Developing a virtual reality stepwise endovascular simulation curriculum on renal artery intervention

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Introduction

Endovascular therapy benefits a large number of patients for its minimally invasive nature and is frequently utilised by interventional radiology, vascular surgery and interventional cardiology. Hands-on endovascular training usually starts at higher specialty training levels due to its complexity and steep learning curve. Pre-subspecialty and junior trainees have limited access to endovascular training which can have a negative impact on informing career choices. Endovascular simulation training has been shown to enhance training for specialty trainees[1,2] as well as increase enthusiasm among pre-subspecialty junior doctors[3]. This pilot study aims to describe the development of a virtual reality, metric-based, stepwise endovascular simulation curriculum.

Methods

The study was conducted at the Centre for Screen-Based Simulation of the Royal Free Hospital. Simulation sessions were performed using the ANGIO Mentor™ (Simbionix Corporation, Cleveland, Ohio, USA), a virtual reality high fidelity endovascular simulator, running the "renal artery intervention" module. Expert computer-generated metrics (*Figure 1*) were established by a panel of one interventional radiology registrar and three interventional radiology consultants. The curriculum was divided into three stages, with the later stages building on the earlier; focusing on aortograms, selective renal angiograms and renal artery interventions, respectively.

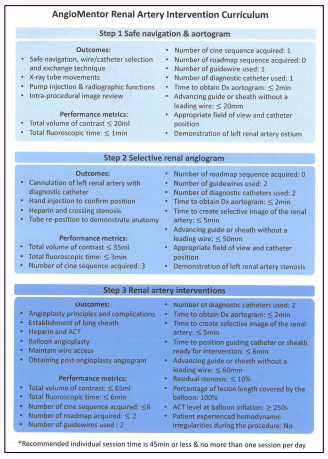

Figure 1. Renal artery intervention curriculum metrics

The participants had open access (24 hours a day, 7 days a week) to the simulator (up to one session per day, for a maximum of 45 minutes per session) to practice at their own individual pace. Once the metrics were met for each stage, or by the request of the participant due to difficulties encountered, in-person sessions would be arranged with the interventional radiology registrar for feedback or progression onto the next stage until completion.

Results

A total of four trainees, two FY2 doctors and two Radiology ST1 registrars, participated in the pilot study. The participants spent on average 113 days [range: 73-169] over 12 practice sessions [range: 10-14], from induction to curriculum completion (Table 1), with significant variation among these individuals (Figure 2a-c, 3 and 4).

N=4		Median	Average	Min	Max
From induction to completion	Days	105	113	73	169
	Practice sessions	12	12	10	14
	Practice cases	24	34	17	69
Stage 1 metrics met	Days	57	54	27	77
	Practice sessions	3	3	2	5
	Practice cases	10	12	6	21
Stage 2 metrics met	Days	32	29	9	42
	Practice sessions	4	4	3	5
	Practice cases	8	12	4	28
Stage 3 metrics met	Days	20	30	8	73
	Practice sessions	5	5	3	6
	Practice cases	7	10	5	20

Table 1. Time, practice sessions and cases required for the whole curriculum with breakdown for each stage

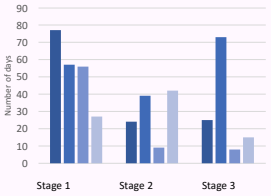

Figure 2a. Days taken to complete each stage for individual participants

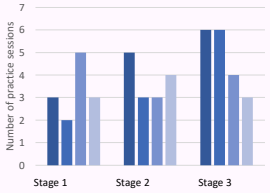

Figure 2b. Number of practice sessions to complete each stage for individual participants

The longest lead time occurred during Stage 1 where the average was 54 days [range: 27-77], compared to 29 days [range: 9-42] during Stage 2 and 30 days [range: 8-73] during Stage 3

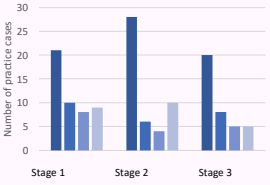

Figure 2c. Number of practice cases to complete each stage for individual participants

There were less practice sessions during Stage 1, with an average of three [range: 2-5], when compared to four [range: 3-5] during Stage 2 and five [range: 3-6] during Stage 3. Throughout the curriculum, the participants completed an average of 34 cases [range: 17-69].

Each participant had at least four in-person feedback sessions in order to progress; one participant requested an additional in-person session during Stage 3 as a refresher following a long pause.

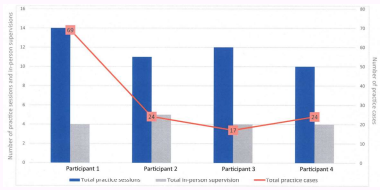

Figure 3. Total practice sessions, cases and in-person supervision for individual participants

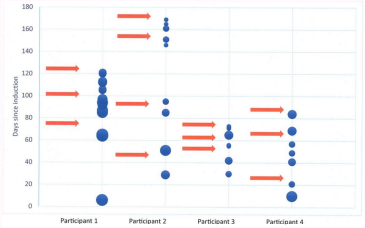

Figure 4. Days taken to complete the curriculum for individual participants

Questionnaires were submitted by participants following successful curriculum completion. Regular checkpoints and in-person instructor feedback sessions were identified as particularly beneficial to participants' learning. All participants found the curriculum met their expectation, with the completion of the curriculum helping to inform their career choices.

Discussion

The current study described the development of an endovascular simulation curriculum for pre-subspecialty and junior trainees. The participants were able to achieve the metrics set by experts using a stepwise approach with interval individualised feedback. This provided the participants early access to endovascular practices in a safe environment and had a positive impact on informing their career choices.

References

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