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Letters

Does Radial Artery Harvest for Coronary Surgery Compromise Forearm Blood Flow to 22 Years Post-Operative?

Up to 95% of contemporary coronary artery bypass surgery is performed without use of the radial artery (RA). Since 1997, >80% of our patients received RA and total arterial revascularization (1,2), and it has been associated with survival advantage (3). We investigated the early and midterm outcome in the remaining ulnar artery (UA) after RA harvest (4,5), and found preserved forearm blood flow, compensatory UA dilation, and no increase in UA atheroma. This study aimed to investigate the effect of RA harvest on the UA in the late period (>10 years post-operative), which is longer than all prior studies.

Patients with unilateral RA harvest allowed for contralateral control comparisons of UA using high-frequency ultrasound (15 to 6 MHz linear array probe, SonoSite HFL50xp, Fujifilm SonoSite, Bothell, Washington). All patients were from 1 hospital after informed consent (HREC 2015.291). Maximal flow was measured after cuff occlusion of the brachial artery and forearm exercise of 1 min. Two observers and an average of 3 measurements per endpoint were used. Forearm flow measured the brachial artery flow at the elbow, and hand flow was measured 5 cm proximal to the flexor wrist skin crease.

Mean ± SD, paired samples *t*-test, and Bland-Altman were used with SPSS version 23.0 (IBM SPSS Statistics for Windows, IBM, Armonk, New York). Significance was defined as $p < 0.05$.

Of 86 patients, 81 were male, age 74.2 ± 7.4 years (54 to 90 years). The post-operative duration was 17.4 ± 2.4 years (12 to 22 years). All but 1 patient had the left radial artery harvested. The patients' height was 170 ± 10 cm, weight was 84 ± 15 kg, 47% had diabetes, 92% had hypertension, 93% were taking lipid-lowering medications, 9% were current smokers, and 34% had body mass index ≥30 kg/m^2.

The total forearm flow was not different between the harvested or the nonharvested side at rest (238 ± 112 ml/min vs. 249 ± 128 ml/min; $p = 0.123$) or after ischemic exercise (maximum flow) (918 ± 411 ml/min vs. 963 ± 434 ml/min; $p = 0.114$) (**Table 1**).

The flow in the distal UA was significantly higher on the harvested side compared with the nonharvested side. When combined, the UA and RA flow at the wrist of the nonharvested side at rest was similar to the UA of the harvested side (92 ± 58 ml/min vs. 84 ± 56 ml/min; $p = 0.04$).

Nonocclusive medial calcification of the UA was infrequent, present in 6 patients (7%) on the harvested side and 5 patients (6%) on the nonharvested side. Atheromatous plaques of the UA were not present on the harvested side and 2 patients with single-site lesions were present on the nonharvested side of 30% and 40% stenosis, respectively. There were no patients describing pain in the hand at rest or with exercise.

Interobserver reliability was acceptable, with limits of agreement (LA) ranging from 4% to 8% for the 3 measurements: diameter mean 0.4 cm, bias 0.001, $r = 0.999$, LA 0.02 cm, LA 5%; velocity time integral mean 30.2 cm, bias 0.01, $r = 0.999$, LA 2.53 cm, LA 8%; and heart rate mean 68.0 beats/min, bias 0.46, $r = 0.993$, LA 2.96 beats/min, LA 4%.

We report the longest follow-up of forearm blood flow after radial artery harvest ≤22 years after surgery. The key finding was that the total forearm blood flow was not different after RA harvest compared with the nonharvested forearm in the same patient in the long-term. Our report supports the long-term safety of RA use as an arterial conduit for coronary surgery.

The second key finding was that dynamic increases in blood flow with exercise were preserved and not different between the 2 forearms. This provides assurance that the harvested forearm and hand may be used in vigorous daily activities without restriction. At rest, there was a small reduction in flow in the UA at the wrist (hand flow) than for the combined UA and RA flow on the nonharvested side, but this secondary outcome was not considered clinically significant.

Third, we have shown that there is no evidence of accelerated atheroma formation in the UA, consequent on chronically increased blood flow.

