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Vasopressor Infusions in Various Venous Accesses (VIVVA)

Principle Investigators: Richard Fagley, MD; Barb Nickel, APRN-NS, CCRN, CRNI
Co-Investigators: Prasad Manian, MD; Laura Crumley, APRN-CNS; Jason Lambrecht, MD; Michelle Belusic, APRN-CNS; Brenda Downs, MSN, APRN, ACNS-BC; Tammy Kear, PhD, RN, CNN, FAAN,; Ken Farrell, System Director Data Science

BACKGROUND

Scientific Rationale/Significance:

- Peripheral administration of vasopressor therapy has been explored for over a decade in research and clinical practice to reduce central venous access device (CVAD) utilization and related complications.
- Despite a reported high failure rate of peripheral intravenous catheters (PIVCs) as high as 60%, low adverse events are reported with peripheral vasopressor administration.
- However, due to the predominance of retrospective methodology, heterogeneity in methodologies, inadequate documentation trends, and variances in peripheral device nomenclature, it is difficult to draw meaningful conclusions from current evidence.
- Currently peripheral vasopressor use for > 48 hours and midline use for vasopressor administration is not supported by organizational policy but acknowledged that practice exists in effort to reduce CVAD utilization, to ensure vasopressor is initiated promptly, and in patients where the intent is to successfully discontinue the vasopressor is delayed.

	VAD Name	Definition for purposes of this study
1	**Peripheral Intravenous catheter (PIVC)**	• Short, superficial PIVC • long ultrasound guided PIVC placed in the deeper vessels of the forearm
2	**Midline Peripheral Catheter (MPC)**	• Designated by the manufacturer as a midline • Placed in the upper arm with the distal tip at or near the axillary fold
3	**Central Venous Access Device (CVAD)**	• Peripherally inserted central catheter (PICC) • Multi-lumen non-tunneled central catheter • Introducer (large bore device used to introduce, exchange, and manage catheters) • Totally implanted venous access device (port)

OBJECTIVES/HYPOTHESIS

- **Retrospective Arm:** to identify potential associations between vasopressor use, the VAD utilized for vasopressor initiation, device-related complications, and patient characteristics via retrospective EHR review
- **Prospective Arm:** examine the same criteria through daily assessment/rounding by facility-based co-investigators; compare accuracy of data collection between retrospective and prospective arms of the study
- **Outcomes:** incidence of adverse events involving the VAD used to initiate the vasopressor therapy, including extravasation, infection (site and bloodstream infection), phlebitis, thrombosis, occlusion, leaking at the site; patient characteristics related to VAD-specific outcomes
- **Null Hypothesis:** there will be no significant difference in clinical outcomes between the three VAD routes of delivery (PIVC vs MPC vs CVAD)

- **Inclusion criteria:** Patients in ED/ICU with first vasopressor administration via one of the VAD types
- **Exclusion criteria:** Patients less than 18 years of age, pregnant, previously receiving a vasopressor infusion during hospital stay, CVAD insertion required for non-vasopressor purpose, ineligible for ICU admission or imminent death

POPULATION / METHODOLOGY

Retrospective: Data was retrospectively collected from a quota-based, randomly selected sample of patients per facility (at least 50 peripheral, 25 midline, 25 central).
Prospective: Data was then collected prospectively on a similar quota-based, convenience sample to determine patient and VAD-related outcomes.
Sample Size: Estimated total of 400 records to be audited for retrospective: 50 PIVCs, 25 MPCs, 25 CVAD in quota-based sampling, based on usage patterns and reported complication rates

Observational Arm of Study	Peripheral	Midline	Central Lines	Total
Retrospective	200	32	107	339
Prospective	198	22	147	367

RESULTS

Outcome	Retrospective	Prospective	Fisher's Exact p-value (2 sided, 0.05)
Extravasation	15/339 (4.42%)	17/367 (4.63%)	1.000
Phlebitis	4/339 (1.18%)	6/367 (1.63%)	0.760
Leaking	39/339 (11.5%)	53/367 (14.44%	0.222
Occluded	21/339 (6.19%)	20/367 (5.45%)	0.749
Site Infection	1/339 (0.29%)	2/367 (0.55%)	0.999
Bloodstream Infection	0/339 (0%)	1/367 (0.27%)	1.000
No reason for removal documented	86/339 (25.36%)	11/367 (2.99%)	<0.001

Negative Outcome	Peripheral n=398 (rate/%)	Midline n=54 (rate/%)	Central Line n=254	Fisher's Exact p-value (2-sided, 0.05)
Extravasation	30 (7.54%)	1 (1.85%)	1 (0.39%)	<0.001
Phlebitis	8 (2.01%)	2 (3.70%)	0 (0.0%)	0.001
Leaking	90 (22.61%)	1 (1.85%)	1 (0.39%)	<0.001
Occluded	34 (8.54%)	1 (1.85%)	6 (2.36%)	<0.001
Site Infection	1 (0.25%)	0 (0.0%)	2 (0.79%)	0.407
Bloodstream Infection	0 (0.0%)	0 (0.0%)	1 (0.39%)	0.208

