Original Article

Distal transradial access for post-CABG coronary and surgical grafts angiography and interventions

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Article info

Article history:
Received 9 September 2020
Received in revised form 10 April 2021
Accepted 9 June 2021
Available online 15 June 2021

Keywords:
Distal transradial access
Coronary artery bypass grafting
Coronary angiography
Percutaneous coronary interventions

Abstract

Background: Post-CABG coronary and grafts angiography (CGAG) and interventions (PCI) have historically been performed via classic transfemoral approach. Particularly for those with left internal mammary artery (LIMA) grafts, left standard transradial access (lsTRA) represents a feasible alternative, with significant fewer vascular complications, but it has ergonomic disadvantage for the operator because of the need to bend over the patients, especially in obese ones. Distal transradial access (dTRA) may provide important advantages, including shorter hemostasis and greater patient and operator comfort, mainly for left dTRA (ldTRA). We aim to describe the feasibility and safety of right and left dTRA for post-CABG CGAG and PCI.

Material and methods: From February 2019 to April 2021, 111 consecutive post-CABG patients submitted to CGAG and/or PCI via dTRA have been enrolled.

Results: Mean patient age was 67.6 years old. Most were male (88.3%) and had chronic coronary syndromes (61.3%). Overall, 35.1% had acute coronary syndromes. Distal RA was successfully punctured in all 111 patients, always without ultrasound guidance. All procedures involving LIMA grafts were done via ipsilateral ldTRA. We had only 5 (4.5%) access site crossovers. Successful dTRA sheath insertion was then achieved in 95.5% of all patients, mostly (74.8%) via ldTRA and with standard 6Fr sheath (99.1%). Distal and proximal RA pulses were palpable in all patients at hospital discharge. No major adverse cardiac and cerebrovascular events and no major complications related to dTRA were recorded.

Conclusions: dTRA for routine post-CABG CGAG and PCI by experienced transradial operators appears to be feasible. Further randomized and larger trials are needed to assure clinical benefits and safety of this new technique.

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1. Introduction

Patients who have undergone coronary artery bypass grafting (CABG) surgery are usually older, with higher prevalence of comorbidities, risk factors and atherosclerotic burden, thus representing a challenging subset. At post-CABG follow-up, they often require additional coronary and grafts angiography (CGAG) and percutaneous coronary intervention (PCI), historically performed via classic transfemoral approach (TPA). Particularly for those with left internal mammary artery (LIMA) grafts, left standard transradial access (lsTRA) represents a feasible alternative, with significant fewer vascular complications. Nonetheless, lsTRA is ergonomically uncomfortable for the operators, since patient’s left arm in the volar position limits flexion of the forearm towards the operator, who therefore needs to bend over the patient, especially in obese ones. To overcome this, the left distal transradial access (ldTRA) in the anatomical snuffbox was recently described. The adoption of distal transradial access (dTRA) as default approach for any coronary angiography and PCI by our group has been recently published. Of note, after extensive literature review, we have not found any manuscript specifically addressing dTRA as default for post-CABG CGAG or PCI.
Our aim is to describe the feasibility of both ldTRA and right dTRA (rdTRA) for post-CABG routine coronary and surgical grafts angiography and interventions.

2. Material and methods

Ethical approval from the hospital committee was obtained (CAAE: 30384020.5.0000.5505) and informed consent was given by every patient as a prerequisite. Since February 2019, patients referred to our cath lab have been continuously included in the Distal TRA (rdTRA) as default approach for Coronary angiography and interventions (DISTRACTION) registry (ensaioclinsicos.gov.br Identifier: RBR-7nzxkm). After the first 26 months, out of all 2580 consecutive patients submitted to coronary angiography and/or PCI via dTRA, 111 had previous CABG surgery and were included into this analysis.

2.1. Statistical analysis

All analyses were performed with the REDCap version 10.6.5 - ©2021 Vanderbilt University. Continuous variables were reported as mean ± standard deviation. Categorical data were reported as numbers and percentages.

