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ORIGINAL ARTICLE

Radiation Exposure with the Radial Approach for Diagnostic Coronary Angiography in a Centre Previously Performing Purely the Femoral Approach

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Introduction Use of the radial approach for coronary angiography and percutaneous coronary intervention (PCI) is known to improve many patient outcome measures. However, there is some concern that it may be associated with increased patient radiation exposure. This study explores radiation exposure with the radial approach compared with the femoral approach in a centre previously performing purely femoral approach.

Patients and Methods Data was collected retrospectively for all patients undergoing diagnostic coronary angiography over a six month period. PCIs and procedures with inherent technical difficulty or use of additional techniques (graft studies, optical coherence tomography, fractional flow reserve) were excluded. Dose area product (DAP) and fluoroscopy time (FT) were analysed for all remaining procedures (n=389), comparing radial (n=109) and femoral (n=280) approaches.

Results The overall mean FT for transradial cases (7.45 mins) was significantly higher than for transfemoral cases (4.59 mins; $p<0.001$). The overall mean DAP for transradial cases (95.64 G $Gycm^2$) was significantly higher than for transfemoral cases (70.25 $Gycm^2$, $p<0.05$)). Neither the FT nor the DAP decreased over the six month period.

Conclusion The radial approach was associated with significantly higher DAP and FT compared to the femoral approach during an initial introductory phase which was likely insufficient to develop radial proficiency. The results of this study are consistent with previous studies and may influence choice of access for non-emergent diagnostic coronary angiography before radial proficiency has been established, particularly for patients more susceptible to radiation risks.

Keywords Coronary angiography • Coronary artery disease • Radiation dosage • Radial artery • Femoral artery

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Introduction

Since the introduction of the transradial approach to coronary angiography over 20 years ago, there has been much interest in this method and the possible advantages over the traditional transfemoral method [1–4]. Centres throughout the world now use the radial approach not only as an alternative to the femoral approach, but as the default arterial access [1,2,5,6].

Previous studies have attempted to determine whether or not there is a difference in patient radiation exposure for coronary angiography and percutaneous coronary intervention (PCI) depending on the arterial access route. The results of these studies have varied, with most studies finding measures of radiation exposure to be higher with radial access [2,4,7–14], some showing no appreciable difference between access routes [15–17] and one study finding higher exposure with femoral compared to radial access [18]. Differences in the results of these studies may be attributed to many study design and patient factors, including study methodology, different measures of radiation exposure, patient demographics and variability in included procedures. Many studies also had broad objectives, looking at many aspects of procedural safety and effectiveness, rather than focusing purely on patient radiation dose [7–11,13,15,18,19].

Another explanation for the significant variability of results between studies is operator experience with the radial approach. It has been demonstrated that radiation exposure with the radial approach is higher for an individual operator until he/she becomes radial proficient and higher in low-volume centres [5,6,19–21]. As such, it would be expected that studies with radial proficient operators would have less difference in radiation exposure between the radial and femoral approaches.

This study explores radiation exposure for diagnostic coronary angiography with the radial approach in a centre previously performing purely femoral approach. Unlike some previous studies, only standard diagnostic coronary angiograms (without additional techniques or PCI) are included and radiation exposure is the primary outcome examined. By allowing cardiologists to choose arterial access and imaging methods, this study demonstrates the true radiation exposures that occur in the cardiac catheterisation laboratory in our centre. While this is not generalisable to all centres, it may provide an approximation of radiation exposure in other teaching hospitals with similar case volume.

Methods

Study Design and Patient Population

This study was undertaken in a large metropolitan hospital in Melbourne. Coronary angiograms were performed by five experienced interventional cardiologists and one interventional cardiology fellow. Training cardiology registrars only performed procedures in conjunction with an experienced interventional cardiologist or the interventional fellow.

Coronary angiograms were performed in two new cardiac catherisation laboratories, both equipped with *Phillips Allura Xper biplane cardiovascular x-ray systems* (FD10 & FD20 models). Total procedural radiation dose is reported by these units as dose area product (DAP) in $Gycm^2$ and fluoroscopy time (FT) in mins:secs.

Retrospective data was collected for all diagnostic coronary angiograms performed over a six month period from April to October 2012. Data was obtained primarily from the radiographers' record and cardiologists' reports, with additional information obtained as needed from procedural data, cardiac catheterisation admission forms, hospital admission forms and patient notes. Patient age, height and weight was recorded in whole numbers.

This study covers the period of time during which the radial approach for coronary angiography was being formally introduced in a centre that was previously preferentially using the femoral approach. Each of the cardiologists had some previous experience with using the radial approach. Prior to April 2012 most operators used the radial approach very infrequently, generally only where there was a relative or absolute contraindication to using the femoral approach. One cardiologist had begun using the radial approach in 2011 and may have achieved radial access proficiency, as defined by a European Society of Cardiology (ESC) Working Groups [6], by the start of our study period. The remainder of the operators were not radial proficient at the start of the study and remained on the learning curve (were not yet radial proficient) at the end of the study.

Choice of arterial access route for each procedure was determined by the interventional cardiologist, based on operator preference and clinical indications and contraindications. While the interventional cardiologists were actively trying to increase use of the radial approach during this time period, there was no pressure to use the radial approach if they felt that the femoral approach would be better for any individual patient or situation.

Imaging parameters, including beam filtration, field size and frame rate were set by radiographers as per department protocols designed to minimise radiation exposure while optimising image quality. These were adjusted as required based on radiographers' judgement, to produce optimal images for each patient.

Exclusion Criteria

This study looked only at standard diagnostic coronary angiograms and not interventional procedures, due to the variable nature and differing technical and procedural characteristics of PCIs, compared to diagnostic procedures. In the setting of interventional procedures, radiation dose is far more likely to be influenced by such factors as the number, location and nature of lesions being treated, as well as the nature of the intervention undertaken (angioplasty, stenting, rotational artherectomy, thrombus aspiration).