

Efficacy of PIVC insertion using Imaging technology compared to Combined palpation and visualization.

The EPIC randomised controlled trial.

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Background

Paediatric peripheral intravenous catheter (PIVC) insertion can be difficult and time-consuming. Ultrasound-guided PIVC insertion is a superior alternative to standard (palpation and visualisation) technique in high-risk patients.

Purpose

The aim of this study was to test the effect of ultrasound-guided PIVC insertion compared to standard technique using palpation and visualisation only, across all risk categories in the general paediatric hospital population.

Our **primary hypothesis** was children who have their PIVC inserted with ultrasound-guidance (USG) will have increased first attempt success compared to landmark PIVC insertion (standard care).

Our **secondary hypotheses** Children who have their PIVC inserted with USG compared to standard technique will have decreased PIVC insertion failure, prolonged dwell, and reduced pain on insertion.

The trial was prospectively registered Australia New Zealand Clinical Trials Registry, ACTRN12621000206820, Hospital (HREC/20/QCHQ/61248) and University (UQ Ref No: 2022/HE002352), (GU Ref No: 2021/042) ethics approval.



Methods

Design/setting:

- A randomized controlled trial (July 2021 - December 2022)
- In a quaternary paediatric hospital, Brisbane, Australia.

Participants:

- Eligibility:** Patients aged 0 to 18 years requiring insertion of PIVC. PIVC inserted in awake/conscious state, e.g. maintaining own airway.
- Exclusion criteria:** Patients were excluded if palliative, unable to provide consent (under care of social services, non-English speaking without an interpreter) previous enrolment in this study, or previously documented as high-risk DIVA that has required USG for successful PIVC insertion in the past.

Interventions:

- Computer based randomisation in 1:1 ratio to receive a **Standard technique** or **Ultrasound-guided** PIVC insertion (see Figure 1)
- Stratified by DIVA key (see figure 2).
- One catheter was studied per patient.

Outcomes:

- Primary** – First time insertion success.
- Secondary** – Number of insertion attempts, total PIVC insertion failure, all cause PIVC failure, patient reported pain on insertion, parent satisfaction with insertion, PIVC postinsertion failure and healthcare costs.

