

MIDCAB

Standardization of the Minimally Invasive Approach in off-pump coronary Revascularization

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MIDCAB

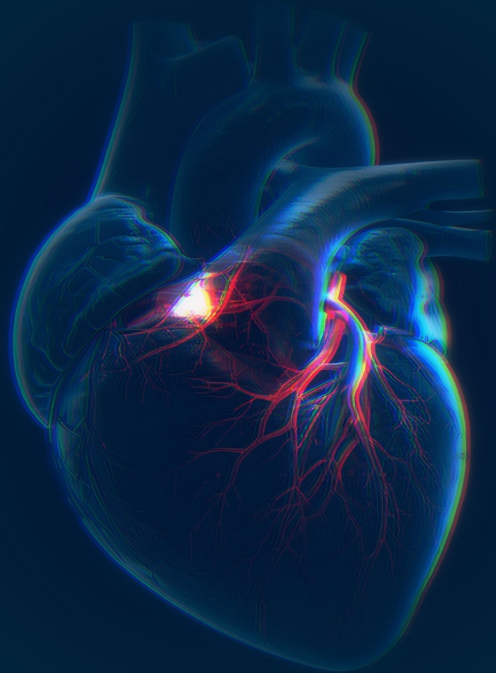
Minimally Invasive Direct Coronary Artery Bypass

Single LITA-to-LAD bypass

Anastomosis: off-pump

Approach: left-sided minithoracotomy (IV-V s.i.)





From sternotomy to minimally invasive surgery

Ischemic heart disease: the leading cause of global death

LAD: most frequently involved vessel

Traditional CABG: median sternotomy+CEC = historical gold standard revascularization by implantation of LITA on LAD

Problems: invasiveness of sternotomy with longer recovery times and specific risks

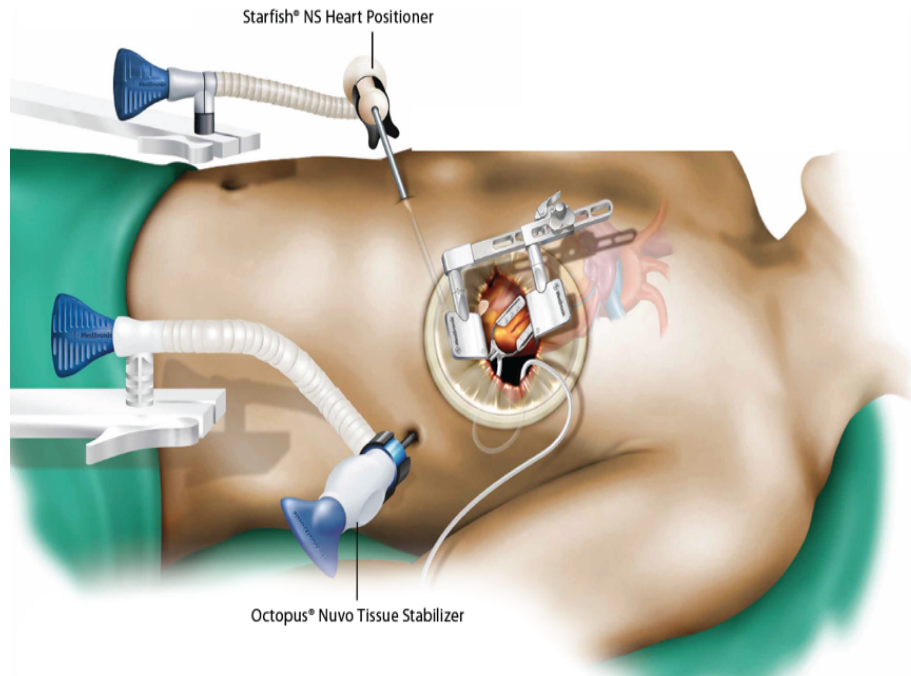


PROS

- No sternotomy
- Reduced postoperative pain
- Lower risk of sternal infections
- Faster functional recovery
- Patient satisfaction
- Acceptance of the procedure
- Comparable results

CONS

- Technical complexity
- Steep learning curve
- Limited exposure
- Risk of conversion



MIDTERM RESULTS AFTER MINIMALLY INVASIVE CORONARY SURGERY (LAST OPERATION)

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Background: Our experience with a left internal thoracic artery graft to the left anterior descending artery via a left anterior small thoracotomy is reviewed to evaluate midterm results. **Methods:** From November 1994 to April 1997, four hundred sixty patients were scheduled to undergo a left internal thoracic artery graft to the left anterior descending coronary artery via a left anterior small thoracotomy; 26 of these patients (5.7%) were converted and 434 of them had the operation. Two hundred fourteen patients (49.3%) had isolated disease of the left anterior descending artery, and 220 patients (50.7%) had multiple vessel disease. A sufficient length of

Table I. Preoperative data (434 patients)

Age (yr)	61.1 ± 9.9 (mean, 32-88)
≥70 yr	85 (19.6%)
Sex (female)	54 (12.4%)
Unstable angina	126 (29.0%)
Previous MI	130 (29.9%)
Major risk factors	85 (19.6%)
Age >75 yr	27 (6.2%)
Redo	14 (3.2%)
Diffuse encephalopathy	13 (3.0%)
Malignancy	13 (3.0%)
Renal failure	10 (2.3%)
Diffuse vasculopathy	4 (0.9%)
Untouchable aorta	3 (0.7%)
Coagulation disorders	2 (0.5%)
HIV positive	1 (0.2%)
Hepatic cirrhosis	1 (0.2%)
Single-LAD disease	214 (49.3%)
Multiple-vessel disease	220 (50.7%)
LM disease	17 (4.0%)
EF (%)	61.5 ± 12.9 (15-90)
≤ 35	13 (3.0%)

Table II. Perioperative data

LAD occlusion time (min)	25.3 ± 8.0
Anastomotic time (min)	18.3 ± 5.8
Operation time (hr)	2.1 ± 0.5
LAD grafting	
LITA (%)	398 (91.7)
IEA	
Elongation (%)	32 (7.4)
Bridge from LITA (%)	1 (0.2)
SVG elongation (%)	3 (0.7)
Diagonal grafting (IEA as Y graft) (%)	2 (0.5)
Associated surgery (%)	6 (1.4)

LAD, Left anterior descending; LITA, left internal thoracic artery; IEA, interior epigastric artery; SVG, saphenous vein graft.



