Robotic Totally Endoscopic Coronary Bypass Surgery (TECAB) to Complete Three or More Grafts: Pushing the Envelope of Endoscopic Beating Heart CABG

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BACKGROUND

Robotic totally endoscopic coronary bypass surgery (TECAB) is the least invasive form of coronary revascularization but is perceived to be limited by the number of distal anastomoses that can be performed. Robotic TECAB with the aid of the Endo-wrist stabilizer allows the harvesting of bilateral internal thoracic arteries (BITA) and their deployment in multiple coronary territories using sequential anastomoses. This report aims to evaluate outcomes in our patients undergoing Robotic TECAB with three or more grafts.

METHODS

A retrospective analysis of 596 patients who underwent TECAB at a single institution from 7/2013 to 5/2021 was performed. 43 patients had a BITA TECAB X3 or X4. Pre-operative, intraoperative and post-operative results at 30 days and at a mean follow up of 40±26 months were analyzed. Graft patency from patients undergoing hybrid coronary revascularization was included when available. Intraoperatively, ports were placed in standard TECAB fashion. Bilateral internal thoracic arteries were harvested and triple vessel coronary anastomoses were completed using either an automated stapler device or robotic sutured approach. Intraoperative flows were checked for all grafts.

RESULTS

Group Characteristics	3V TECAB (N=43)
Age (years)	67 ± 8
Female Gender, n (%)	4 (9.3)
Triple Vessel Disease, n (%)	33 (80)
Left Main Disease (>70%), n (%)	5 (12)
STS Predicted Mortality, mean ± SD	1.39 ± 1.9
Diabetes, n (%)	17 (40)
Hypertension, n (%)	33 (77)
Ejection Fraction <40%, n (%)	10 (23)

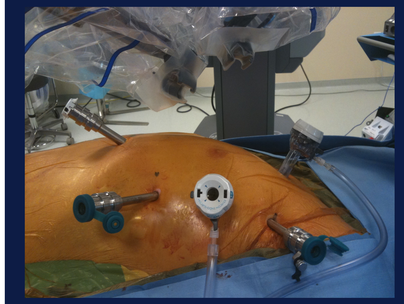
Table 1. Baseline Characteristics

Intraoperative Characteristics	3V TECAB (N=43)
Operative time (minutes), mean ± SD	368 ± 41
Bilateral ITA Use, n (%)	42 (98)
CPB Conversion, n (%)	0 (0.0)
Sternotomy Conversion, n (%)	0 (0.0)
Intraoperative Blood Transfusion, n (%)	4 (10)
Concomitant Procedure, n (%)	5 (12)
Double Lung Ventilation, n (%)	14 (33)
Hybrid Revascularization, n (%)	19 (44)

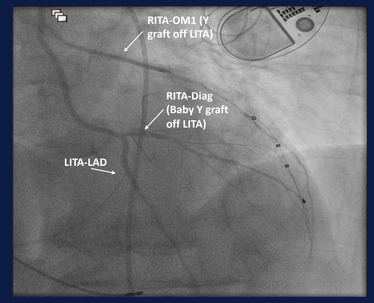
Table 2: Intraoperative Characteristics

Graft Information	3V TECAB
Total Grafts	130
Sequential Graft total LITA, n (%) RITA, n (%)	26 24 (92) 2 (8)
Y Graft total LITA, n (%) RITA, n (%)	19 14 (74) 5 (26)
Anastomosis, n/130 total grafts (%) Stapler Device Robotic Sutured U-Clip	 73 (56) 45 (35) 12 (9)
Redo Anastomosis, n (%)	2 (1.5)
LITA Flow, mean ± SD	59 ± 25
LITA PI, mean ± SD	1.5 ± 0.5
RITA Flow, mean ± SD	62 ± 29
LITA PI, mean ± SD	1.5 ± 0.4
LITA target size, mean ± SD	1.7 ± 0.3
RITA target size, mean ± SD	1.7 ± 0.3

