

Prolonged administration of Intravenous Medication through Midline compared to Standard PIVC: The PIMMS randomized controlled trial.



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Background

Peripheral intravenous catheterization (PIVC) is a one of the most painful inpatient procedures across children’s hospital admissions. Approximately 30-50% of PIVCs fail (dislodgement, extravasation/infiltration, infection, device occlusion, pain, phlebitis, and thrombosis) prematurely causing interruption to therapy, pain, re-catheterization, escalation to a more invasive intravascular device, and additional healthcare costs.

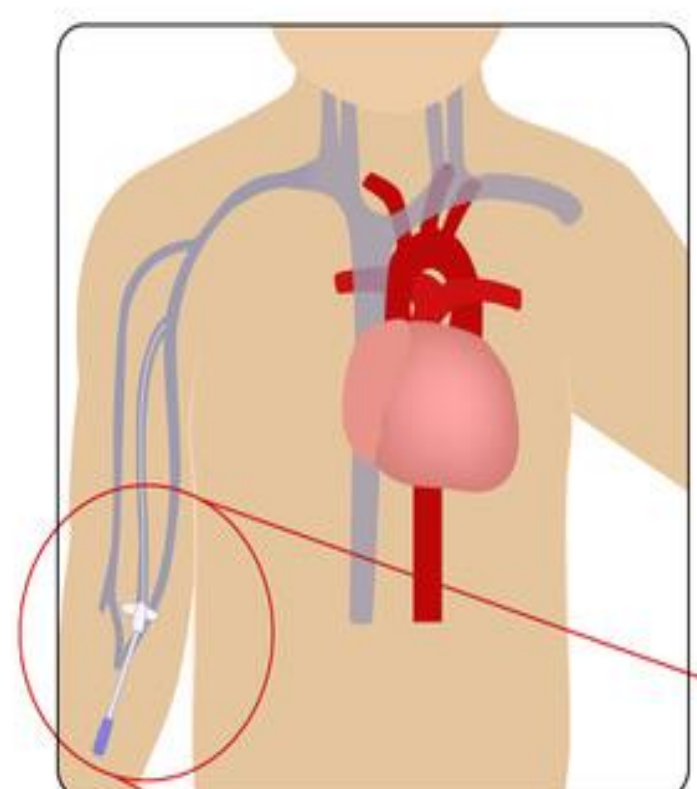
Midline Catheters are a peripheral device that are an alternative to traditional PIVCs. They are a longer length device, and usually inserted in an upper arm vein with the tip terminating at or distal to the axillary vein, outside the thoracic cavity.

Purpose

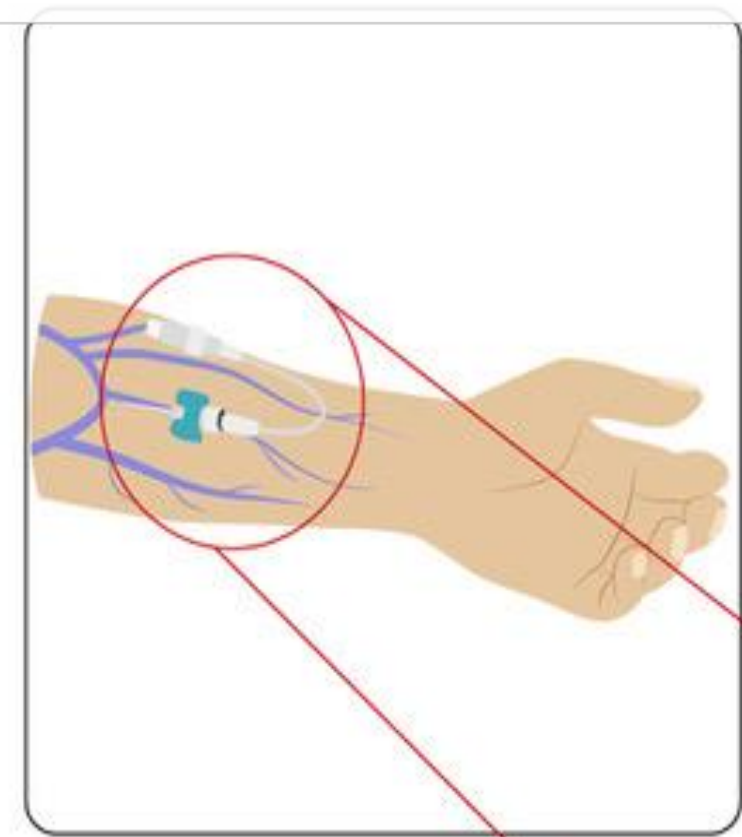
The **aim** of this study was to compare the clinical effectiveness and performance of **midline catheters** compared to **PIVCs** in children requiring peripherally compatible intravenous infusions for ≥ 4 days.