ORIGINAL ARTICLE

Five-Year Outcomes after PCI or CABG for Left Main Coronary Disease

G.W. Stone, A.P. Kappetein, J.F. Sabik, S.J. Pocock, M.-C. Morice, J. Puskas, D.E. Kandzari, D. Karpaliotis, W.M. Brown III, N.J. Lembo, A. Banning, B. Merkely, F. Horkay, P.W. Boonstra, A.J. van Boven, I. Ungi, G. Bogáts, S. Mansour, N. Noiseux, M. Sabaté, J. Pomar, M. Hickey, A. Gershlick, P.E. Buszman, A. Bochenek, E. Schampaert, P. Pagé, R. Modolo, J. Gregson, C.A. Simonton, R. Mehran, I. Kosmidou, P. Génereux, A. Crowley, O. Dressler, and P.W. Serruys, for the EXCEL Trial Investigators*

Circulation

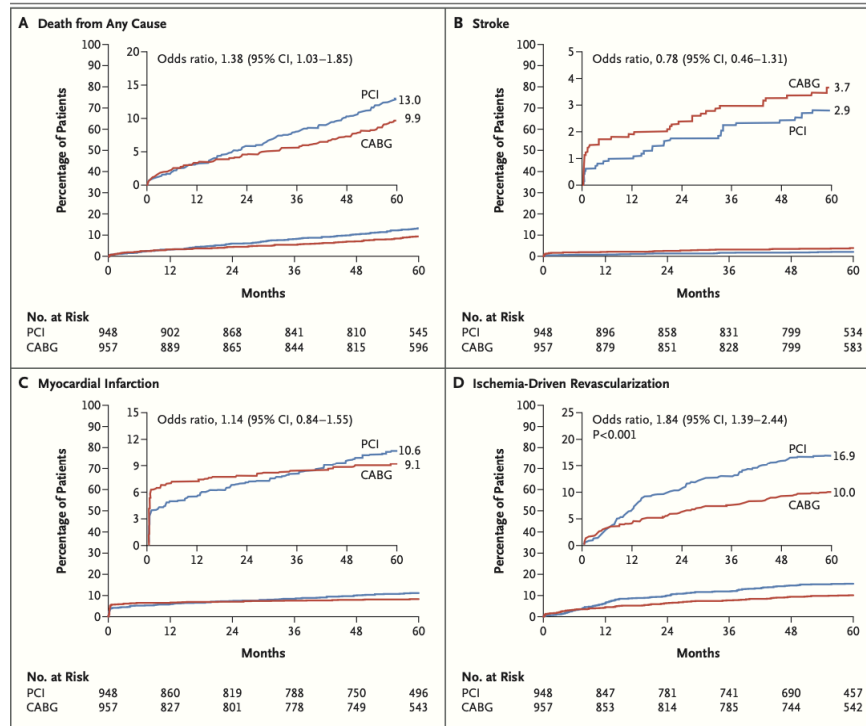
Volume 112, Issue 22, 29 November 2005; Pages 3445-3450
<https://doi.org/10.1161/CIRCULATIONAHA.105.578492>



INTERVENTIONAL CARDIOLOGY

Comparison of Bare-Metal Stenting With Minimally Invasive Bypass Surgery for Stenosis of the Left Anterior Descending Coronary Artery

A 5-Year Follow-Up

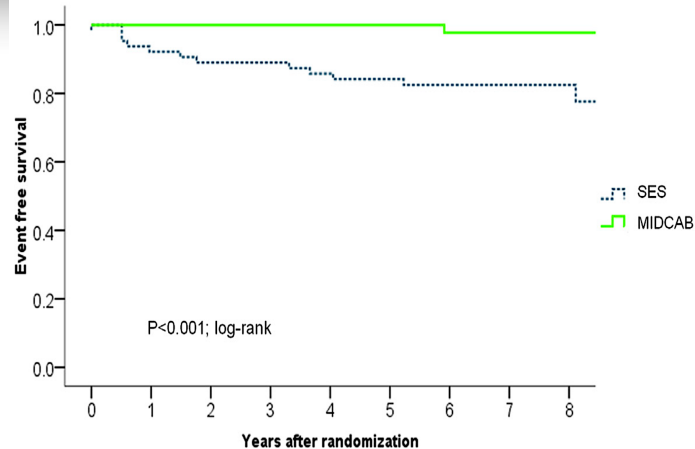
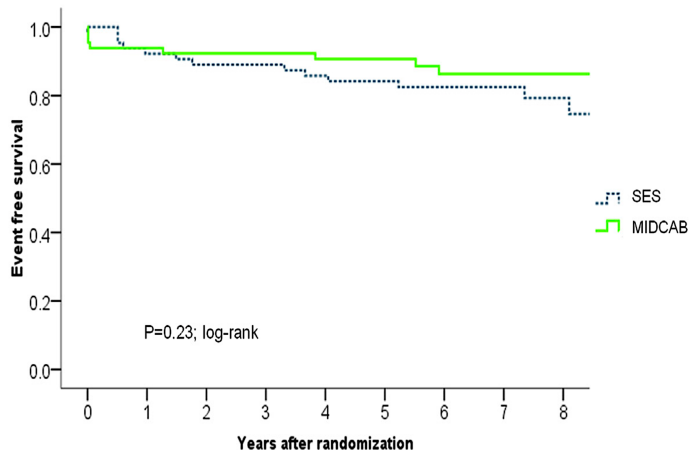


Comparison of Sirolimus-Eluting Stenting With Minimally Invasive Bypass Surgery for Stenosis of the Left Anterior Descending Coronary Artery



7-Year Follow-Up of a Randomized Trial

Stephan Blazek, MD,* Cornelius Rossbach, BSc,* Michael A. Borger, MD,† Georg Fuernau, MD,* Steffen Desch, MD,*‡ Ingo Eitel, MD,*‡ Thomas Stiermaier, MD,* Philipp Lurz, MD,* David Holzhey, MD,† Gerhard Schuler, MD,* Friedrich-Wilhelm Mohr, MD,† Holger Thiele, MD*‡



2018 ESC/EACTS Guidelines on myocardial revascularization

The Task Force on myocardial revascularization of the European Society of Cardiology (ESC) and European Association for Cardio-Thoracic Surgery (EACTS)

