Letter to the Editor

Left Internal Mammary Arterial Angiography Via the Right Radial Approach: Description of Technique, Single-Centre Experience, and Brief Review of the Literature

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Transradial access for coronary angiography and interventions has gained increasing popularity during recent years, due to its facilitation of patient mobilisation and the dramatic reduction in access site-related complications. Although the transradial technique requires special skills that are associated with a significant learning curve,[1] it tends to be the default technique in many laboratories worldwide and shows a continuously increasing rate of expansion. Nevertheless, there are patient-related anatomic subsets in which the transradial technique via the right radial artery is considered technically challenging, as in the majority of patients with a previous coronary artery bypass graft (CABG) involving a left internal mammary artery (LIMA) graft to the left anterior descending artery (LAD). The presence of a LIMA graft was previously considered a relative contraindication for a right radial procedure; thus, many radial operators choose to perform procedures in CABG patients from a left radial approach using standard diagnostic catheters. The use of the left radial artery as an arterial graft in many CABG procedures renders the left radial approach impossible. On the other hand, the common use of the right internal mammary artery as a graft and the subsequent need for its selective cannulation during catheterisation render any preference for the left transradial approach useless.

Therefore, techniques permitting selective or semi-selective cannulation of the LIMA via right transradial access have evolved and have been adopted by dedicated radialists. We report a single Greek tertiary centre's methodology and experience in a series of consecutive prior CABG patients with the *in situ* (pedicled) LIMA as one of the grafts requiring coronary angiography.

Between 2009 and 2012, 184 consecutive patients with prior CABG underwent diagnostic coronary angiography. Of these, 166 (90.2%) had a pedicled LIMA graft. There were 158 (86%) men and 26 women, aged 58 to 82 years (mean 71.32 ± 8.4 years). Mean height was 1.68 ± 0.11 m, mean body weight 81 ± 20 kg, and mean body mass index 29 ± 6 kg/m^2. Sixty-two percent of patients had anginal episodes and 31% had a recent acute coronary syndrome. For the remaining patients, the angiography was performed for follow-up evaluation of previous percutaneous coronary interventions or bypass

Table 1. Patients' characteristics.

Total number of patients	184
Age (years)	71.32 ± 8.4
Male sex	158 (86%)
Height (m)	1.68 ± 0.11
Weight (kg)	81 ± 20
Number of grafts	2.2
LIMA as pedicled	166 (90.2%)
LIMA + RIMA (pedicled)	21 (11.4%)
Reason for catheterization:	
ACS	31%
Stable angina	62%
Follow up or other reason	7%
Initial decision on approach:	
Left radial approach (% of LIMA pts)	102 (61.5%)
Right radial approach (% of LIMA pts)	57 (34.3%)
Left radial artery used as graft	43
RIMA used as graft	22
Femoral approach (% of LIMA pts)	7 (4.2%)

LIMA – left internal mammary artery; RIMA – right internal mammary artery; ACS – acute coronary syndrome.

surgery. The patients' characteristics are given in Table 1. The left radial approach was the default procedure for 102 of them (61.5%), unless the left radial artery had been used as a bypass graft or there was a RIMA (pedicled) graft. In 57 (34.3%), the procedure was undertaken by the right transradial approach, whereas for a small minority (n=7, 4.2%) the transfemoral approach was initially selected (negative Barbeau test, fistula in right forearm, etc.).

The Allen test and reverse Allen test, as described elsewhere,[2] were conducted for each procedure. In equivocal Allen tests, the Barbeau test[3] was used. Radial artery cannulation was performed with the wrist hyper-extended using a dedicated armboard (Philips Healthcare). Local anaesthesia with 1 mL of 2% lidocaine was administered, the radial artery was punctured with a 20 gauge iv cannula and a 0.018" straight guidewire was inserted. Upon removal of the needle, a 10 cm long 6 Fr sheath (Cordis Corporation, Miami, Florida) was placed over the guidewire. An intra-arterial drug "cocktail" containing 200 μg of glyceryl trinitrate and 20 mg of lidocaine, was administered. Heparin, typically 5000 IU, was given intra-arterially to prevent radial artery occlusion.

Selective angiography of native coronaries using typically JL3.5 (Judkins Left) and JR4 (Judkins Right) was performed, followed by selective engagement of venous and arterial grafts (if any). For that purpose LCB (left coronary bypass) and MPA1 (multipurpose A1) catheters were typically used.

