

# Use of a Novel Simulator and Simulation-Based Mastery Learning to Improve Femoral Arterial Access Skills

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## Background

Femoral artery access (FAA) is a fundamental endovascular clinical skill across multiple specialties. Simulation-based mastery learning (SBML) is a rigorous form of competency-based education that improves procedural skills and clinical outcomes.

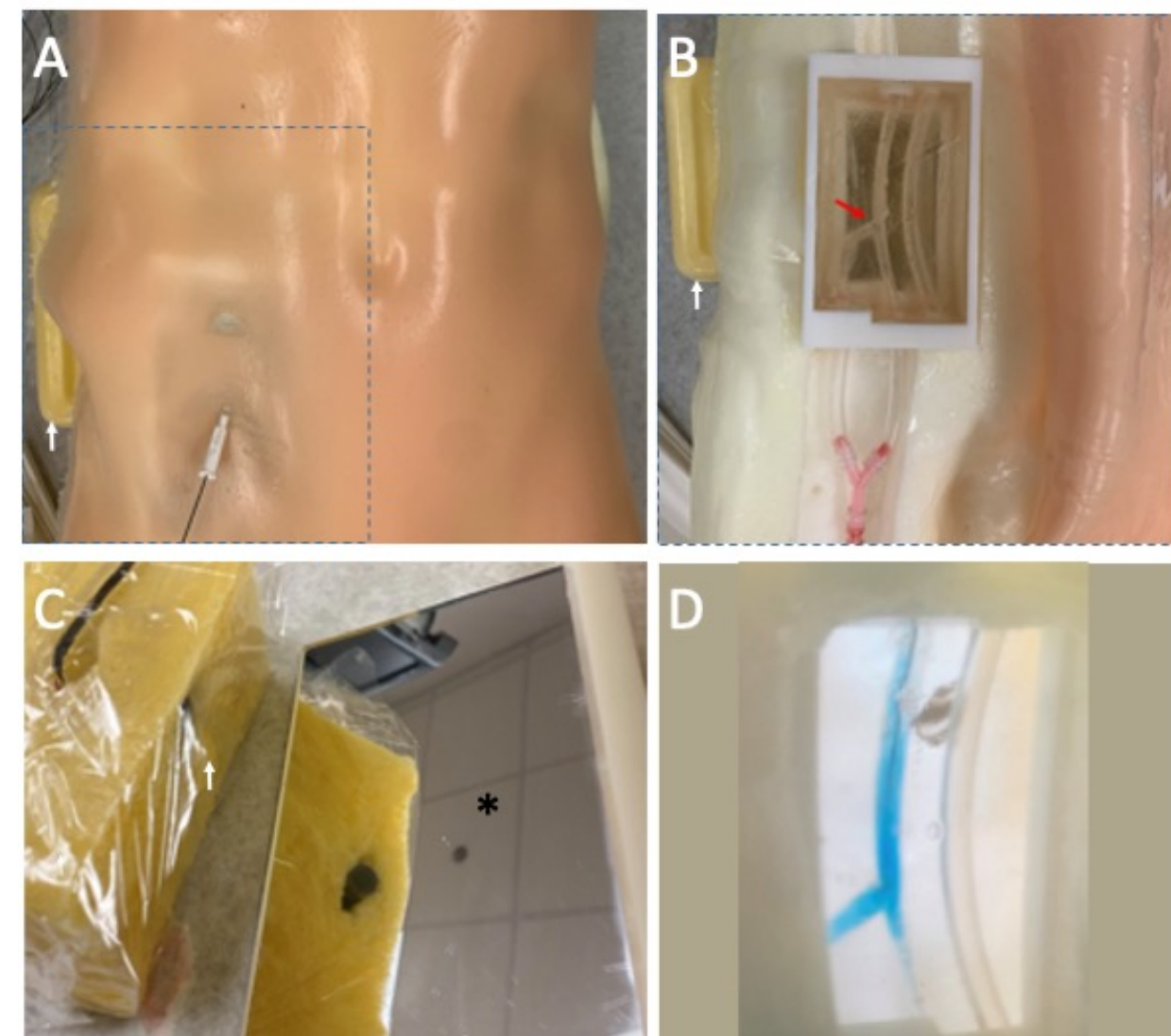
## Objectives

To assess the impact of a FAA SBML curriculum on procedural competency amongst cardiology fellows (CF) and vascular surgery trainees (VST).