Recommendations on procedural aspects of coronary artery bypass grafting

Recommendations	Class ^a	Level ^b
General considerations		
Complete myocardial revascularization is recommended [131, 132]. ^c	I	B
Minimization of aortic manipulation is recommended [508, 509, 544, 545].	I	B
Routine intraoperative graft flow measurement should be considered [516, 517].	IIa	B
CT scans of the ascending aorta should be considered in patients over 70 years of age and/or with signs of extensive generalized atherosclerosis.	IIa	C
Prior to aortic manipulation, epiaortic ultrasound should be considered to identify atheromatous plaques and select the optimal surgical strategy.	IIa	C
Conduit selection		
Arterial grafting with IMA to the LAD system is recommended [453, 454, 546].	I	B
An additional arterial graft should be considered in appropriate patients [467, 482, 547–551].	IIa	B
The use of the radial artery is recommended over the saphenous vein in patients with high-grade coronary artery stenosis [482, 549, 550, 552, 553]. ^d	I	B
BIMA grafting should be considered in patients who do not have a high risk of sternal wound infection [467, 547, 548, 551]. ^e	IIa	B
Vessel harvesting		
Skeletonized IMA dissection is recommended in patients with a high risk of sternal wound infection [471, 484, 485].	I	B
Endoscopic vein harvesting, if performed by experienced surgeons, should be considered to reduce the incidence of wound complications [490, 493, 494, 500, 554].	IIa	A
No-touch vein harvesting should be considered when an open technique is used [506, 507, 555, 556].	IIa	B
Minimally invasive techniques		
Off-pump CABG and preferably no-touch techniques on the ascending aorta, by experienced operators, are recommended in patients with significant atherosclerotic aortic disease [508, 509, 544, 557–559].	I	B
Off-pump CABG should be considered for subgroups of high-risk patients by experienced off-pump teams [525, 557–560].	IIa	B
Where expertise exists, minimally invasive CABG through limited thoracic access should be considered in patients with isolated LAD lesions or in the context of hybrid revascularization [143, 534, 535, 561].	IIa	B
Hybrid procedures, defined as consecutive or combined surgical and percutaneous revascularization, may be considered in specific patient subsets at experienced centres [536, 561–563].	IIb	B

SELECTION PATIENT

Who is the ideal MIDCAB patient?

INDICATIONS

Isolated LAD disease
Patients at high risk for sternotomy
Complex multivessel disease (HYBRID APPROACH)

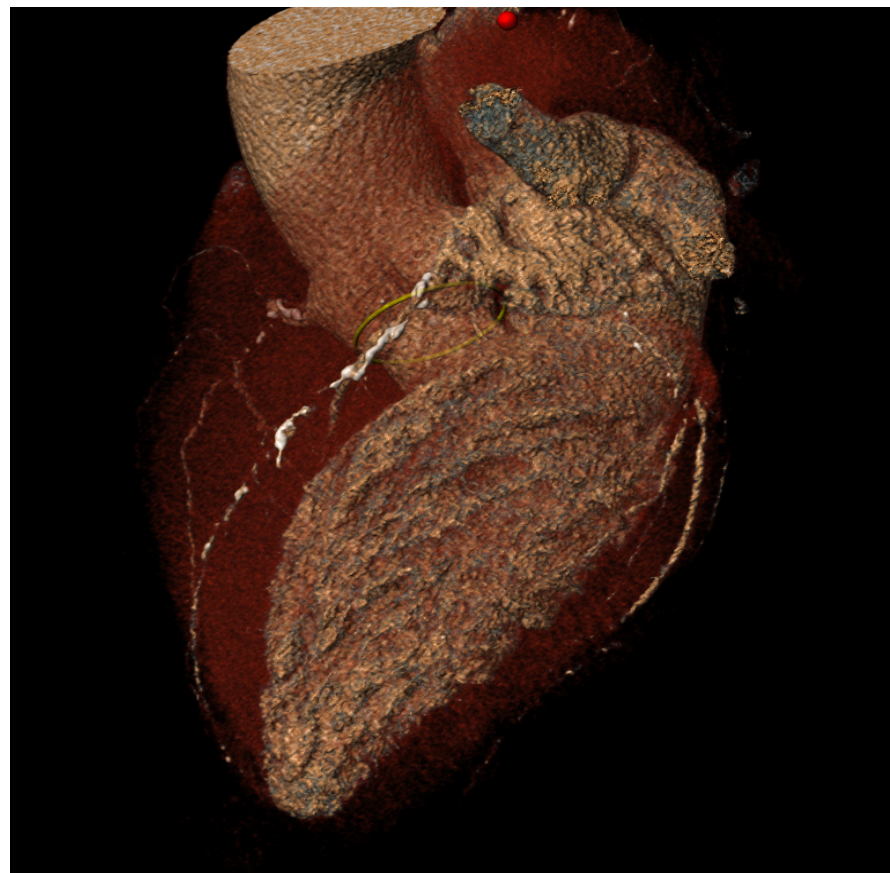
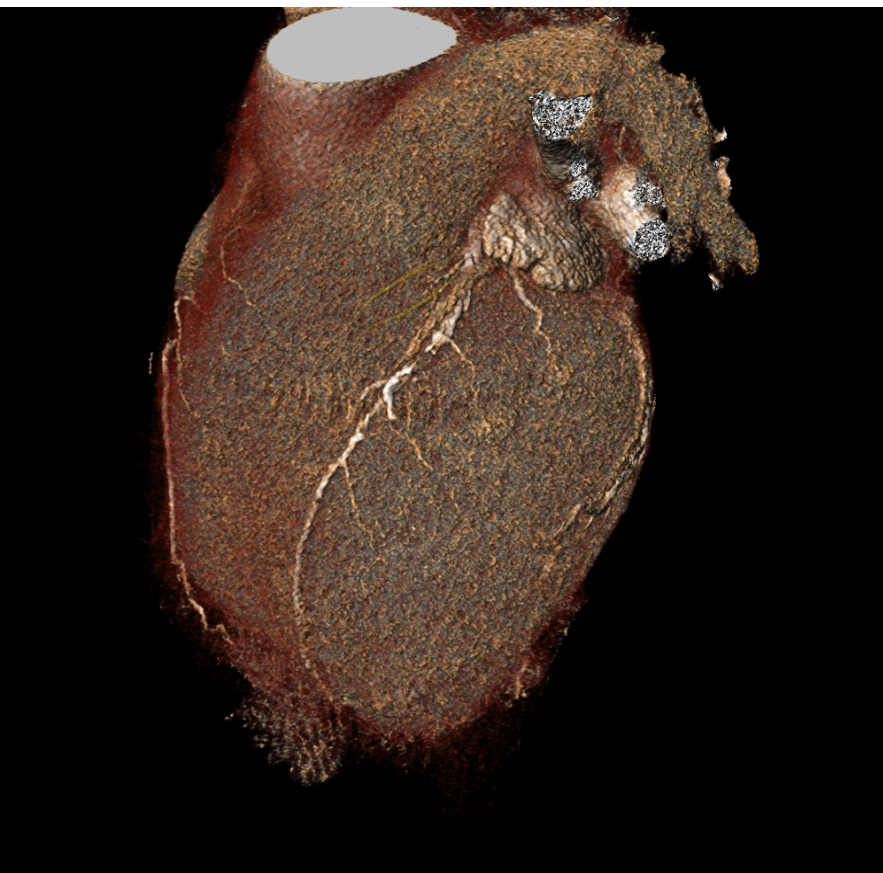
FAVORABLE CRITERIA