Our **primary hypothesis** was fewer midline catheter failures prior to treatment completion compared to PIVCs.

Our **secondary hypotheses** were midline catheters would have a longer dwell, require fewer additional devices to complete treatment, greater patient and parent satisfaction and reduced healthcare costs.



Midline Catheter



Peripheral Intravenous Catheter

Methods

Design/setting:

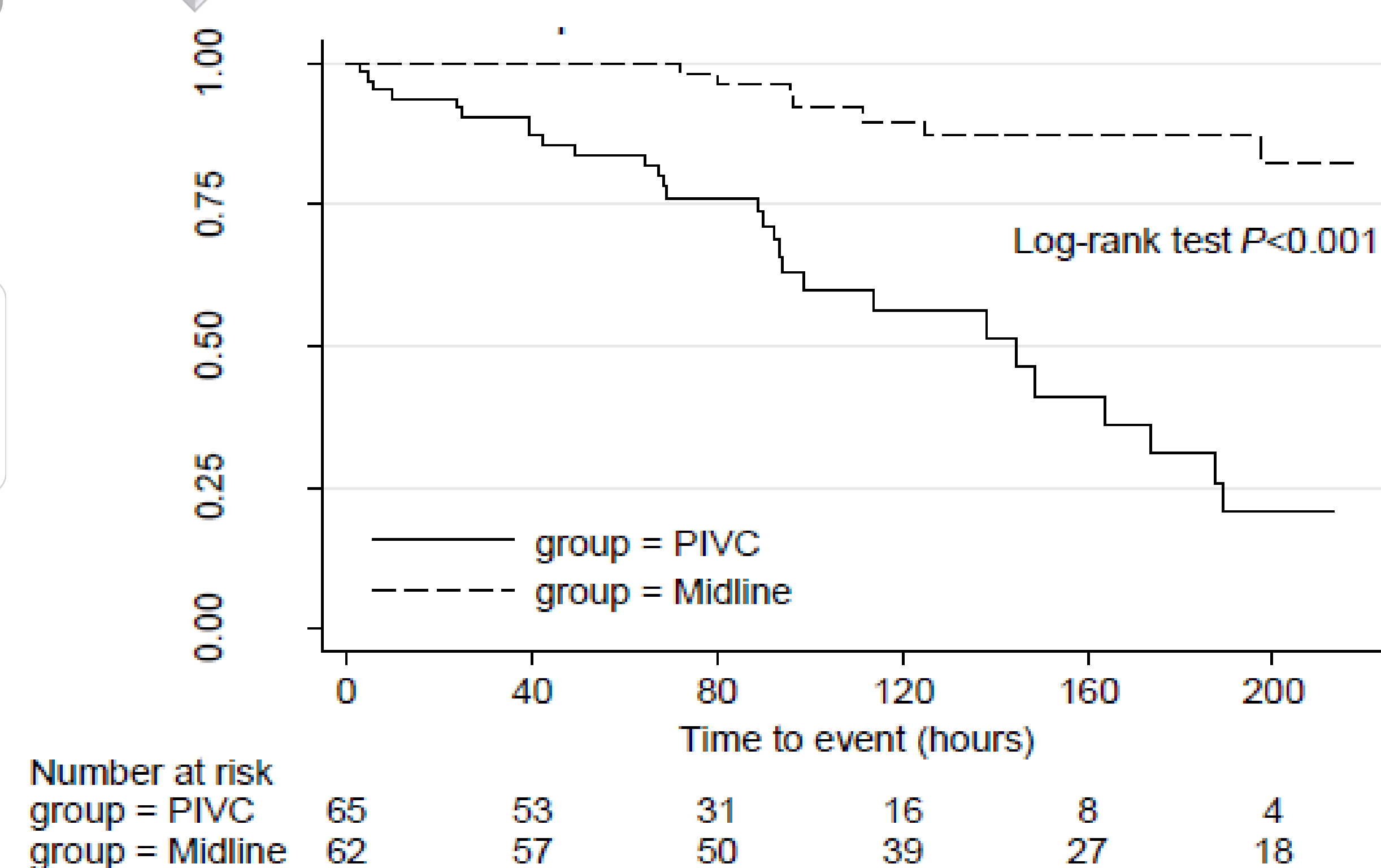
- A randomized controlled trial (July 2020 - May 2022)
- In a quaternary pediatric hospital, Brisbane, Australia.