## Methods

- First-year CFs (Postgraduate year 4) and all VSTs (postgraduate years 1-7) at a single institution were eligible for the curriculum from June 2020-December 2021
- SBML curriculum consisted of a pretest, video didactics, deliberate practice with feedback, and a post-test
- FAA was performed on a novel simulator using ultrasound guidance and simulated fluoroscopy. Learners were evaluated by trained faculty using a 17-item skills checklist and a minimum passing score (MPS) of 96%.
- Learners who did not achieve the MPS at post-test received additional training and were re-tested until the MPS was met (final post-test).

## Figure 1.



A. Silicone torso with sheath in right common femoral artery. B. Silicone "skin" lifted away revealing the femoral artery with bifurcation (red arrow) and vein cast in silicone set in a 3D-printed manifold with tubing. C. Video camera set in a foam block (white arrows) with mirror (\*) mounted below the torso allowing for simulated fluoroscopy and angiography. D. Screen capture of video showing simulated angiography.

Table 1. Participant Demographics

	Cardiology fellows (n = 15)	Vascular surgery residents (n = 11)
Age (years)	29.9 ± 2.2	31.0 ± 2.2
Male (percent)	73.3%	63.6%
PGY (%)		
1		2 (18.2)
2		1 (9.1)
3	1 (6.7)	2 (18.2)
4	11 (73.3)	2 (18.2)
5	3 (20.0)	1 (9.1)
6		1 (9.1)
7		1 (9.1)
8		1 (9.1)
# prior femoral access simulations	0.09 ± 0.3	0.07 ± 0.3
# prior femoral lines	2.4 ± 2.0	71.8 ± 100.2

Characteristics of trainees who participated in the curriculum. Abbreviations: PGY = post-graduate year, SD = standard deviation