A Simmons diagnostic catheter (100 cm) was used to selectively engage the left subclavian artery (after non-selective angiography). The Simmons catheters selected, depending on anatomical considerations, were either a TEMPO® AQUA® Sidewinder 1&2 5F (Simmons 1&2) (Cordis Corporation, Miami, Florida), which is stiffer, or a Glidecath® Simmons 1&2 5F (Terumo), a more flexible catheter with the drawback of less support. A hydrophilic 260 cm long exchange 0.035" guide wire was used. The options were either an AQUATRACK® angled guidewire, regular or stiff (Cordis Corporation, Miami, Florida), which comes with a torque device in the package, or alternatively the Radifocus® Guidewire M (Terumo). Subsequently, after advancing the guidewire via left brachial to the left ulnar artery, the Simmons catheter was exchanged for a dedicated internal mammary (IM) diagnostic catheter. The concept of this technique was described back in the 80s for use with the then popular brachial approach involving arteriotomy.[4,5] When the guidewire showed a tendency to flip to the ascending aorta, special manoeuvres, such as left brachial blood pressure (BP) cuff inflation or flexing the patient's left elbow joint (as described by Patel et al elsewhere[6]), permitted entrapment of the guidewire and resulted in adequate support for catheter exchange. In a minority of patients (n=10, 17.5%) where catheter exchange failed repeatedly, semi-selective or non-selective opacification of the LIMA with the Simmons catheter was satisfactory (especially when peripheral brachial circulation was obstructed using a inflated BP cuff).[7]

Results are summarised in Table 2. The aforementioned procedure was used in 57 patients (34.3% of CABG patients with pedicled LIMA graft) and was successful in 54 patients (94.7% of patients with right radial approach). Imaging was achieved in 77.2% of them selectively. Crossover to a femoral approach was undertaken in 3 (5.3%). The reasons for failure of selective or semi-selective opacification were vascular tortuosity, or a distal anatomical origin of the LIMA. The mean time to LIMA opacification was 208 ± 93 s (mean ± SD). Mean fluoroscopic time for LIMA cannulation was 134 ± 42 s, compared to 44 ± 15 s for the left radial approach ($p<0.0001$, unpaired t-test). Mean dose area product (DAP) was 95.134 ± 34.283 Gy.cm^2 vs. 52.476 ± 11.594 Gy.cm^2, respectively. Contrast medium use was 32 ± 12 mL vs. 14 ± 7 mL ($p<0.0001$). There were no procedure-related complications (cerebrovascular events, arterial dissection, or arterial thromboembolism).

The need for LIMA cannulation via the contralat-

Table 2. Success rates, procedural times and contrast use.

Total with LIMA (pedicled) and right radial approach graft		57	
Successful procedure (%)		54 (94.7%)	
Selective (%)		44 (77.2%)	
Semi-selective or non-selective (%)		10 (17.5%)	
Crossover to femoral (%)		3 (5.3%)	
	Right radial	Left radial	p
Mean fluoroscopy time for LIMA cannulation (s ± SD)	134 ± 42	44 ± 15	<0.0001
Mean DAP (Gy·cm^2 ± SD)	95.134 ± 34.283	52.476 ± 11.594	<0.0001
Mean contrast volume for LIMA opacification (mL ± SD)	32 ± 12	14 ± 7	<0.0001

DAP – dose area product. Other abbreviations as in Table 1.

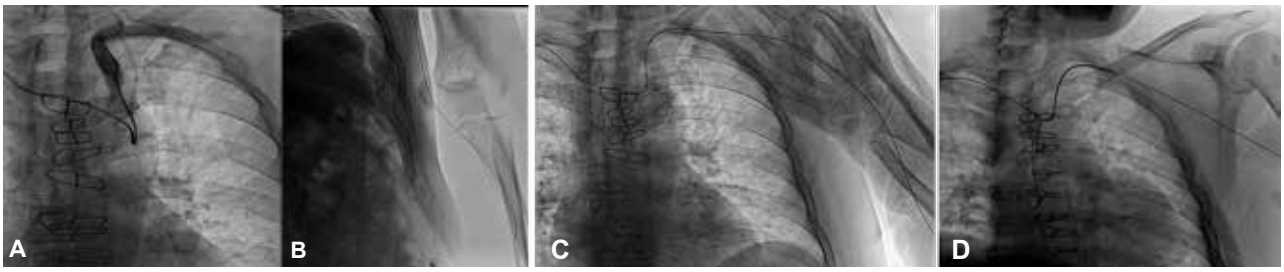

Figure 1. Cannulation of left subclavian artery with a Simmons I catheter (A), advancement of the wire to the left ulnar artery (B), folding of the left forearm to stabilise the wire (C), and over-the-wire catheter exchange (D).