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TABLE 1 Ultrasound Measurements

Brachial Artery	At Rest	After Ischemic Exercise	p Value
Nonharvested side			
Diameter, mm	5.1 ± 0.7	5.5 ± 0.6	<0.001
VTI, cm	18.7 ± 9.0	61.3 ± 24.8	<0.001
Heart rate, beats/min	67 ± 13	68 ± 12	0.418
Flow, ml/min	251 ± 128	963 ± 434	<0.001
Harvested side			
Diameter, mm	5.0 ± 0.6	5.4 ± 0.6	<0.001
VTI, cm	18.6 ± 7.7	58.7 ± 22.8	<0.001
Heart rate, beats/min	68 ± 14	69 ± 12	0.315
Flow, ml/min	238 ± 112	912 ± 412	<0.001
Ulnar Artery at Rest	**Non-Harvested**	**Harvested**	**p Value**
Diameter, mm	2.1 ± 0.4	2.6 ± 0.5	<0.001
VTI, cm	17.1 ± 10.3	23.0 ± 12.7	<0.001
Heart rate, beats/min	68 ± 12	68 ± 12	0.929
Flow, ml/min	43 ± 34	84 ± 56	<0.001

Values are mean ± SD.
VTI = velocity time integral.

The selection of patients may have been subject to survivor bias. Functional assessment of the forearm was not part of this study.

There was preserved forearm blood flow without increased ulnar atheromatous disease in patients 12 to 22 years after radial artery harvesting.

Alistair G. Royse, MBBS, MD
Megan J. O'Donnell, BBiomedSc
Laura Mocioaca
Varun Sharma, MBBS, BMedSci
Jared C. Ou-Young, MSc, BSc
David J. Canty, MBBS, PhD
***Colin F. Royse, MBBS, MD**
*University of Melbourne
P.O. Box 2135
Royal Melbourne Hospital
Melbourne, Victoria 3050
Australia
E-mail: Alistair.Royse@unimelb.edu.au
Twitter: @AlistairRoyse, @unimelb

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Please note: Loan ultrasound equipment was received from Sonosite (FujiFilm) for education purposes; it was not used in this research project and is unrelated to this research project. All authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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High-Molecular-Weight von Willebrand Factor Multimer Ratio

A Novel Biomarker for Low-Flow, Low-Gradient Aortic Stenosis Subclassification

Low-flow, low-gradient (LF/LG) aortic stenosis (AS) is a diagnostic dilemma (1) as routine work-up remains challenging. Dobutamine stress echocardiography (DSE) and multidetector computed tomography (MDCT) represent accepted imaging modalities for further subcategorization into a true severe (TS) or pseudo-severe (PS) subform. However, uncertainty about stenosis severity may persist even after DSE and MDCT. Accurate subclassification is crucial for prognosis and treatment decision-making; therefore, there is a need for laboratory parameters to expand the diagnostic portfolio.

The present pilot study was designed to elucidate the value of high-molecular-weight (HMW) von Willebrand Factor (vWF) multimer deficiency to distinguish TSLF/LG AS from PSLF/LG AS. vWF is a multimeric plasma glycoprotein that can be regarded as a sheer flow sensor. Upon high shear stress, vWF undergoes a conformational change, which enhances its susceptibility to proteolysis. Excessive proteolytic degradation leads to a loss of HMW vWF multimers, which is the main feature of an acquired von Willebrand syndrome.

Therefore, we prospectively recruited 40 consecutive patients with echocardiographic diagnosis of LF/LG AS, defined by a peak aortic jet velocity <4 m/s, mean pressure gradient <40 mm Hg, aortic valve area (AVA) <1 cm^2, stroke volume index of <35 ml/m^2, and left ventricular ejection fraction <50% (2). To differentiate TS from PSLF/LG AS we utilized low-dose DSE (duration of each dose stage [2.5, 5, 10, 15, 20 μg/kg/min]: 5 min) or, if DSE was contraindicated (poor image quality, symptomatic coronary artery disease, Canadian Cardiovascular Society class ≥III) or inconclusive, quantification of aortic valve calcification by MDCT. LF/LG AS was considered TS when the mean