3. Standardized protocol for dTRA procedures

For ldTRA procedures, patient’s left upper arm (comfortably placed on a cushion) was folded over his/her belly toward the operator, who was always standing on the right side of the patient. For rdTRA procedures, patient’s right upper arm was placed on a sideboard with the hand in a neutral position (Fig. 1). After disinfection, the patient was covered with sterile drapes (Fig. 1). All patients were asked to grasp their thumb under the other four fingers in order to bring the distal radial artery (RA) to the surface of the anatomical snuffbox, with slight ulnar wrist flexion (Fig. 1).

After 2–3 mL of lidocaine hydrochloride subcutaneous injection through a 25G needle, distal RA was punctured proximal from the extensor pollicis longus tendon in the anatomical snuffbox using a 20G micropuncture plastic cannula-over-needle with the Seldinger’s technique, under an angle of 30°–45°, from lateral to medial, into direction of proximal course of RA. The “through-and-through” puncture (operator preference) was always performed with special caution, since the contact of the needle with the periosteum of scaphoid and trapezium bones can be painful. Despite many advantages of ultrasound (US) evaluation, like proper assessment of RA diameters and establishment of postprocedural patency, this resource was not routinely available in our cath lab.

After successful arterial puncture, with brisk back flow, a flexible, soft, straight 0.021” hydrophilic guidewire was smoothly advanced through the cannula and then used as a rail to sheath advancement through the RA. Our cases were routinely performed using a short 10 cm hydrophilic radial 6Fr sheath Radifocus® Introducer II Standard Kit (Terumo Corp., Tokyo, Japan), the default device in our cath lab.

After confirmation of arterial waveform pressure tracing, nitroglycerin (200 µg) plus saline followed by unfractioned heparin (50 U/Kg or 5000U) were infused through side-port arterial sheath. CGAG and/or PCI were then performed using standard techniques. Additional weight-adjusted dose of heparin was administered in case of PCI, fractional flow reserve (FFR) or intravascular vascular ultrasound (IVUS). The 5Fr diagnostic TIG® catheter (Terumo Corp., Tokyo, Japan) was used for all patients (video 1); additional catheters were sometimes required, at operator discretion, for surgical grafts or ectopic/anomalous coronary arteries, for example.

Supplementary data related to this article can be found online at https://doi.org/10.1016/j.ihj.2021.06.005.

At the end of the procedure, the sheath was pulled out for a few centimeters, and a TR BAND® Radial Compression Device (Terumo Corp., Tokyo, Japan - Fig. 2) or a simple handmade folded gauze hemostatic pad (Fig. 3) was placed over puncture site. By following the concept of patent hemostasis (just enough pressure to prevent bleeding but not so much as to cause complete vessel collapse), TR band was inflated with only 2 mL above the “bleeding volume” at sheath removal and is left in situ for 20 min, when deflation process started, by removing 2–3 mL each 15 min. If bleeding occurred, the removed volume was reloaded, and the process restarted as described. In general, TR band was completely removed within one and 2 h for CGAG and PCI, respectively.

Just after TR band (or gauze pad) removal and at hospital discharge, proximal and distal RA pulses were carefully checked. Access site-related bleeding were classified according to EASY hematoma classification.18

Fig. 1. Left panel: for ldTRA, left upper arm is positioned over belly; for rdTRA, right arm is placed on a side board with hand in a neutral position. Thumb is grasped under other fingers, with slight ulnar wrist flexion. Right panel: after disinfection, sterile drape with holes is placed. ldTRA, left distal transradial access; rdTRA, right distal transradial access.
4. Results

Table 1 summarizes baseline characteristics of all post-CABG 111 patients. Table 2 presents total 160 procedures characteristics.

Mean patient age was 67.6 ± 8.0 years old. Most were male (88.3%) and had chronic coronary syndromes (61.3%). Overall, 35.1% had acute coronary syndromes. One patient presented to the cath lab in cardiogenic shock and was successfully submitted to CGAG via ldTRA (Table 1).

