Simulation Training Reduces Complications during Non-Tunneled Hemodialysis Catheter Insertion

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Background and Objectives

▪Traditional apprenticeship model of teaching in temporary hemodialysis catheter insertion (THDC) can result in propagation of errors and complications.

▪Simulation-based training offers step by step standardization of skills and allow trainees to repeatedly practice invasive procedures in realistic environment prior to performing it on actual patient.

▪We aim to determine whether simulator based mastery learning (SBML) in ultrasound-guided THDC insertion improves success rate and reduce complications rate among nephrology fellows.

Methods

▪This is an observational cohort study of first-, second- and third year nephrology trainees in a tertiary care teaching hospital from September 2008 to September 2015.

▪The intervention group or SBML-trained fellows (n=7) received a didactic and hands-on, competency-based simulation training course in ultrasound-guided THDC insertion.

▪The historical control group or the traditionally trained fellows (n=14), received training through traditional, bedside, apprenticeship model.

▪The primary outcome was successful THDC insertion and secondary outcome was the complication rates.

Results

▪923 internal jugular catheters and 1588 femoral catheters were inserted by 21 trainees in the 96-month period.

▪Successful internal jugular and femoral THDC insertion occurred in 100% of the intervention group vs. 99.7% of the control group (P=0.533) and 99.2% of the intervention group vs. 99.5% of the control group (P=0.509), respectively.

▪The intervention group reported fewer overall complications, 3.5% vs 7.7% (P=0.010); and fewer arterial puncture 0.3% vs 1.9% (P=0.039) for internal jugular THDC insertion.

▪The complication of bleeding/hematoma formation was also lower during femoral THDC insertion in the intervention group. (0 vs 1.2%, P=0.007).

▪No significant differences occurred between time to first complications between the two groups in both internal jugular and femoral THDC insertion.

Conclusions

▪SBML program was more effective than traditional training in THDC insertion and is associated with decreased procedure-related complications.

Table 1. Baseline Characteristics Data of Traditionally-trained and SBML-trained Nephrology Fellow

	Traditional n = 14	SBML n = 7	P Value
Age	30.9 (2.6)	30.1 (1.7)	0.485
Male, n (%)	6 (42.9)	2 (28.6)	0.656
Chinese, n (%)	12 (85.7%)	7 (100)	0.575
Local Graduate, n (%)	4 (28.6)	4 (57.1)	0.346
Post-graduation years	6.1(1.7)	6.0 (1.4)	0.848

† Mean (SD) unless otherwise specified

Table 2. Rates of Failure and Complications between Traditionally-trained versus SBML-trained Nephrology Fellows

	Internal Jugular Catheter n = 923			Femoral Catheter n = 1588		
	Traditional	SBML	P-value	Traditional	SBML	P-value
Number of catheters, n (%)	581 (62.9)	342 (37.1)		956 (60.2)	632 (39.8)	
Number of catheters per person, n (%)	51.0 (19.6)	32.6 (25.3)	0.093	91.8 (45.3)	54.0 (28.1)	0.064
Successful insertion, n (%)	579 (99.7)	342 (100)	0.533	844 (99.5)	627 (99.2)	0.509
Time to first Complications, days	282.6 (403.0)	143.4 (176.0)	0.475	201.4 (267.6)	114.2 (107.1)	0.459
Overall complications, n (%)	45 (7.7)	12 (3.5)	**0.010**	110 (13.0)	68 (10.8)	0.226
Obstruction, n (%)	24 (4.1)	10 (2.9)	0.373	67 (7.9)	46 (7.3)	0.693
Hematoma/ Bleeding, n (%)	4 (0.7)	1 (0.3)	0.657	10 (1.2)	0 (0)	**0.007**
Arterial Puncture, n (%)	11 (1.9)	1 (0.3)	**0.039**	15 (1.8)	9 (1.4)	0.681
More than one venous site puncture, n (%)	20 (3.4)	8 (2.3)	0.429	72 (8.5)	51 (8.1)	0.849

† Mean (SD) unless otherwise specified

References:
1. Barsuk JH, McGaghie WC, Cohen ER, O'Leary KJ, Wayne DB. Simulation-based mastery learning reduces complications during central venous catheter insertion in a medical intensive care unit*. Critical Care Medicine. 2009;37(10):2697-701.
2. Evans LV, Dodge KL, Shah TD, Kaplan LJ, Siegel MD, Moore CL, et al. Simulation training in central venous catheter insertion: improved performance in clinical practice. Acad Med. 2010;85(9):1462-9.
3. Barsuk JH, Cohen ER, Potts S, Demo H, Gupta S, Feinglass J, et al. Dissemination of a simulation-based mastery learning intervention reduces central line-associated bloodstream infections. BMJ Quality & Safety. 2014;23(9):749-56.