Research Article

Technical Success and Safety of Transradial Uterine Artery Embolisation for Symptomatic Fibroids at a Single Centre in South Africa

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Abstract:

Background

The femoral artery has remained the primary means of vascular access for uterine artery embolisation in the treatment of uterine fibroids. Transradial access for coronary artery catheterization is gaining wider acceptance, with studies in the cardiac literature demonstrating key advantages. The primary objective of this study was to compare the technical success and safety of the transradial approach for uterine artery embolization performed at a single centre in South Africa.

Methods

Data was obtained from consecutive patients undergoing uterine artery embolisation for the treatment of symptomatic fibroids over a 30-month period. Specifically technical success and patient safety were analysed.

Results

A total of 496 patients were included in the study. Of these 27 patients had primary contraindications to radial access. The remaining 469 patients who underwent radial artery access, technical success was achieved in 459 cases (97.9%). The primary cause of technical failure was radial artery spasm (9.9%). Mean procedure times were 53.5 minutes ± 15.2 minutes with total screening times of 9.6 ± 9.1 minutes. The mean radiation dose area product was 6321.7 ± 3449.8 cGy.cm². Complications were recorded in 40 (8.5%) patients, of which 7 (1.5%) were major complications.

Conclusions

This study corroborates evidence that this approach is a safe and effective alternative to the traditional transfemoral route for the treatment of uterine fibroids.
symptomatic fibroids performed at Park Lane hospital, a private hospital in Johannesburg, South Africa. The analysis was performed over a 30 month period between July 2018 and December 2020. The TRA was the primary intended technique employed in all patients who underwent uterine artery embolisation during this period. The TFA was only used if radial access was contraindicated or radial access failed. Pre-procedural assessment of the radial and ulnar artery collateral supply was performed via a Barbeau test or a modified Allen test. Poor ulnar artery collateral supply to the hand or a radial artery that was too small (<1.6 mm) were contraindications to radial artery access.

The techniques, and technical endpoints were standardized across all patients. Radial access was gained with a 5F micropuncture set for transradial access under ultrasound guidance. Endovascular consumable equipment typically consisted of a 125cm 5F angled catheters for cannulation, 150cm 2.8F microcatheter in combination with a microwire chosen for uterine artery super-selective catheterization. Embolic agents used were 250–355 and 300–500 um polyvinyl alcohol particles. Our patients received nitroglycerin alone via the radial sheath to protect against radial spasm and a dose of intravenous heparin. Radial haemostasis was achieved using a pneumatic compression device, TR Band (Terumo Interventional Systems). Technical endpoint was defined as visual confirmation of adequate blood stasis within the uterine arteries bilaterally on digital subtraction angiography. Stasis of blood within the uterine arteries was deemed adequate if one or both of the following visual identifiers were present: slow clearance of intravenous contrast media from uterine arteries (3–5 patient heartbeats); significant reflux of intravenous contrast media within the uterine arteries.

All patients in the study underwent pre-operative MRI, except for 4 (0.9%) patients who exceeded the size limit for the MRI and received pre-operative CT and ultrasound as an alternative. All patients received a pregnancy test prior to embolisation.

Data points collected were guided by the studies included in the systematic review by Himiniuc et al. (5) and recommendations made by the Royal College of Radiologists and the Royal College of Obstetricians and Gynaecologists.(7) Data for the study included: patient demographic information; pre-procedural pelvic MRI and pre-procedural pregnancy test. Technical success was defined as visual confirmation of blood stasis within the uterine arteries bilaterally. Procedure times, screening times, radiation dose, length of hospital stay and procedure-related complications were recorded for all patients.

After exclusion of inadequate data, the study database was imported into Stata BE version 17.0 (StataCorp LLC, 4905 Lakeway Drive, College Station, Texas). Continuous variables are presented as means and standard deviations or medians and inter-quartile ranges while categorical data is presented as counts and frequency. Ethical clearance for the study was obtained from the University of Witwatersrand Human Research and Ethics committee.

RESULTS
Four hundred and ninety-six patients were included in the study. Twenty-seven patients had primary contraindications to radial access. Contraindications included: the radial artery too small (15 [55.5%]), poor collateral blood supply to the hand from the ulnar artery (11 [40.7%]), and one case of severe carpal tunnel syndrome. Of the 27 patients with primary contraindications to radial access, 6 (22.2%) patients progressed to ulnar artery access and 21 (77.8%) patients progressed to femoral artery access.

Thus the study constituted 469 patients who underwent primary radial artery access for embolisation of their uterine arteries. Technical success, defined as adequate cessation of blood flow in the uterine arteries bilaterally, with successful transradial cannulation, was achieved in 459 cases (97.9%). The TRA was deemed a failure in 10 patients (2.1%). Reasons for failure included: inability to advance the guidewire or catheter due to radial arterial spasm (9 [90%]), and the inability to cannulate the radial artery in 1 patient (10%). There were no cases of technical failure once the radial artery was successfully cannulated and traversed with both guidewire and catheter.

The mean procedure time of all technically successful TRA uterine artery embolisations was 53.5 ± 15.2 minutes (IQR range 24–132 minutes). The median procedure time was 51 minutes with data skewed towards higher values (2.03 skewness with standard error of skewness of 0.11).

Complete radiation data was available in 222 cases of successful TRA uterine artery embolisations. The mean screening time was 9.6 ± 3.6 minutes (IQR range 3.5–28.1 minutes). The median screening time was 9.1 minutes with data skewed towards higher values (1.43 skewness with standard error of skewness of 0.16). The mean radiation dose area product was 6321.7 ± 3449.8 cGy.cm2 (IQR range 1334.0–23022.4 cGy.cm2). The median dose area product was 5537.4 cGy.cm2 with data skewed towards higher values (1.56 skewness with standard error of skewness of 0.16).