Distal RA was successfully punctured in all 111 patients, always without US guidance. All procedures involving LIMA grafts were performed via ipsilateral ldTRA; rdTRA (the operators’ first option for regular coronary angiography and PCI) was reserved for “non-LIMA” CGAG or PCI. In one patient, due to left subclavian and ascending aorta huge tortuosities, calcifications and angulations, bilateral dTRA was required, after successful LIMA graft cannulation via initial ldTRA.

We had only 5 (4.5%) access site crossovers. Despite successful left distal RA puncture with brisk back flow (for all those 5 patients), wire advancement failed. In two patients, the same also occurred after successful left standard RA puncture, so TFA was undertaken for the intended procedures, including LIMA grafts angiography. For two others patients, due to not palpable standard left RA pulses, after ldTRA wire advancement failures, direct

| Table 1 | Baseline characteristics of all 111 patients. |
|---------|---------------------------------------------|
| Patient characteristics | N (%) |
| Age | 67.6 ± 8.0 |
| Height (m) | 1.68 ± 0.08 |
| Weight (kg) | 79.01 ± 13.43 |
| BMI (Kg/m²) | 28.01 ± 4.02 |
| Men | 98 (88.3%) |
| Hypertension | 107 (96.4%) |
| Diabetes Mellitus | 69 (62.2%) |
| Current smoking | 10 (9%) |
| Former smoking | 30 (27.3%) |
| Obesity | 23 (21.1%) |
| Reduced ejection fraction heart failure | 14 (12.6%) |
| Previous percutaneous coronary intervention | 56 (50.5%) |
| Chronic Kidney Disease without dialysis (eGFR <60) | 12 (10.8%) |
| Chronic Kidney Disease under dialysis | 3 (2.7%) |

**Indication for Coronary and Grafts Angiography/Intervention**
- Chronic Coronary Syndromes
- NSTE MI
- Unstable Angina
- Anterior STEMI
- Inferior STEMI
- Severe Aortic Disease
- Severe Mitral Disease
- Cardiogenic Shock

Data presented as mean ± standard deviation or number (percentage).

BMI, body mass index; eGFR, estimated glomerular filtration rate; NSTE MI, non-ST-elevation myocardial infarction; STEMI, ST-elevation myocardial infarction.
crossover to TFA was required (LIMA grafts). Finally, in one patient, crossover to lSTRA (LIMA graft) was effective (Table 2).

Successful dTRA sheath insertion was then achieved in 106 (95.5%) of all 111 patients, mostly (74.8%) via ldTRA and with standard 6Fr sheath (99.1%) and 6Fr guiding-catheters according to operator discretion. Out of all 111 patients, 71 (64%) underwent PCI. One case of complex left main bifurcation IVUS-guided PCI was performed with a 7Fr sheath via rdTRA.

Native right coronary artery followed by all surgical grafts were the most common territories treated by PCI (Table 2).

Three patients were already under hemodialysis via upper arm arteriovenous fistulae and 12 (10.8%) were possible future candidates due to advanced stages of chronic kidney disease. In those patients, sTRA has historically been avoided in order to preserve RA for potential future AV fistula creation.

Neither major adverse cardiac and cerebrovascular nor major ischemic local events were recorded. According to EASY hematoma classification,15 no significant access site-related hematoma type ≥2 was recorded. There was no documentation of hand/thumb dysfunction after any procedure. Although not reliable for radial or distal radial occlusion due to lack of Doppler US evaluation, distal and proximal RA pulses were palpable in all patients at hospital discharge.