Figure 2. Percentage Scores at Each Testing Period

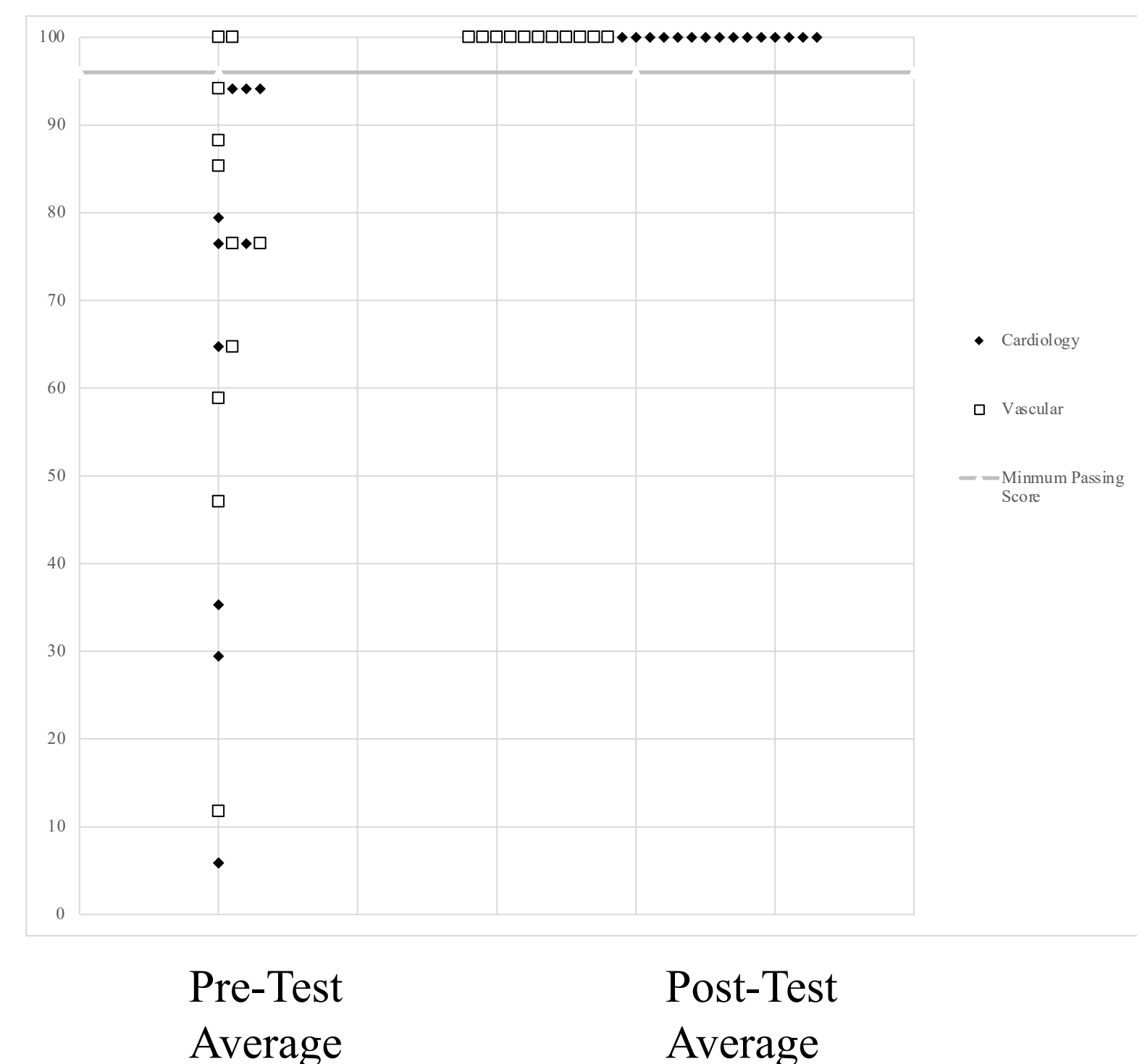


Table 2. Average Number of Complications

	Pretest		Passing Post-test			
	Introduction of Air	Vascular Injury	Introduction of Air	P-value	Vascular Injury	P-value
Number of Prior FAA Cases	Median (IQR)	Median (IQR)	Median (IQR)	P-value	Median (IQR)	P-value
0-4	2 (2,3)	4 (1,9)	0 (0, 0)	0.002	0 (0,1)	0.003
5-19	2.25 (1, 3)	2.75 (1,5)	0 (0,1)	0.09	0 (0,1)	0.06
>19	2 (0, 2.5)	0 (0,1)	(0,0)	0.04	0 (0,0)	0.16

## Results

- All learners eventually achieved the MPS
- The median checklist score improved from pretest (13, interquartile range [IQR], 5-16) to final post-test (17, IQR 16-17, p=0.002) for and for VSTs from 13 (IQR, 10-16) to 17 (IQR, 17-17; P = .01)
- The number of potential air and vascular complications significantly decreased from pretest to final post-test for CFs and VSTs.
- Trainees with no prior FAA clinical experience (N=6) had lower pre-test scores and higher possible complications compared to those with >5 prior FAA clinical experiences (N=8, p=0.002)
- There were no significant differences in post-test scores between those with no prior FAA experience versus >5 FAA clinical experiences

## Conclusions

Trainees from both disciplines displayed significantly improved FAA skills after completing SBML. There was a significant difference in test scores and complications compared to those with no prior FAA experience to those with the most FAA experience with significant improvement in test scores and complications after completing SBML.