Interventional Study of Care Protocols Including Use of Ultrasonography to Reduce Mechanical Irritation for the Prevention of Peripheral Intravenous Catheter Failure

Toshiaki Takahashi^{1,2} PhD, RN; Ryoko Murayama^{2,3} PhD, RN, RMW; Mari Abe^{2,3} MHS, RN; Maki Miyahara⁴ MHS, RN; Chiho Kanno⁴ BNS,RN; Hiromi Sanada,^{2,4} PhD, RN, WOCN

¹Department of Life Support Technology (Molten) Graduate School of Medicine, the University of Tokyo; ²Global Nursing Research Center, Graduate School of Medicine, the University of Tokyo, Japan; ³Department of Advanced Nursing Technology, Graduate School of Medicine, The University of Tokyo; ⁴Department of Gerontological Nursing/Wound Care Management, Graduate School of Medicine, The University of Tokyo,

Mail: takahashito-ky@umin.ac.jp

Use of Ultrasonography can prevent catheter failure
by merely performing blood vessel selection and catheter position confirmation **rather than puncture guide**

Introduction

A peripheral intravenous catheter (PIVC) is a commonly used medical device for the administration of fluid. PIVC failure is a great concern in the clinical setting. It affects the patient's comfort and treatment and continuing intravenous therapy becomes difficult. Risk factors of various PIVC complications have been pointed out, but healthcare providers are unable to prevent the complications. Rather than focusing on the outcomes of each process, it is essential to introduce the outcome of the all processes, simultaneously. A care bundle is defined as a "set of processes - generally three to five - that are proven by randomized control trials and are performed as a whole to obtain optimal outcomes".

Aim

- Effectiveness of the care protocols approach in preventing PIVC Failure.
- "pre-scan" for selecting a large-diameter vein before catheterization
  - "post-scan" for confirming the catheter tip position after catheterization
  - "use of polyurethane catheter" with more flexibility

Methods

- University of Tokyo Hospital, Japan; July 2017-November 2017
- Non-randomized controlled trial
- Effectiveness of care protocols, including "pre-scan", "post-scan" and "use of polyurethane catheter," which were compared to the control group, receiving conventional care treatment.
- Inverse-probability score-based weighted methods

Figure 1: tablet type Ultrasonography

Figure 2: Flow diagram of catheter use in the intervention group

Results

Figure 3: Flowchart of the subjects

	Unadjusted			Adjusted		
	Control group	Intervention group	p Value	Control group	Intervention group	p Value
Sex (male)	162 (69.5)	124 (65.6)	0.39	(65.9)	(68.9)	0.48
Age (years)	66.4±15.9	65.2±14.3	0.40	65.7±15.9	64.4±14.3	0.21
BMI	23.1±3.4	22.9±4.1	0.51	23.1±3.3	22.8±4.3	0.36
Present illness (tumor)	96 (41.2)	121 (64.0)	0.00*	(47.4)	(53.0)	0.11†

Conclusion

Catheter failure incidence in the intervention group than that in the control group was significantly lower (11.1% vs 29.2%) using care protocols for reducing mechanical irritation. Care protocols, including assessment of vein diameter, vein depth, and catheter tip location using ultrasound examination and use of polyurethane catheter for reducing mechanical irritation is a promising method to reduce catheter failure incidence.

Results

Figure 4: Kaplan-Meier survival curve of time weighted with inverse probability of propensity score

Table 2: Incidence of catheter failure (unadjusted)			
	Catheter failure incidence (%)	p-Value	No. of catheter failures per 1,000 catheter days
Intervention (n = 189)	21 (11.1)	< 0.001	35.0
Control (n = 233)	68 (29.2)		89.5

Table 3: Incidence of catheter failure weighted by inverse probability of propensity score			
	Rate of catheter failure incidence (%)	RRR (95% CI)	NNT (95% CI)
Intervention	11.0	0.60 (0.47–0.71)	6.04 (4.71–8.82)
Control	27.6		

RRR = (rate of catheter failure incidence in control – rate of catheter failure incidence in intervention)/rate of catheter failure incidence in control. NNT = 1/(rate of catheter failure incidence in control – rate of catheter failure incidence in intervention). Abbreviations: RRR, relative risk reduction; CI, confidence interval; NNT, number needed to treat.

References

- Tanabe H, Takahashi T, Murayama R, et al. Using ultrasonography for vessel diameter assessment to prevent infiltration. J Infus Nurs 2016;39:105-11.
- Takahashi T, Murayama R, Tanabe H, et al. Observational study at the time of peripheral venous catheter placement using the ultrasonography and qualitative sketching method. J Nurs Sci Eng 5(1), 12-20, 2018
- Murayama R, Takahashi T, Tanabe H, et al. The relationship between the tip position of an indwelling venous catheter and the subcutaneous edema. Biosci Trends 2015;9:414-9.
- Tanabe H, Murayama R, Yabunaka K, et al. Low-angled peripheral intravenous catheter tip placement decreases phlebitis. J Vasc Access. 2016;17:542-7

Funding and Acknowledgement

This work was supported by a JSPS grant (No. 16H05561) and Yamaji Fumiko Nursing Research Fund. The study was a joint research program with the Terumo Corporation and was conducted under the sponsorship of the Terumo Corporation. The author declares no conflict of interest.