Table 2

| Procedural characteristics | N (%) |
|----------------------------|-------|
| Elective coronary and grafts angiography | 51 (45.9%) |
| Urgency coronary and grafts angiography | 38 (34.2%) |
| Elective PCI | 22 (19.8%) |
| Primary PCI | 6 (5.4%) |
| Ad hoc PCI (following urgency or elective CGAG) | 43 (38.7%) |
| Intravascular ultrasound (IVUS) guidance | 5 (4.5%) |
| CTO PCI | 2 (1.8%) |
| Rotational atherecthomy | 1 (0.9%) |

Coronary artery territory treated by PCI

| Left Main | 7 (6.3%) |
| Left anterior descending artery (LAD) and/or branches | 14 (12.6%) |
| Left Circumflex (LCx) artery and/or branches | 17 (15.3%) |
| Right coronary artery (RCA) and/or branches | 25 (22.5%) |
| Ramus Intermedius | 1 (0.9%) |
| SVG-RCA | 4 (3.6%) |
| SVG-LAD | 4 (3.6%) |
| SVG-LCx | 6 (5.4%) |
| SVG-R | 1 (0.9%) |
| LIMA-LAD | 4 (3.6%) |

Successful dTRA sheath insertion (out of all 111 patients)

| ldTRA | 106 (95.5%) |
| redo ldTRA | 83 (74.8%) |
| rdTRA | 2 (1.8%) |
| redo rdTRA | 1 (0.9%) |

Bilateral dTRA (ldTRA and rdTRA) | 1 (0.9%) |

Sheath size of dTRA

| 6Fr | 110 (99.1%) |
| 7Fr | 1 (0.9%) |

Hemostasis of dTRA

| TR BAND radial compression device® | 109 (98.2%) |
| Handmade folded gauze hemostatic pad | 2 (1.8%) |
| Crossover to another access site (out of all 111 patients) | 5 (4.5%) |
| ldTRA -> lSTRA (LIMA graft) | 1 (0.9%) |
| ldTRA -> > lSTRA (LIMA graft) -> right TFA | 2 (1.8%) |
| ldTRA -> right TFA (LIMA graft) | 2 (1.8%) |

Data presented as mean ± standard deviation or number (percentage).

CGAG, coronary and grafts angiography; PCI, percutaneous coronary intervention; SVG, saphenous vein graft; RCA, right coronary artery; LAD, left anterior descending; LCx, left circumflex; Dg, diagonal branch; LIMA, left internal mammary artery; dTRA, distal transradial access; ldTRA, left distal transradial access; rdTRA, right distal transradial access; Fr, French; lSTRA, left standard transradial access; TFA, transfemoral access.

5. Discussion

To the best of our knowledge, this is the first manuscript addressing dTRA for post-CABG routine coronary and surgical grafts angiography and interventions. After extensive literature review, we have only found some comparisons of lsTRA versus TFA, and scarce data about right standard TRA (rsTRA) for post-CABG CGAG or PCI.

According to a recent meta-analysis, including 2763 patients, TFA, as compared to TFA, was associated with similar procedural and fluoroscopy times, procedural success rate, and contrast dose but with a significantly lower rate of vascular complications. In turn, the main disadvantage of TFA was an increased risk of crossover to TFA, mainly because of failed selective engagement of surgical grafts.7

Burzotta et al compared lsTRA and TFA for CGAG in 60 (20 vs 40) respectively) post-CABG patients with LIMA grafts. The groups were matched for age, sex and number of grafts. The authors concluded lsTRA facilitated LIMA evaluation, in particular in patients with a lower number of grafts, with less periprocedural complications.11

Pasley et al retrospectively evaluated 326 post-CABG patients submitted to CGAG (254 via TFA and 72 via TRA). Primary efficacy endpoint was procedure time and secondary, patient radiation exposure. There was neither significant difference in procedure time (37 min in TRA versus 35 min in TFA; p = 0.43) nor in radiation exposure (7855 μGy/m² in TFA versus 6825 μGy/m² in lpTRA; p = 0.08).19

Balaban et al evaluated rsTRA, lsTRA and TFA for post-CABG CGAG in 442 patients (120, 148 and 174, respectively). TFA was better than lsTRA, which was also better than rsTRA in terms of fluoroscopy time (10.71 ± 1.65, 10.94 ± 1.25, 16.12 ± 5.28 min, p < 0.001) and total procedure time (17.28 ± 1.68, 17.68 ± 2.34, 23.04 ± 5.84 min, p < 0.001) and lsTRA was the most effective way for LIMA angiography.20

In the present study, when LIMA grafts were to be evaluated, ldTRA, instead of contralateral rdTRA, was the preferred approach, based on anatomical rationale and literature evidence with lsTRA.