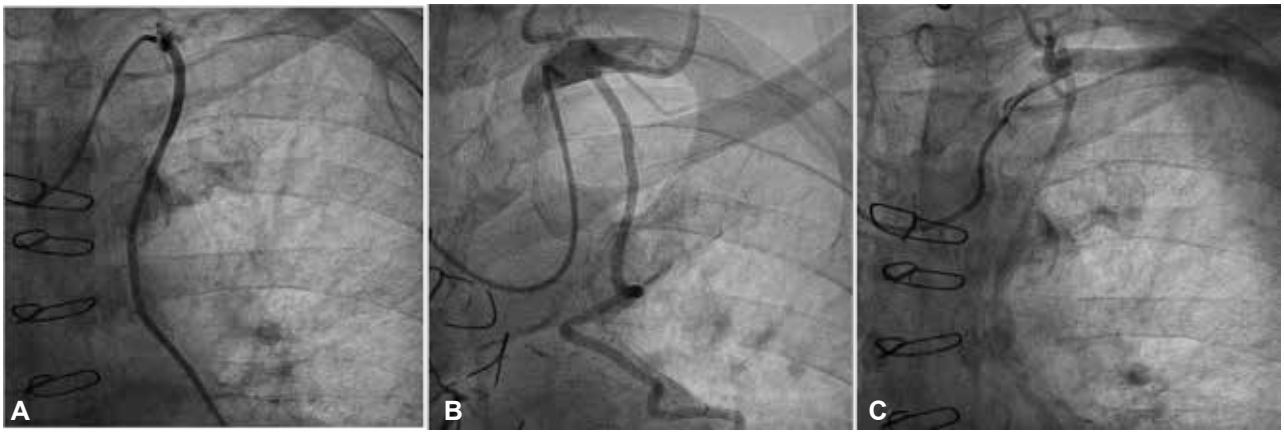

Figure 2. Selective (A) and semi-selective (B) opacification of the left internal mammary artery (LIMA) by internal mammary catheters. Non-selective LIMA opacification by Simmons catheter (C).

eral radial approach is sometimes considered a relative contraindication for the radial technique.[8] Nevertheless, the use of the left radial as a CABG graft or the concomitant use of RIMA renders the preferred left transradial approach useless. The feasibility of a contralateral (brachial) approach for LIMA cannulation was reported even before the era of radial coronary angiography.[4,5] With the progressive adoption of the right radial technique, there have been case or series reports addressing the problem with the use of conventional catheters,[9] balloon flotation catheters,[10] non-selective cannulation with concomitant use of inflated BP cuffs over the left brachial artery,[7] and more recently with the use of Simmons,[11] modified Simmons,[12,13] or Simmons-resembling (such as the Yumiko)[14,15] catheters, or even Tiger 4.0 catheters.[16] Many use the same aforementioned catheters for LIMA cannulation, whereas others, as in our institution, use them as an aid for guidewire advancement through the left subclavian artery to the left forearm arteries and then exchange the catheter over the wire typically for an IM or a Bartorelli-Cozzi catheter[11] to selectively cannulate the ostium of the LIMA. Others have used JL catheters (JL1, JL3.5) for left subclavian can-

nulation and then exchanged them for IM catheters.[2]

In our institution, the procedure described herein has been proven to be rapid, safe, and effective, as it provides selective cannulation of the LIMA without the need for special catheter shapes. The available Simmons catheters and guidewires allow the operator to choose their stiffness and special characteristics depending on the anatomical considerations for each patient. The higher DAPs measured are in only in part explained by the relatively longer fluoroscopic times, and may reflect the complexity of the cases and the total number of grafts used (RIMA, left radial) in patients where the right radial approach had been undertaken. The low percentage of failures and relatively short fluoroscopy times render it feasible (after a learning curve) when contralateral opacification of LIMA is needed.

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