3	2.1
EURO Score log (mean, SD)	3.7	3.6
NYHA class (mean, SD)	2.6	1.2
class I/II (n,%)	152	25.9
class III/IV (n,%)	276	47.1
MR grade (mean, SD)	3.9	0.2
Ejection fraction (mean %)	63.1	8.0
Ejection fraction <50% (n, %)	41	7.0
Previous cardiac surgery (%)	11	1.9



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MV repair - Perioperative and postoperative complication

Type of complication **(n=586)**

Renal insufficiency (n,%) 5 (0.9)

Neurologic event (n,%) 5 (0.9)

Reoperation for bleeding (n,%) 7 (1.2)

MOF (n,%) 2 (0.3)

Postoperative drainage of

Righthpleural effusion (n,%) 7 (1.2)

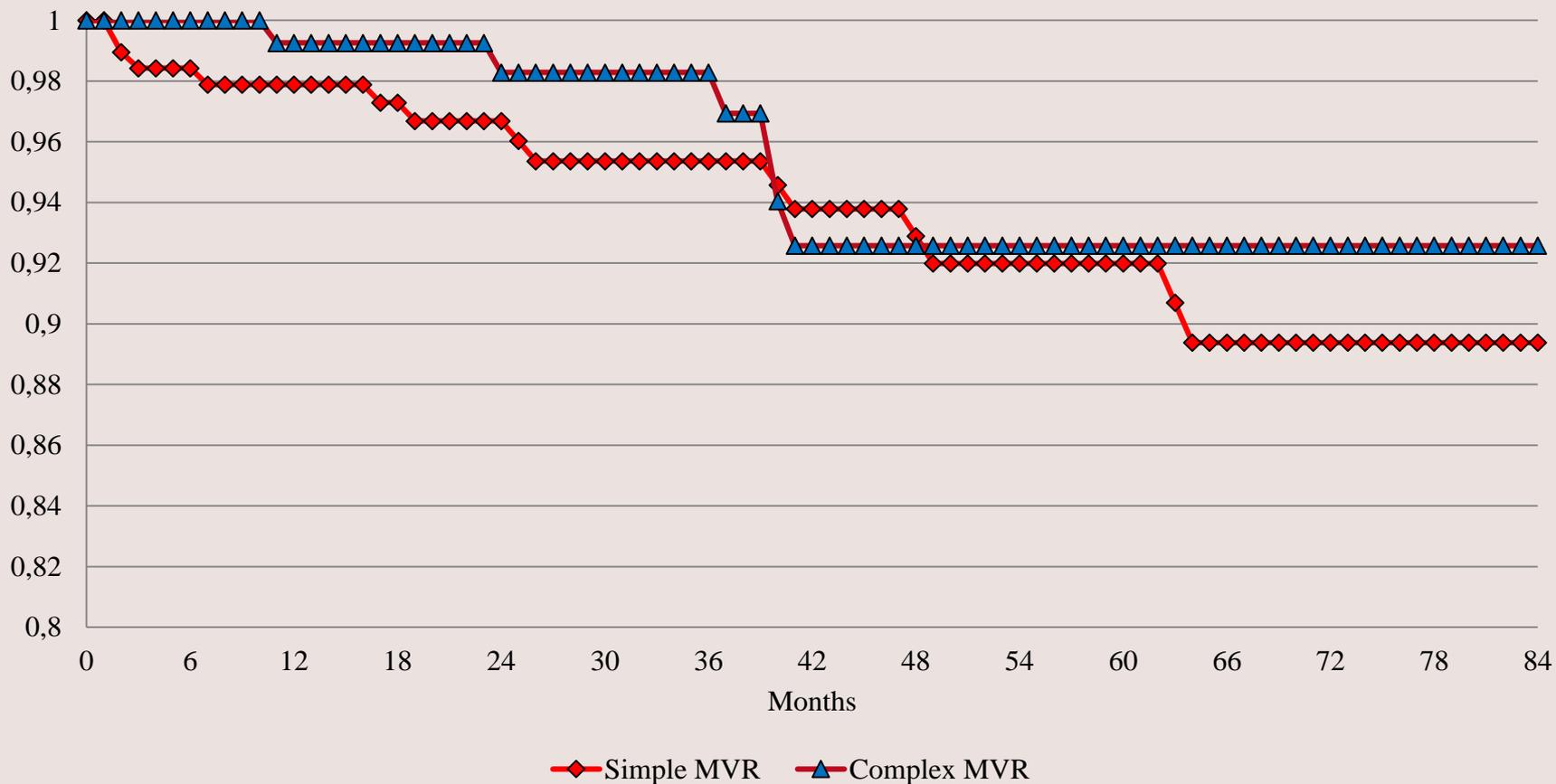
30-day mortality (n,%) 4 (0.5)