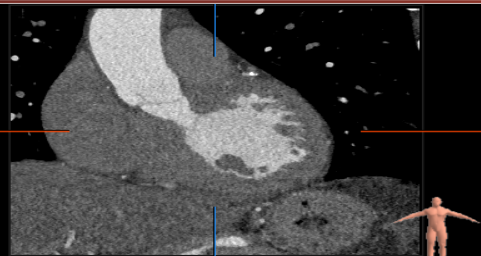
Male gender
Cardiothoracic index <0.5
Good ejection fraction
Good pulmonary function

CONTRINDICATIONS

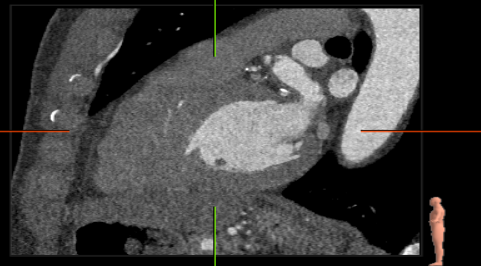
Intramycardial course of the LAD
Left subclavian occlusion
Unfavorable thoracic anatomy
Severe pulmonary diseases



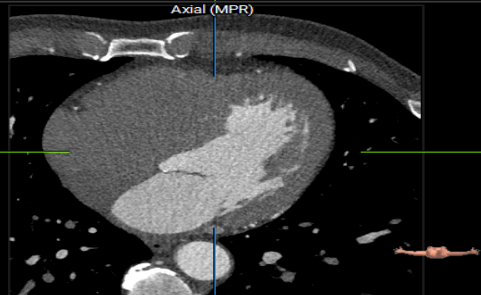




Sagittal (MPR)



Axial (MPR)

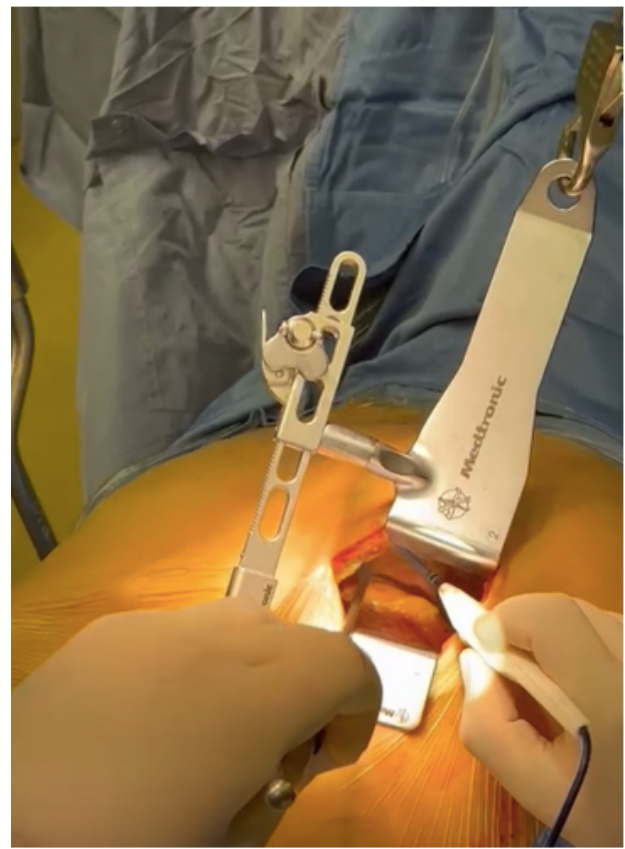
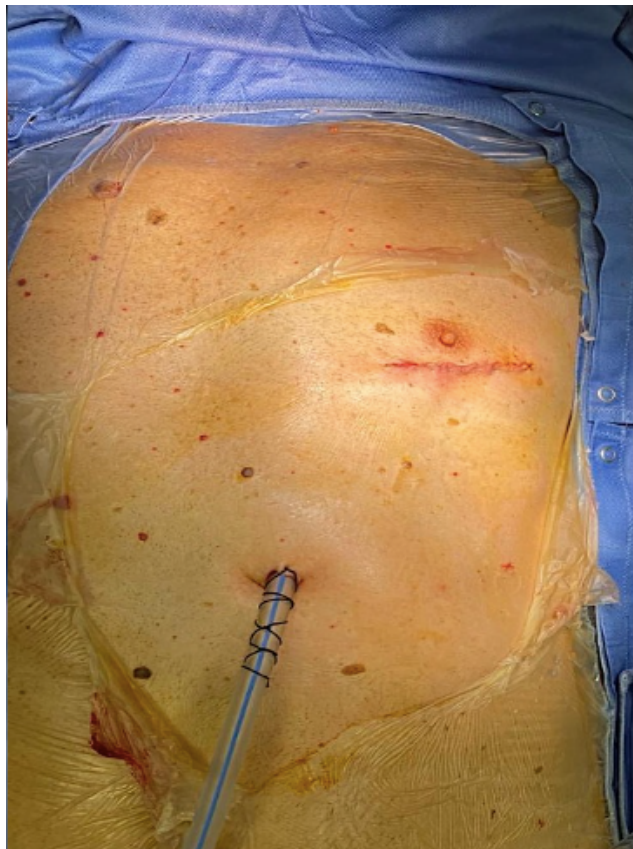