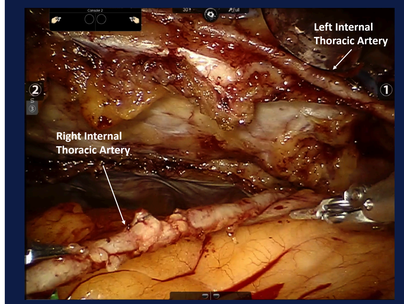
Table 3. Graft Information



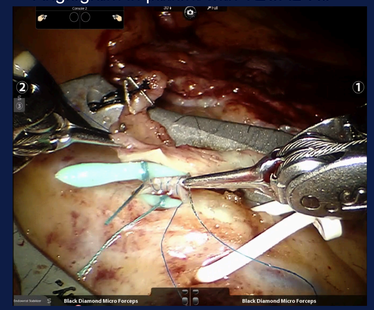
Port Placement



Angiogram in patient with TECAB X3



BITA Harvesting for 3V TECAB



Sutured Anastomosis



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Target Description	3V TECAB
TECAB x3, n (%)	42
LITA-LAD; LITA-Diag/Ramus; RITA-Cx	20 (48)
LITA-LAD; LITA-Diag/Ramus; RITA-Diag/Ramus	2 (5)
LITA-LAD; LITA-Cx/OM; RITA-Cx/OM	2 (5)
LITA-LAD; RITA-Diag/OM; RITA-Diag/Ramus/OM	2 (5)
RITA-LAD; LITA-Diag/Cx; LITA-OM	10 (24)
LITA-LAD; RITA-Diag; LITA-Cx	3 (7)
LITA-LAD; LITA-LAD; LITA-Diag	1 (2.4)
RITA-LAD; LITA-OM2; LITA-PDA	1 (2.4)
RITA-LAD; LITA-PLB; RITA-Diag (U graft)	1 (2.4)
TECAB x4, n (%)	1
LITA-LAD; LITA-Diag; LITA-OM; RITA-OM	1 (100)

Table 4. Triple/Quadruple Vessel Targets

Post Operative Outcomes	3V TECAB (N=43)
Extubation in OR, n (%)	17 (40)
Hospital LOS (days)	2.4 ± 1.0
ICU LOS (days)	1.2 ± 0.5
Chest Tube Output (mL)	689 ± 287
Postoperative Blood Transfusion, n (%)	3 (7.0)
Atrial Fibrillation, n (%)	3 (7.0)
Wound Infection, n (%)	0 (0.0)
Postoperative Bleeding, n (%)	0 (0.0)
Readmission, n (%)	2 (4.7)
Mortality, n (%)	1 (2.3)*

Table 5. Postoperative Outcomes
*Single mortality from large CVA secondary to carotid stent thrombosis

Mid-Term Outcomes	3V TECAB (N=42)
Average Time to Follow-Up (months)	40 ± 26
All-cause Mortality, n (%)	5 (12)
Cardiac-related Mortality, n (%)	2 (4.8)
Repeat Cardiac Surgery, n (%)	1 (2.4)
Myocardial Infarction, n (%)	1 (2.4)
Unplanned PCI, n (%)	1 (2.4)
Freedom from Angina, n (%)	42 (100)
Freedom from MACE, n (%)	38 (90)
Early Graft Patency (hybrid), n/total (%)	19/20 (95)

Table 6. Mid-Term Outcomes
*Additional cardiac mortality due to pulmonary embolism

CONCLUSION

In the hands of a dedicated robotic coronary team, off-pump multivessel TECAB with BITA and 3 or more grafts is feasible and extends the benefits of multiarterial grafting to a selected subset of patients using a totally endoscopic approach. Good outcomes were demonstrated in our cohort, including in post-operative recovery, LOS, and midterm results. Further studies are warranted.

DISCLOSURES

Dr. Balkhy discloses he a proctor for Intuitive Surgical, maker of the Da Vinci robot.