

# Is routine total arterial aorta no-touch coronary artery bypass grafting possible in all elective patients?

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**Introduction** Current guidelines recommend the use of arterial grafts and the aortic no-touch technique for coronary artery bypass grafting (CABG).<sup>1</sup> A recent study showed better outcomes after CABG if arterial grafts were used.<sup>2</sup> Additionally, avoidance of aortic manipulation during CABG reduces the risk of early postoperative stroke.<sup>3</sup> However, transition to routine use of a total arterial, aortic no-touch procedure for CABG is yet to occur. This study aimed to determine the feasibility and safety of changing from a standard CABG to a total arterial, aortic no-touch, off-pump technique in consecutive patients.

**Methods** A prospective registry was conducted to collect data on 100 consecutive patients who were operated on using the total arterial, aortic no-touch, off-pump technique. We excluded patients with single-vessel disease who were referred for minimally invasive CABG, those undergoing surgery while in cardiogenic shock, and those referred for hybrid revascularization. Preoperative characteristics of the included patients are presented in [TABLE 1](#).

In all patients, the chest was opened with either a full or partial median sternotomy. Internal mammary arteries (IMAs) were harvested using the skeletonization technique. The left radial artery (RA) was harvested with an open approach if the result of the Allen test was negative. In patients with diabetes or chronic obstructive pulmonary disease (COPD), the use of both IMAs was avoided to reduce the risk of sternal wound infection. In patients with severe renal failure, RA harvesting was avoided to save this vessel for dialysis fistula formation.

**TABLE 1** Preoperative characteristics of the study group patients (n = 104)

Parameter	Value
Age, y, mean (SD)	64.7 (8.9)
Female sex, n (%)	28 (27)
CCS, median (range)	2 (1–3)
NYHA, median (range)	2 (1–3)
History of MI, n (%)	38 (37)
Vascular disease, n (%)	38 (37)
Diabetes, n (%)	35 (34)
History of PCI, n (%)	35 (34)
Atrial fibrillation, n (%)	10 (10)
History of TIA or stroke, n (%)	10 (10)
Renal failure, n (%)	17 (16)
GFR, ml/min, mean (SD)	76 (23)
COPD, n (%)	11 (11)
LVEF, %, mean (SD)	50.8 (11.8)
Euroscore II, %, mean (SD)	1.5 (1.2)

Abbreviations: CCS, Canadian Coronary Score; COPD, chronic obstructive pulmonary disease; GFR, glomerular filtration rate; LVEF, left ventricular ejection fraction; MI, myocardial infarction; PCI, percutaneous coronary intervention; NYHA, New York Heart Association; TIA, transient ischemic attack

The anastomosis proximal to the aorta was replaced using the Y-graft technique, as an end-to-side anastomosis of the RA to IMA. All distal anastomoses were completed with intracoronary shunts. All patients underwent transit-time flow

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measurement. To standardize the surgical aspects, all patients were operated on by the same principal surgeon.

Feasibility of the new approach was assessed as the percentage of patients treated successfully with the new protocol technique out of all consecutive registered patients undergoing CABG. Safety of the new approach was assessed using the rate of in-hospital mortality, perioperative myocardial infarction, stroke, transient ischemic attack (TIA), and repeated revascularization and reoperation, as well as the length of intensive unit and hospital stay and wound healing complications.

**Statistical analysis** Statistical analyses were performed using the Statistica 12™ program (StatSoft™, Inc. 2012; Palo Alto, California, United States). The Shapiro–Wilk test was used to test for normality. If the *W* statistic was significant ( $P < 0.05$ ), then the hypothesis that the respective distribution was normal was rejected. Normally distributed continuous variables were expressed as the mean (SD). Nonnormally distributed data were expressed as median and range.

**Results** Between January 2017 and April 2018, 104 consecutive patients fulfilled the study inclusion criteria and were enrolled prospectively into the registry. The total arterial, aortic no-touch, off-pump CABG was feasible in 96% of patients (100 of the 104 individuals). In 4 patients (3.8%), total arterial revascularization was not possible and use of venous grafts was necessary. This was because RA harvesting was contraindicated due to a positive Allen test result (2 patients), the presence of venoarterial dialysis fistula on the left arm (1 patient), and inability to use bilateral IMA due to concurrent insulin-dependent diabetes and severe COPD (1 patient).

All patients in the arterial grafting group fulfilled the intraoperative success criteria including complete revascularization, accomplishment of the procedure with the off-pump and aortic no-touch technique, and satisfactory graft flow parameters. Five distal anastomoses (1.8%) required revision and subsequent suturing due to unsatisfactory graft flow parameters. In all these cases, proper flow parameters were obtained after the second suturing.

A total of 269 distal anastomoses were completed in the 100 patients from the registry cohort. The mean (SD) number of distal anastomoses was 2.7 (0.7) per patient. The left IMA was used in 100 patients (100%); right IMA, in 33 (33%); and left RA, in 85 (85%). A composite Y-graft with the use of the left IMA and RA was performed in 81 patients (81%); the left and right IMAs, in 4 patients (4%), and the right IMA and RA, in 4 patients (4%). In 11 patients

(11%), bilateral IMA in situ grafts were done. In 10 patients (10%), epicardial ablation of atrial fibrillation and left atrial appendage occlusion were performed concurrently. In 19 patients (19%), surgery via a less invasive partial lower L-shape sternotomy was feasible.

The early mortality rate was 1% (1 patient). There was no perioperative myocardial infarction or need for in-hospital repeated revascularization. None of the patients experienced a stroke or transient ischemic attack. Two patients (2%) required early chest revision due to bleeding in the first few hours after surgery. None of the patients required surgical intervention due to wound healing complications. The mean (SD) hospital length of stay was 10 (4) days and all patients (except the one patient who died) were discharged home.

**Discussion** The main finding of this study was that the total arterial aortic no-touch technique may be used in the vast majority of patients undergoing routine CABG. However, total arterial grafting has not yet been introduced worldwide as a standard method. Cardiac surgeons have reported several factors that inhibit this process, including increased surgical complexity, risk of sternal infection after bilateral IMA use, and lack of randomized evidence of benefit.<sup>4</sup> Our results may support breaking down these barriers. A clinically relevant finding of our study is elimination of early stroke risk with the presented procedure. To complete surgery using the aortic no-touch technique, the whole procedure must be done off-pump and without a proximal anastomosis sutured to the ascending aorta.

The incidence of sternal wound healing complication in our population was slightly lower than that observed in other studies.<sup>5</sup> This may result from the more frequent use of RAs than bilateral IMAs in our study. The use of RA has several advantages, including lack of increased sternal wound healing complications, and so it may be used in patients with diabetes or COPD.

With the adopted surgical strategy, it is essential to confirm intraoperative graft patency. First, some data have shown worse anastomosis patency in off-pump CABG.<sup>6</sup> Second, incomplete revascularization significantly increases long-term complication rates.<sup>7</sup> Third, using composite grafts requires monitoring of flow distribution because significant competitive flow may result in graft dysfunction. Thus, intraoperative transit-time flow measurement of the coronary grafts is indicated.<sup>8</sup> In conclusion, total arterial aortic no-touch off-pump CABG with intraoperative verification of graft patency can be adopted in the vast majority of elective patients. The presented CABG technique was safe, was not associated with any strokes, and showed a low rate of early complications.

## ARTICLE INFORMATION

**CONFLICT OF INTEREST** None declared.

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