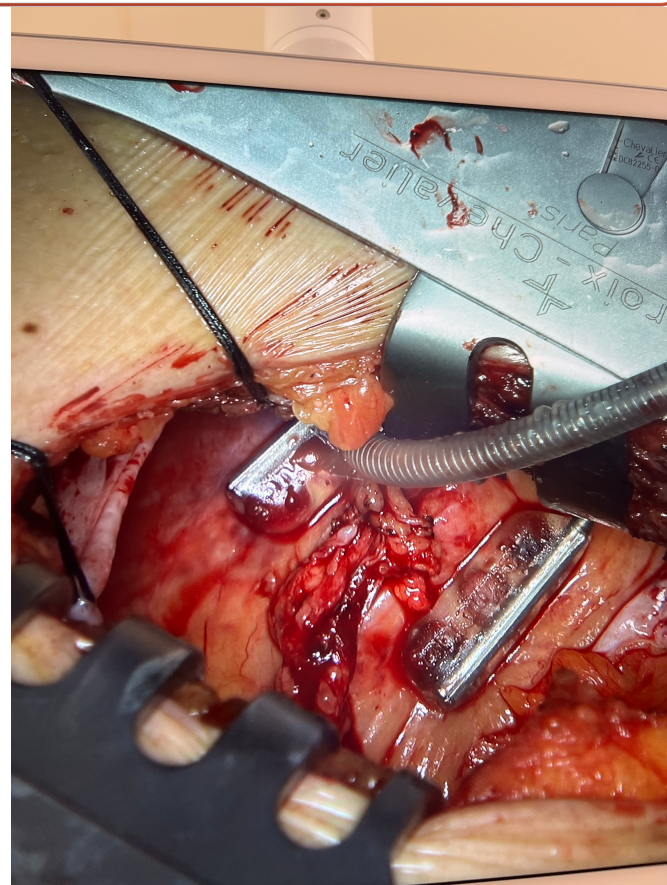
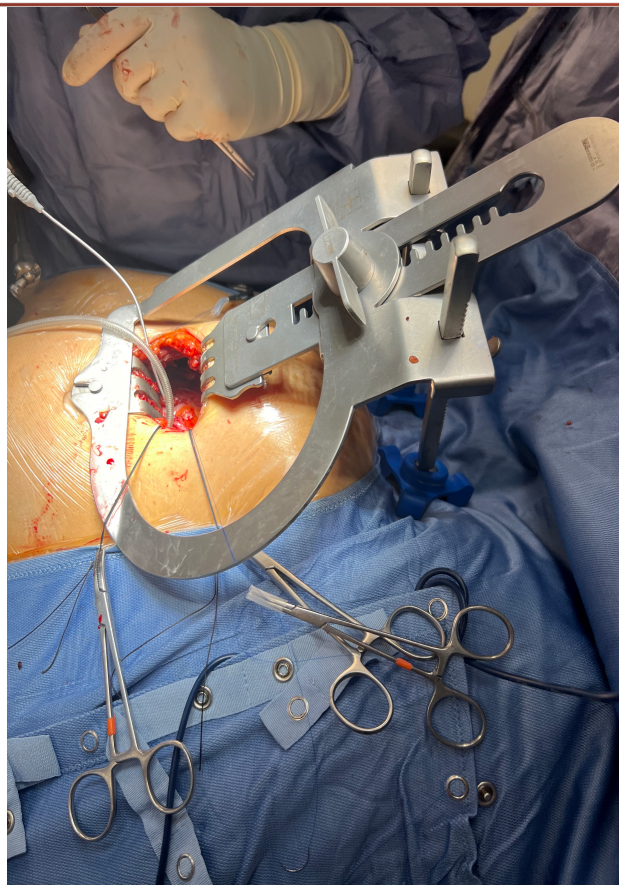
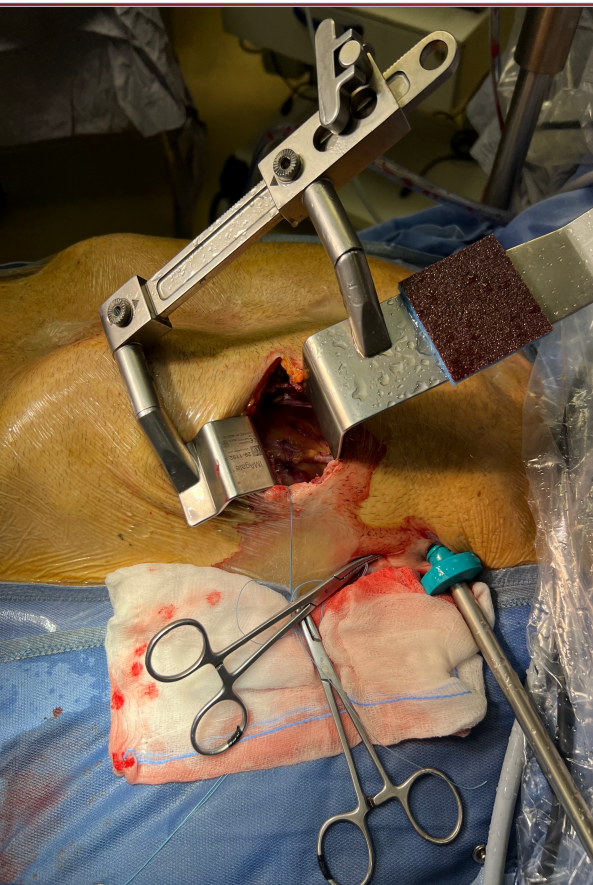
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LAO: 15°
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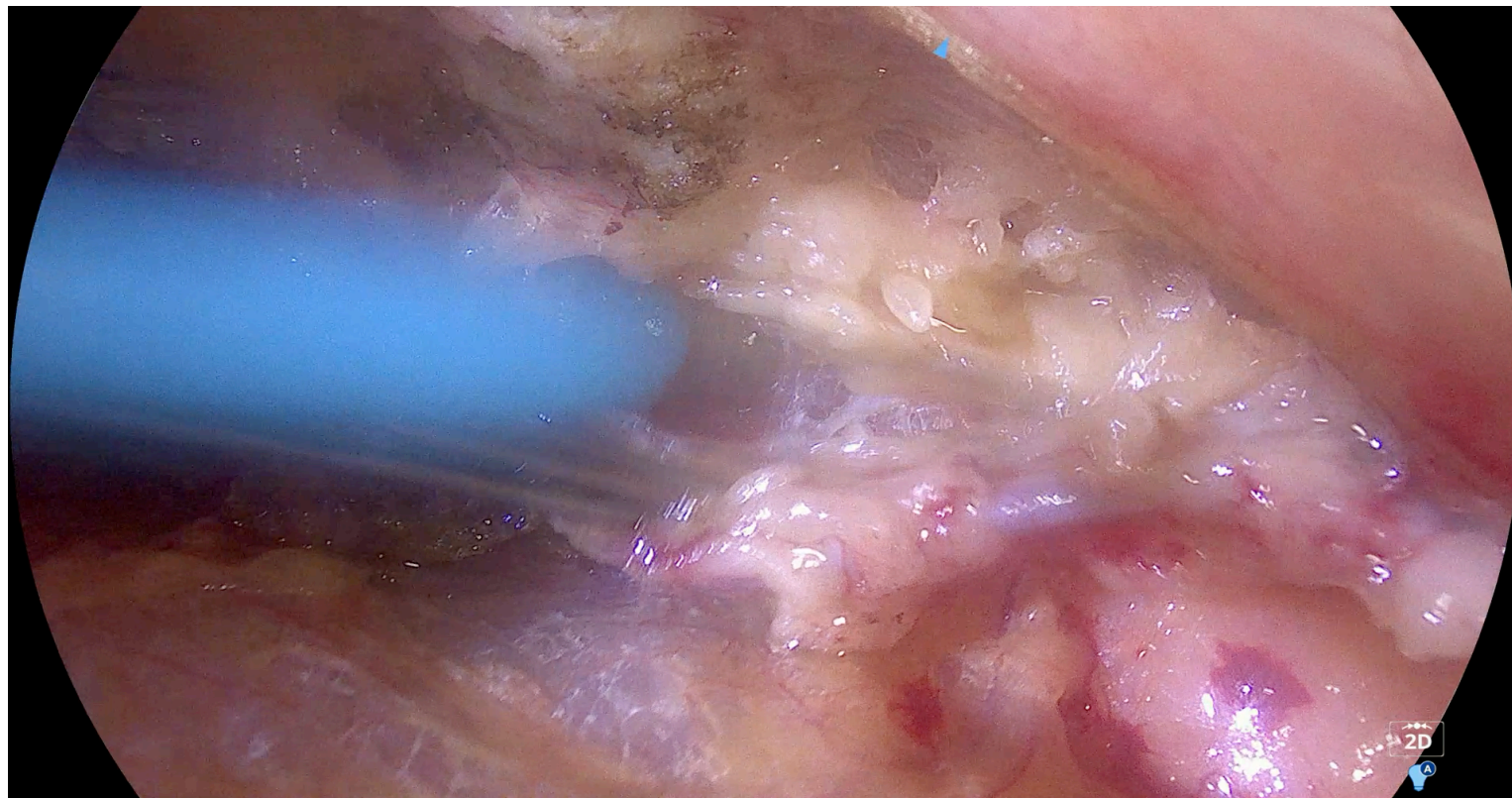
DS_CorCTA 0.6 Bv49 3 BestDiast 79 %
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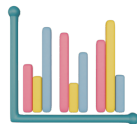