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KM - MVR survival

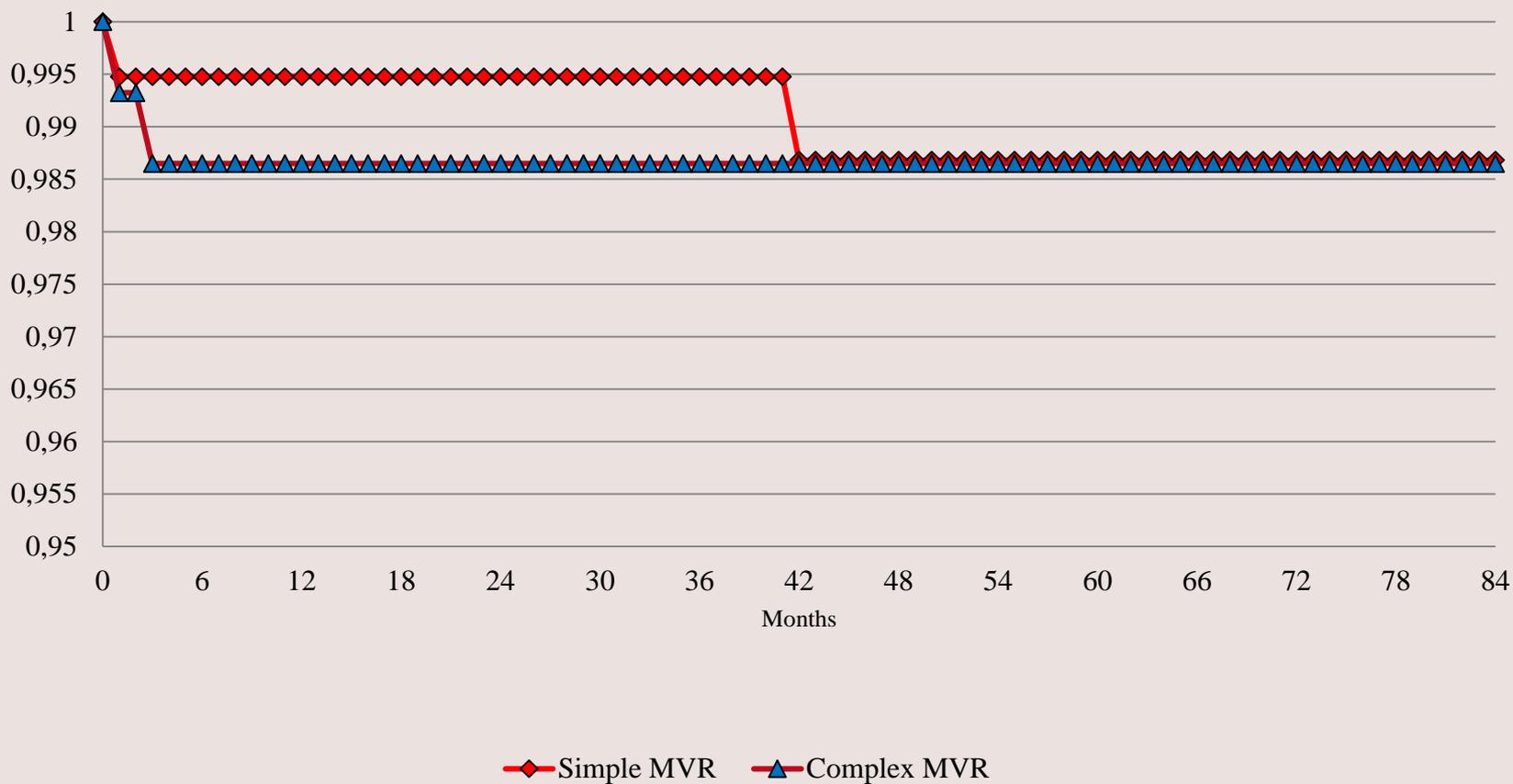




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Freedom from mitral valve reoperation





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CONCLUSIONS

- ✓ Same or even better safety and efficacy respect to standard technique
- ✓ Reduction of surgical dissection → low blood loss
- ✓ Reduction of postoperative pain
- ✓ Improvement of postoperative respiratory function
- ✓ Early mobilization & shorter hospital stay
- ✓ Faster recovery to functional activity
- ✓ Less rehabilitation resources
- ✓ Cosmetically superior incision
- ✓ Facilitation for reoperation at a later date
- ✓ Reduction of costs





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SUMMARY

- ✓ MIMVS (limited incision, no-rib retraction, thoracoscopic indirect vision) has become the "standard of care" for almost ANY isolated mitral valve surgery
- ✓ In dedicated centers, MIMVS can offer better results in terms of transfusions, pulmonary function, quick discharge and rehabilitation. In some subsets of pts (redo) it can provide better survival
- ✓ Concomitant procedures as tricuspid and AF surgery are safely performed through this approach
- ✓ Perfusion and clamping strategies (site of cannulation, use of TTC or endo-balloon clamping) MUST be tailored upon individual characteristics