Relevant drawbacks of dTRA are more challenging puncture of a smaller artery, with a learning curve, and higher rate of failure to advance wire for further sheath insertion through distal RA, due to increased angulations at this point.21,22 Nonetheless, we had a very low rate of access site crossovers, all due to wire advancement failure, despite successful left distal RA puncture with brisk back flow.

Distal and proximal RA pulses were palpable in all patients at hospital discharge. However, this method is not reliable for assessing radial artery occlusion due to the presence of a strong ulnar collateral network.4,5

### 5.1. Potential advantages of dTRA

dTRA represents a novel access site in interventional cardiology and current literature demonstrates high success and infrequent complications rates. dTRA may provide important advantages over sTRA, including patient comfort and shorter hemostasis. Updated observational literature indicates dTRA is reliable and safe.13 Particularly for ldTRA, in comparison to classic lsTRA, since left upper arm can be positioned over patient’s belly towards the operator (Fig. 1), catheters can be more easily handled without the need to bend over patient, thus with greater patient and operator comfort.4,5
5.2. Study limitations

This is a small sample, single center observational registry, and all procedures were performed by two interventional cardiologists highly experienced in dTTRA (to date, more than 1300 consecutive patients each operator). The absence of a control group limits our assumptions. Baseline RA US evaluation was not performed. Despite the presence of proximal and distal RA pulses by manual palpation in all patients at discharge, the lack of post-procedural routine Doppler US evaluation does not confirm absence of RA or dRA occlusion. On the other hand, the successful execution of dTTRA without US guidance is not a limitation. This might instead be a facilitator in order to widespread the technique.

6. Conclusions

Distal transradial access for routine post-CABG coronary and surgical grafts angiography and interventions by highly experienced transradial operators appears to be feasible. Further randomized and larger trials are needed to assure clinical benefits and safety of this new technique.

Disclosure

The authors have completed and returned the ICMJE Form for Disclosure of Potential Conflicts of Interest. The authors report no conflicts of interest regarding the content herein.

Footnote

The authors are accountable for all aspects of the work in ensuring questions related to accuracy or integrity of any part of the work are appropriately investigated and resolved.

Impact on daily practice

dTTRA may provide important advantages over conventional sTTRA, including patient comfort and shorter hemostasis. Post-CABG CGAG and PCI have been historically performed via classic TFA, which has as main drawback access site-related complications. Particularly for LIMA grafts, lTTRA represents a feasible alternative, with significant fewer vascular complications. Nonetheless, it is usually laborious for the operator, who usually needs to bend over the patient, which is ergonomically very uncomfortable, especially in obese ones. A simple solution is given by ldTTRA, since left upper arm can be positioned over patient’s belly towards the operator, with greater patient and operator comfort.

Contributions

(1) Conception and design: MDP Oliveira, A Caixeta; (II) Administrative support: MDP Oliveira, EC Navarro (III); Provision of study materials or patients: MDP Oliveira, EC Navarro (IV); Collection and assembly of data: MDP Oliveira, EC Navarro (V) Data analysis and interpretation: MDP Oliveira, A Caixeta; (VI) Manuscript writing: MDP Oliveira, A Caixeta; (VII) Final approval of manuscript: All authors.

Video 1. A single 5Fr TIG® catheter was needed for both coronaries, two SVG and LIMA angiography. Ad hoc mid right PDA and distal RCA bifurcation PCI was then successfully performed via lTTRA 6Fr sheath. Fr, French; SVG, saphenous vein grafts; LIMA, left internal mammary artery; PDA, posterior descending artery; RCA, right coronary artery; PCI, percutaneous coronary intervention; lTTRA, left distal transradial access.

Declaration of competing interest

The authors declare no potential conflict of interest.

Acknowledgments

To all members of our cath lab, for their indispensable commitment with adoption of dTTRA as default approach for coronary angiography and interventions.

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