Series: 9
Image(s): 1-399
Slice Spacing: 0.4 mm









prospective observational study



29 MIDCAB patients



Montevergine Clinic, Mercogliano (AV)



May 2024 – December 2025



telephone and outpatient follow-up



Preoperative characteristics

Cohort	29
Female gender (n, %)	2 (6,9%)
Age (years, mean $\pm$ SD)	63,1 $\pm$ 11,4
Creatinine (mg/dL, median, IQR)	0,9 (0,8-1,05)
LVEF (%., median, IQR)	60 (51-60)
Euroscore II (%., median, IQR)	0,92 (0,72-1,54)
NYHA class (n, %)	
I	13 (44,8%)
II	12 (41,4%)
III	4 (13,8%)
IV	0
CCS class (n, %)	
I	8 (27,6%)
II	13 (44,8%)
III	8 (27,6%)
IV	0
Risk factors	
Arterial hypertension (n, %)	24 (82,8%)
Obesity (n, %)	10 (34,5%)
Smoke (n, %)	11 (37,9%)
Dyslipidemia (n, %)	23 (79,3%)
Diabetes (n, %)	10 (34,5%)
Atrial Fibrillation (n, %)	3 (10,3%)
Chronic Kidney Disease (n, %)	3 (10,3%)
COPD (n, %)	9 (31%)
Previous myocardial infarction (n, %)	2 (6,9%)
Previous cardiac procedure (n, %)	6 (20,7%)
Previous cardiac surgery (n, %)	0



Intraoperative data

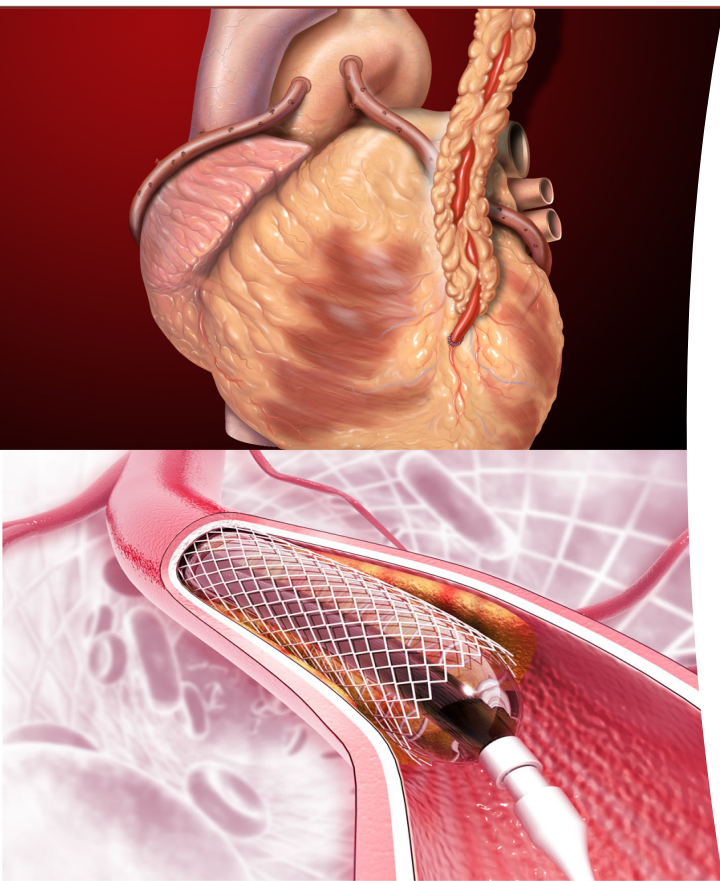
Revascularization surgery	
LITA-LAD (n, %)	20 (69%)
Hybrid revascularization (n, %)	9 (31%)
Mini-thoracotomy Incision	
IV intercostal space (n, %)	22 (75,9%)
V intercostal space (n, %)	7 (24,1%)
LITA harvest technique	
Direct vision (n, %)	28 (96,6%)
VATS (n, %)	1 (3,4%)
Intravascular shunt (mm, median, IQR)	1,75 (1,5-1,75)
MIDCAB timing (hours, median, IQR)	3 (2,4-3,3)
Conversion to sternotomy (n, %)	0



Postoperative results

Mortality 30 days (n, %)	0
Duration	
Mechanical ventilation (hours, median, IQR)	3 (2-4,5)
ICU stay (days, median, IQR)	1 (1-1)
Hospital stay (days, median, IQR)	7 (6-7,5)
Complications	
RBC transfusion (n, %)	3 (10,3%)
Creatinine (mg/dL, median, IQR)	0,8 (0,7-1,2)
Myocardial infarction (n, %)	1 (3,4%)
Stroke (n, %)	0
TIA (n, %)	0
POAF (n, %)	8 (27,6%)
Respiratory complications (n, %)	2 (6,9%)
Wound complications (n, %)	1 (3,4%)