Of the 469 patients who underwent uterine artery embolisation with primary radial artery access, there was a total of 40 complications (8.5%). Complications were divided into immediate/peri-procedural (19 [4.1%]), early (7 [1.5%]) defined as occurring within 30 days, and late (14, 3.0%) defined as occurring after 30 days (Table 1). Of the 40 complications, 7 (1.5%) were deemed major. The mean hospital stay was 1.14 days.

DISCUSSION
Uterine artery embolisation for the management of symptomatic fibroids has been the subject of randomised control trials and a Cochrane Review (1–3) which has solidified its place as an effective uterine preserving treatment for symptomatic fibroids. In 2013, a collaborative document from the RCR and the RCOG (7) was released on the percutaneous management of uterine fibroids. In the aforementioned trials, reviews, and recommendations, a TFA for uterine artery
embolisation was the predominant technique utilised. However, since then TRA has slowly gained traction as it has some key advantages over the transfemoral approach.

The use of TRA for percutaneous coronary intervention has risen steadily due to its well-established safety profile and reduction in vascular complications when compared to the transfemoral approach. (8–11) Numerous studies conducted in cardiac literature have demonstrated that TRA is associated with improved patient satisfaction, fewer puncture site complications, decreased post procedural nursing care, earlier mobilisation, reduced cost, hospital stay and hospital cost. (8–14) However, despite the recognised patient and economic benefits of TRA (8–14) in the setting of coronary angiography, the adoption of TRA amongst interventional radiologists has trailed behind our cardiac counterparts.

Adoption of the TRA for uterine artery embolisation has been slow even in other parts of the world. (4–6) This resistance seems to stem from a reluctance to change established practice, as well as a widely held perception that the transradial approach is technically more difficult with a longer learning curve, longer procedural times, higher patient radiation doses, and overall inefficiency. (5)

A comparative trial reported in 2020, demonstrated no significant differences in radiation exposure (660.4 ± 711.1 mGy vs. 679.3 ± 998.1 mGy; p 0.88), total procedure time (177.1 ± 93.9 minutes vs. 163.3 ± 38.4 minutes; p 0.21), and fluoroscopy duration (41.1 ± 16.0 minutes vs. 39.8 ± 13.6 minutes; p 0.56) between the TFA and TRA groups, respectively. (4) In our study we demonstrated impressive mean procedure times (53.5 minutes ± 15.2 minutes), screening times (9.6 minutes ± 9.1 minutes), and radiation doses (6321.7 cGy.cm² ± 3449.8 cGy.cm²) with an estimate effective dose conversion to 79.02 mGy ± 43.1 mGy using an appropriate conversion coefficient. (15) Although it is known that the TRA has a steeper learning curve compared to the TFA, (16) the level of efficiency demonstrated in our study demonstrates that similar to other types of procedures that are based on the operator’s skills, TRA-operating skills refine as the experience of the operator increase.

The incidence of major complications in our cohort (1.5%) compares well to selected studies. (5) The incidence of local vascular and peri-procedural complications in our study was low (4.1%) and are comparable to the studies included in the systematic review by Himiniuc et al. (5) which ranged from 0% to 3.3%. Radial artery spasm, preventing advancement of the wire or catheter, was the most common complication (1.9%) and also the predominant cause of technical failure of the procedure, requiring conversion to either ulnar or femoral access. Our patients only received intravenous nitroglycerin and heparin. The administration of a combination of heparin, nitroglycerin, and verapamil through the access sheath reduces the risk of arterial vasospasm and occlusion and this may be a reason for the higher success rate of the procedure in other studies. (5) Our technical success rate of 97.9% compared very well to other the selected studies, ranging with an average reported success rate of 98.86%. (5) Interestingly, if the obstacle of radial arterial spasm could be successfully navigated, our technical success rates would approach 100%.

The strength of our study is that we had large cohort of patients, approaching the total number of all patients in the studies included in the systematic review by Himiniuc et al. (5) The limitation of this study is that this was a retrospective study design and patient selection was from a single health facility.

CONCLUSION
Our study of uterine artery embolization for the treatment of uterine fibroids using the transradial approach corroborates current evidence that this approach is safe and an effective alternative to the traditional transfemoral route. Although there is a steeper learning curve for the transradial approach, our study demonstrates excellent levels of efficiency and low levels of radiation exposure once the technical skill is developed. Our findings should encourage more interventional radiologists to explore this technique and consider it as a standard of practice for uterine artery embolization.

REFERENCES

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**Table 1. Incidence of major and minor complications for transradial UAE.**

<table>
<thead>
<tr>
<th>Complications</th>
<th>Incidence</th>
<th>(n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate complications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radial artery spasm</td>
<td>9</td>
<td>19</td>
</tr>
<tr>
<td>Large radial haematoma or excessive radial bruising</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>Arm swelling, pain, or paraesthesia</td>
<td>2</td>
<td>19</td>
</tr>
<tr>
<td>Acute urinary retention</td>
<td>2</td>
<td>19</td>
</tr>
<tr>
<td>Radial artery thrombus</td>
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<td>19</td>
</tr>
<tr>
<td>Uterine artery perforation*</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>Early complications</td>
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<td></td>
</tr>
<tr>
<td>Post embolisation syndrome</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Gynaecological infection*</td>
<td>2</td>
<td>7</td>
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<tr>
<td>Late complications</td>
<td></td>
<td></td>
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<tr>
<td>Fibroid expulsion</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Abnormal vaginal discharge</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Ovarian dysfunction*</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>Abnormal uterine bleeding (change from baseline)</td>
<td>2</td>
<td>14</td>
</tr>
</tbody>
</table>

*Major complications.