Secondary Analysis: Reason Initial Device was Removed	Peripheral n=398 Mean (SD)	Midline n=54 Mean (SD)	Central n=254 Mean (SD)	Fisher's Exact p-value (2-sided)
New Line Placed	23 (5.78%)	5 (9.26%)	25 (9.84%)	0.046
Patient left unit with device	4 (1.01%)	2 (3.70%)	6 (2.36%)	0.17
Patient Expired	27 (6.78%)	11 (20.37%)	66 (25.98%)	<0.001
Removed by Patient	28 (7.04%)	1 (1.85%)	3 (1.18%)	<0.001
Therapy Completed	88 (22.11%)	14 (25.93%)	122 (48.03%)	<0.001

Confounding Variables Retrospective and Prospective	Peripheral n=398 Mean (SD)	Midline n=54 Mean (SD)	Central n=254 Mean (SD)	ANOVA F-statistic
Inpatient LOS (hours)	342.3 (346.7)	480.9 (329.1)	455.4 (461.9)	F(2, 750) = 4.70 p=0.009
MS-DRG-Relative Weight	4.38 (4.40)	6.00 (6.13)	6.67 (6.19)	F(2, 750)=10.74 p<0.001
Age	65.5 (15.6)	61.8 (15.5)	62.5 (15.4)	F(2 750)=3.65 p=0.026
BMI	28.5 (8.3)	27.9 (7.7)	29.8 (8.9)	F(2, 750)=1.34 p=0.264
Initial Device Duration (hours)	126.3 (112.9)	335.7 (274.6)	225.5 (240.6)	F92, 750)=10.96 p<0.001
Vasopressor Duration (hours) in initial device	42.6 (67.4)	48.4 (64.3)	61.5 (86.7)	F(2, 750)=3.78 p=0.023
Female				No significant difference

Logistic Regression Analysis will be available at the conference for review and discussion

DISCUSSION

Global data set:

- No statistically significant changes in rates of extravasation, phlebitis, leaking, occlusion, site infection or BSI comparing retrospective to prospective arms
- Patient demographics very similar between study arms; age, BMI and gender not found to have significant impact on outcomes
- "New line placed" referred to a transition of the vasopressor to a new device: difficult to track in the retrospective data but more accurate prospectively

Data Accuracy:

- Statistically significant increase in accuracy of data collection in prospective arm with direct observation (ie, reduction in "no reason for removal documented p<0.001) illustrating significant limitation in retrospective methodology
- Increased rates of negative outcomes in the PIVC group of the prospective arm may further illustrate higher data accuracy with direct observation
- Data elimination: 27/394 in prospective arm and 85/424 in retrospective arm

PIVC VULNERABILITIES

- Higher rates (statistically significant) of extravasation, phlebitis, leaking (which may represent early extravasation), and occlusion in full PIVC data set
- PIVCs used in lower acuity patients: lower LOS, lower DRG rating, shorter duration of vasopressor duration, lower rate of expired with device in place, yet were associate with highest rates of complications
- Statistically significant higher rates of device removal by patient

STRENGTHS / LIMITATIONS

Strengths:
Multi-center study with site-specific co-investigators contributing to larger. More accurate data base, but also introducing some variability in data collection and in clinical practice
Deficits within the retrospective database reduced the final usable device samples, however clearly illustrated the benefits of direct observation/prospective analysis
Limitations:
Device nomenclature limitations: difficulty identifying midline versus long PIVC in retrospective data may have under-identified the midline volume in that arm
Choosing to monitor outcomes only on the device where the vasopressor was initiated was intentional to clarify data collection and analysis, but may have impacted the accuracy of outcome identification
Inclusion of the retrospective arm data set impacted data accuracy
No attempt to control device selection, vasopressor or dosage decisions through randomization
Not sufficiently powered for causation, especially for midline catheters

CONCLUSIONS

- **Central line utilization:** consistently in higher acuity patients (statistically significant higher DRG rating, longer duration of vasopressor, completion of therapy with the device in place)
- **Midline utilization:** very small sample size, but indicated longer dwell time, duration of vasopressor, higher DRG rating, longer LOS, significantly lower negative outcomes when compared to PIVCs. However, significantly higher number of patients expired with midline in place in the prospective data set. Safe midline utilization requires further evaluation.
- **PIVC utilization:** Given the statistically higher rates of negative outcomes, the central line remains the device of choice for vasopressors when device is present.
- Peripheral administration of vasopressors should be protocolized, of limited duration, and monitored closely due to the high rate of negative outcomes
- Comparison data accuracy comparing the retrospective and prospective data indicates that further research in PIVC outcomes should exclude retrospective review due to limitations.

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- Full Reference List and Evidence Summary Table available on request