Participants:

- **Eligibility:** Patients aged 1 to 18 years requiring peripherally compatible intravenous therapy for ≥ 4 days.
- **Exclusion criteria:** Patients were excluded if palliative, unable to provide consent (under care of social services, non-English speaking without an interpreter) or upper arm vein likely ≤ 2 mm.

Interventions:

- Patients were randomized 1:1 to receive a **PIVC (standard care)** or **midline catheter**.
- Stratified by age (≤ 5 years, > 5 years).
- One catheter was studied per patient.



The trial was prospectively registered Australia New Zealand Clinical Trials Registry, ACTRN12620000724976, Hospital (HREC/20/QCHQ/53466) and University (2020/320) ethics approval.



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Results – What are the findings?

Device failure was lower in Midline catheters (10 [16%]) **compared to PIVCs** (30 [46%]); odds ratio (OR) 0.2; 95% Confidence Interval (CI) 0.1–0.5; $p = <0.001$).

Midline catheters were associated with fewer insertion attempts (mean difference (MD) -0.3; 95% CI -0.5 – 0.0; $p = 0.04$), **increased dwell time** (MD 75 hours; 95% CI 34 – 117; $p = <0.001$), and **fewer additional vascular access devices to complete treatment** (MD -0.5; 95% CI -0.7 – -0.2; $p = 0.002$) **compared to PIVC**.

Midline catheters were associated with greater patient (9.0 vs 7.1 out of 10; $p = 0.002$), and **parent** (9.1 vs 8.2 out of 10; $p = 0.02$) **satisfaction and lower health care costs** (AU -\$151.67 [US -\$100.30] per person; 95% Credible Interval AU -\$171.45 to AU -\$131.90 [US- \$113.38 to US -\$74.98]).

Table 1 – Primary outcome

Device failure	Midline Catheter (N = 62)	PIVC (N = 65)	Between group differences (95% CI); p value
Any failure (n (%))	10 (16.1)	30 (46.2)	OR = 0.22 (0.10 – 0.52); <0.001
Incidence per 1,000 device hr (mean; SD)	0.9; 0.3	4.7; 0.9	HR = 0.15 (0.07 – 0.31); <0.001

Abbreviations: OR, odds ratio; CI, confidence interval; SD, standard deviation; HR, hazard ratio

Table 2 – Secondary outcomes

	Midline Catheter (N = 62)	PIVC (N = 65)	Between group differences (95% CI); p value
Dwell time, hours (median; IQR)	139.3; 95.5- 221.3	74.9; 50.8- 113.8	MedD = 66.9 (36.2–97.5); <0.001
Number of insertion attempts (mean; SD)	1.2; 0.6	1.4; 0.9	MD = -0.3 (-0.5 – 0.0); 0.04
Patient reported pain on insertion (mean; SD)	2.3; 2.2	3.9; 2.7	MD = -1.6 (-2.8 – -0.3); 0.01
Device complication (composite) during dwell (n (%))	24 (38.7)	37 (56.9)	OR = 0.48 (0.24 – 0.97); 0.04
IR per 1,000 device hr, (mean; SD)	2.2; 0.5	5.8; 1.0	HR = 0.26 (0.15 – 0.45); <0.001
Pts. requiring add. IVD to complete treatment (n (%))	4 (6.5)	19 (29.2)	OR = 0.17 (0.05 – 0.52); 0.002
Pt. reported satisfaction at IVD removal (mean; SD)	9.0; 1.4	7.1; 2.8	MD = 1.9 (0.7 – 3.0); 0.002

Abbreviations: OR, odds ratio; CI, confidence interval; SD, standard deviation; HR, hazard ratio; IR, incidence rate; IRR, incidence rate ratio; IVD, intravenous device; MD, mean difference; MedD, median difference; Pts, patients

Conclusion

The results of this RCT support the use of midline catheters for 4 or more days of peripherally compatible intravenous therapies in pediatric healthcare. Use of a midline catheter significantly improved the odds of treatment completion with a single intravenous device, providing positive clinical and financial outcomes for the patient and healthcare facility, respectively.

Future Directions

Further research should focus on implementation in cohorts most likely to benefit (vascular access dependent conditions) and follow up of long-term outcomes including vessel patency.