HYBRID RIVASCOLARIZATION

PCI + MIDCAB -> acute events

MIDCAB + PCI -> after at least 48 h on DAPT

MIDCAB/PCI (one stage) -> in hybrid OR

**HEART TEAM
ASSESSMENT**



MIDCAB – Hybrid

	MIDCAB	HYBRID	p Mann-Whitney	p Fisher
Age (years, mean $\pm$ SD)	64,2 $\pm$ 10,5	60,5 $\pm$ 13,5	0,501	
Female gender (n, %)	2 (6,9%)	0		0,468
bmi (kg/m ² ; median,IQR)	27,3 (24,6-32)	27 (24,1-31,7)	0,871	
Creatinine (mg/dL, median, IQR)	0,95 (0,8-1)	0,9 (0,8-1)	0,472	
LVEF (%; median,IQR)	59 (50-60)	60 (51,5-62,5)	0,501	
Euroscore II (%; median,IQR)	0,88 (0,73-1,32)	0,95 (0,71-2,18)	0,532	
<u>Risk factors</u>				
Arterial hypertension (n, %)	16 (80%)	8 (88,9%)		0,498
Obesity (n, %)	8 (40%)	2 (22,2%)		0,311
Smoke (n, %)	14 (70%)	6 (66,7%)		0,591
Dyslipidemia (n, %)	17 (85%)	6 (66,7%)		0,257
Diabetes (n, %)	6 (30%)	4 (44,4%)		0,364
Atrial Fibrillation (n, %)	3 (15%)	0		0,312
Chronic Kidney Disease (n, %)	4 (20%)	1 (11%)		0,498
COPD (n, %)	7 (35%)	2 (22,2%)		0,409
Previous myocardial infarction (n, %)	1 (5%)	1 (11,1%)		0,532
Previous cardiac procedure (n, %)	5 (25%)	2 (22,2%)		0,631
Previous cardiac surgery (n, %)	0	0		
<u>n° lesions</u>				
1	17 (85%)	1 (11,1%)		
2	2 (10%)	5 (55,6%)		
3	1 (5%)	3 (33,3%)		
TC lesion (n, %)	1 (5%)	1 (11,1%)		0,532
<u>PCI</u>				
Cdx		5 (55,6%)		
MO		2 (22,2%)		
TC-Cx		2 (22,2%)		
CCH PCI (days, median,IQR)		4,5		
RBC transfusion (n, %)	2 (10%)	1 (11,1%)		0,688
Creatinine post (mg/dL, median,IQR)	0,85 (0,7-1,2)	0,8 (0,7-1,15)	0,660	
ICU stay (days, median,IQR)	1 (1-1)	1 (1-1,5)	0,908	
Hospital stay post (days, median,IQR)	7 (5,25-7,75)	7 (6,5-7,5)	0,627	



RESULTS

Favorable early postoperative outcomes

- no deaths within 30 days
- low incidence of complications
- shorter intensive care unit stay
- rapid functional recovery

Good long-term results

- excellent patency of the LIMA-LAD
- high patient satisfaction



Davierwala et al

Adult

Twenty-year outcomes of minimally invasive direct coronary artery bypass surgery: The Leipzig experience

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MIDCAB – A 22-year Leipzig experience

Data and Methods

- **Study Cohort:** 2667 patients operated at a tertiary level single institution between 1996-2018.
- **Procedure:** MIDCAB (LITA–LAD graft) via left small anterior thoracotomy.
- **Objectives:** Observe changes in practice over a 22-year period & evaluate changes in patient profile and outcomes.

Results

- **Demographics:** Patients operated in the most recent era (2011-2018) had **higher burden** of risk factors and co-morbidities.
- **Early outcomes:** Overall in-hospital mortality – **0.9%**. Graft revisions due to **technical errors** reduced over time, but were associated with poor early outcomes.
- **Survival:** **66% @ 15 years** and **55% @ 20 years**.

Implications

- **MIDCAB** is a **safe, feasible and efficacious operation** for patients requiring isolated LAD grafting.
- **Our 20-year follow-up** sets a benchmark for future studies and trials investigating revascularization therapies.

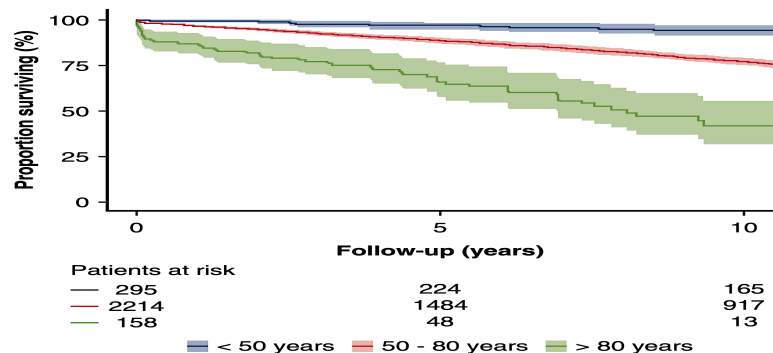


TABLE 2. Postoperative outcomes

Postoperative outcomes	All patients 1996-2018 (N = 2667)	Group A 1996-2003 (n = 1333)	Group B 2004-2010 (n = 627)	Group C 2011-2018 (n = 707)	P value
Low output syndrome	34 (1.3)	28 (2.1)	3 (0.5)	3 (0.4)	<.001
IABP insertion	13 (0.5)	5 (0.4)	6 (1.0)	2 (0.3)	.2
Myocardial infarction	18 (0.7)	13 (1.0)	2 (0.3)	3 (0.4)	.2
Reexploration for bleeding	51 (1.9)	13 (1.0)	13 (2.1)	25 (3.5)	<.001
New dialysis	27 (1.0)	15 (1.1)	3 (0.5)	9 (1.3)	.3
Respiratory failure	95 (3.6)	34 (2.5)	19 (3.0)	42 (5.9)	<.001
Deep chest wound infection	7 (0.3)	4 (0.3)	1 (0.2)	2 (0.3)	.8
Median hospital stay (IQR)	8.0 (7.0-10.0)	8.0 (7.0-10.0)	8.0 (7.0-11.0)	7.0 (6.0-9.0)	<.001
In-hospital mortality	24 (0.9)	13 (1.0)	4 (0.6)	7 (1.0)	.7

Data are presented as n (%) except where otherwise noted. IABP, Intra-aortic balloon pump; IQR, interquartile range.



Cite this article as: Manuel L, Fong LS, Betts K, Bassin L, Wolfenden H. LIMA to LAD grafting returns patient survival to age-matched population: 20-year outcomes of MIDCAB surgery. Interact CardioVasc Thorac Surg 2022; doi:10.1093/icvts/ivac243.

LIMA to LAD grafting returns patient survival to age-matched population: 20-year outcomes of MIDCAB surgery

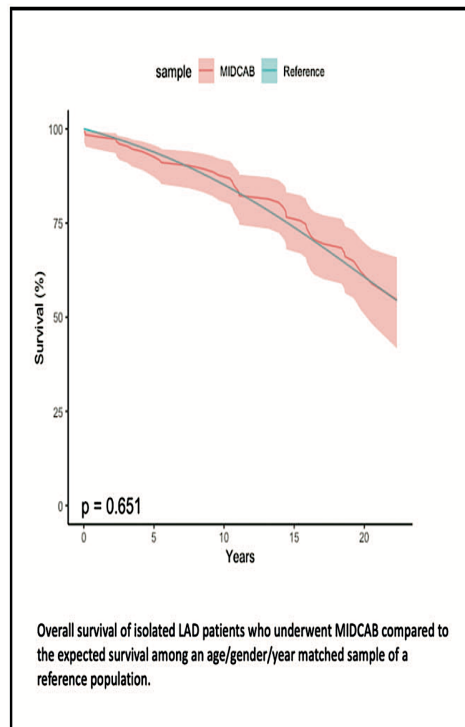
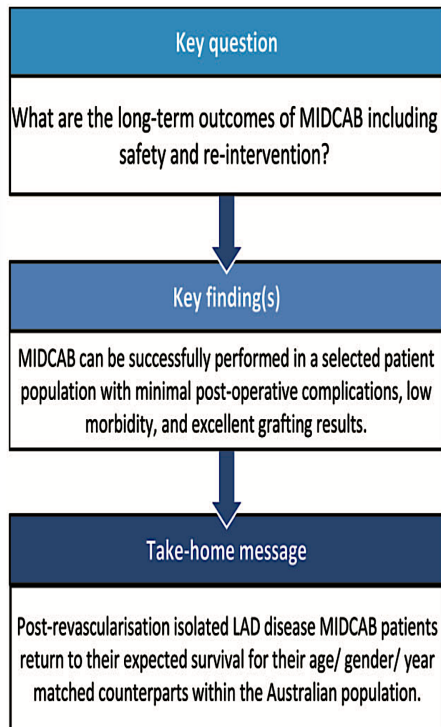
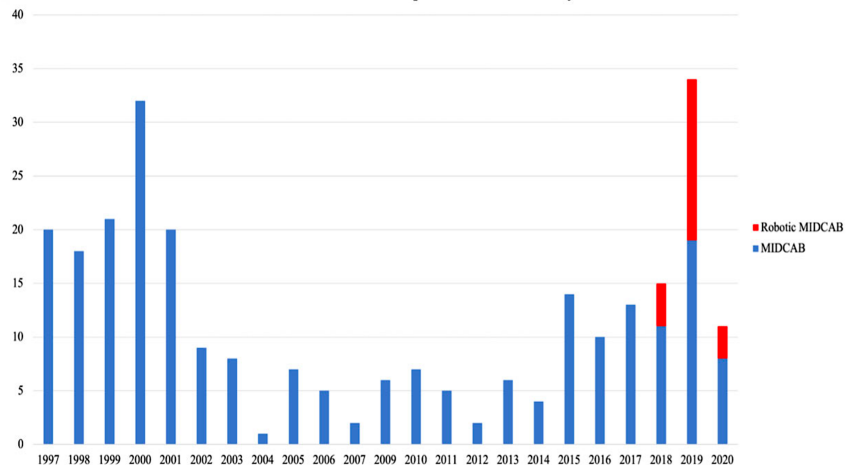
Lucy Manuel^{a*}, Laura S. Fong^b, Kim Betts^c, Levi Bassin^{a,b} and Hugh Wolfenden^b

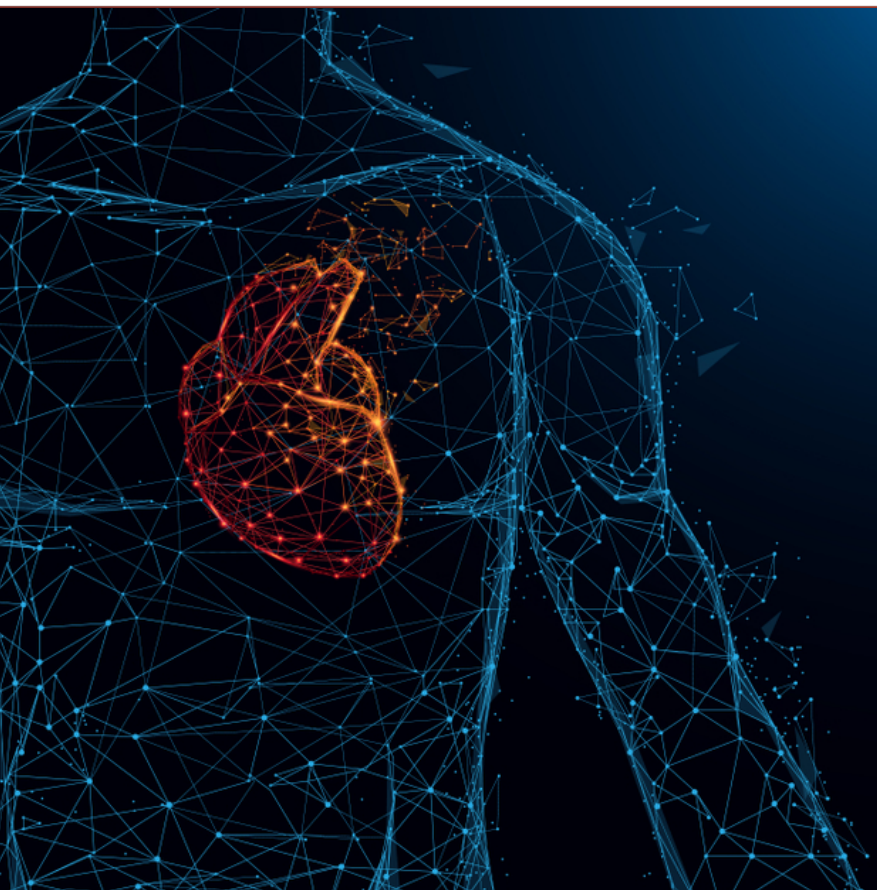
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Number of MIDCAB Operations Performed by Year





MIDCAB & AI

«Coronary Heart Team» support

- ❑ Advanced imaging techniques: detailed plaque analysis and flowmetry, noninvasive
- ❑ Improvement of clinical and practical performance: comparison of group data (which cannot be analyzed individually) followed by matching of these retrospective and prospective data
- ❑ Evaluation of treatment outcomes: measurement of various parameters and identification of the ideal patient (e.g., MIDCAB vs. CABG)



TAKE HOME MESSAGE

- MIDCAB: a safe, effective and long-lasting technique
- MIDCAB produces satisfactory postoperative results with excellent short- and medium-term outcomes, both in MIDCAB-CR and MIDCAB-HCR
- Despite the numerous advantages of minimally invasive CABG, the adoption rate of this minimally invasive strategy within the surgical community remains low
- Patient selection is critical (Coronary Heart Team + AI)
- Center-based experience and dedicated training: hands-on courses and live surgery sessions with an efficient and easily replicable setup





YOU WILL NEVER
CHANGE YOUR LIFE
UNTIL YOU CHANGE
SOMETHING
YOU DO DAILY

John C. Maxwell



THANK YOU
FOR ATTENTION