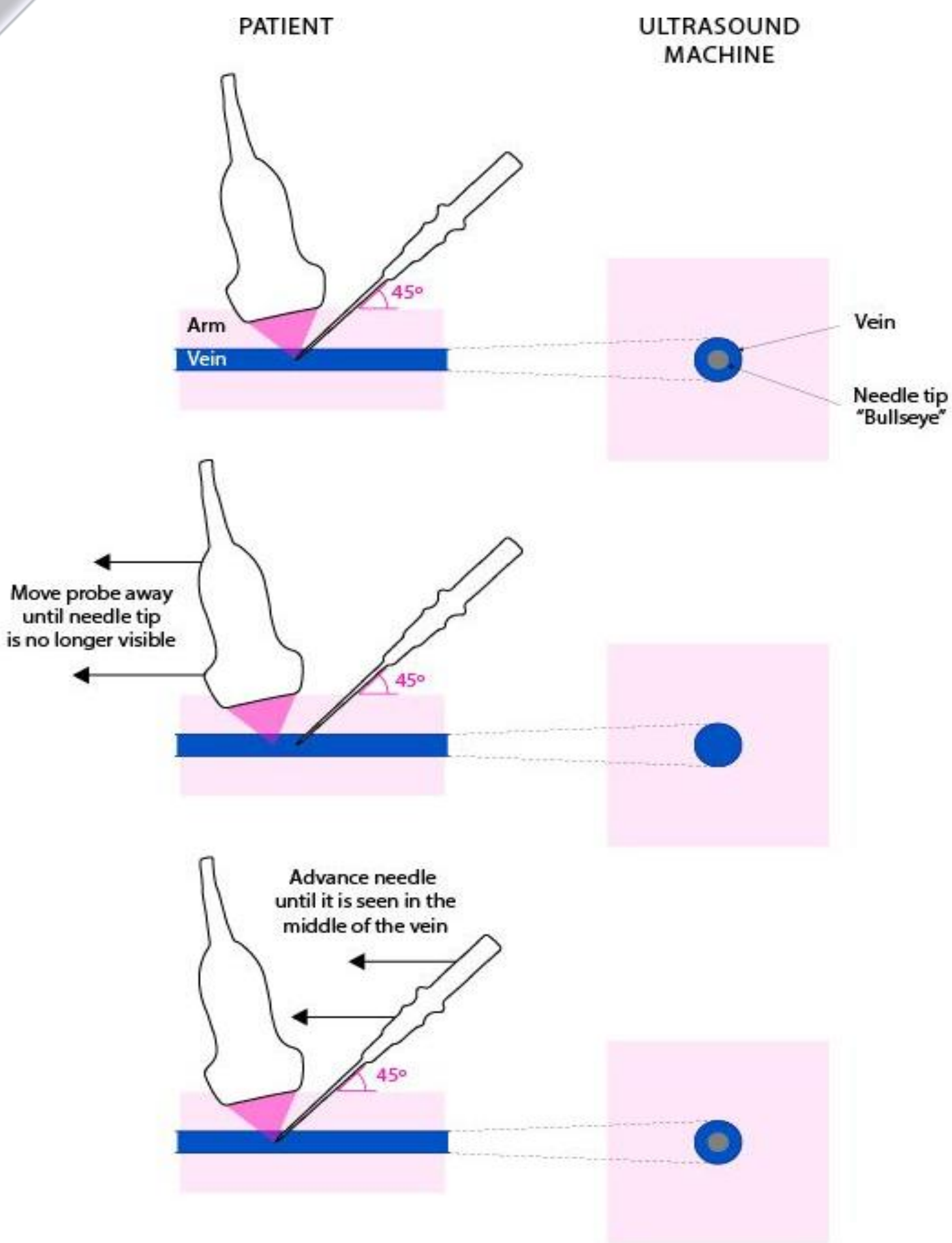
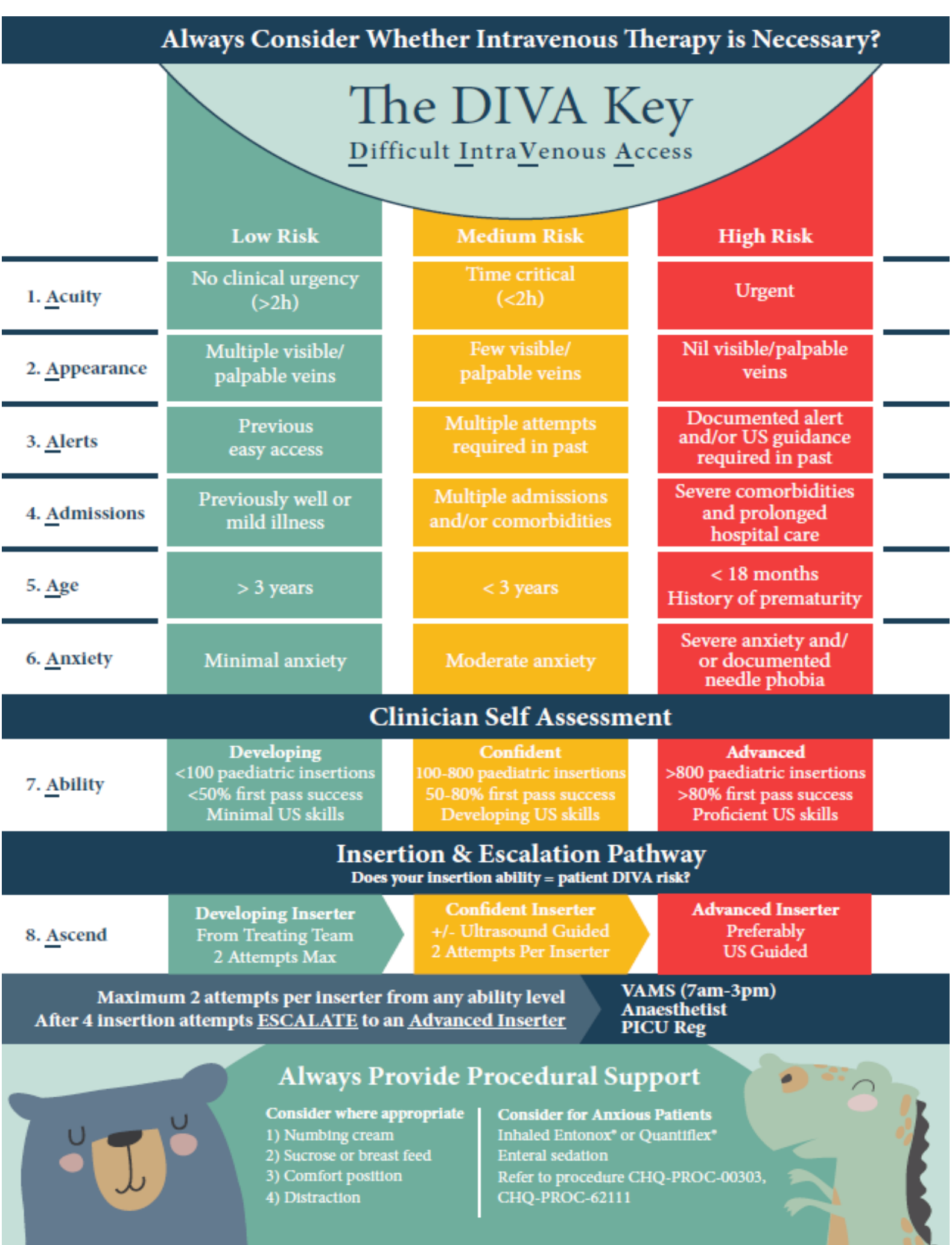


Figure 1

Continue advancing the catheter using this technique and adjust the angle of the needle to ensure the needle tip remains in the centre of the vein ("Bullseye").

Figure 2



Results

PRIMARY OUTCOME	USG (N = 84)	STANDARD (N = 80)	RD (95% CI); P value
First time insertion success (n (%))	72 (85.7)	26 (32.5)	52.2 (39.46-64.96) <0.001
Subgroup and strata	Ultrasound-guided	Standard	Risk difference (95% CI) p value
Primary outcome analysis			
ITT population	72/84 (85.7%)	26/80 (32.5%)	53.2 (40.5 to 65.9) <0.001
PP population	72/81 (88.9%)	25/78 (32.1%)	56.8 (44.4 to 69.3) <0.001
DIVA risk			
Low risk DIVA (Green)	17/18 (94.4%)	14/22 (63.6%)	30.8 (8.1 to 53.5) 0.008
Medium risk DIVA (Yellow)	33/36 (91.7%)	11/31 (35.5%)	56.2 (37.1 to 75.3) <0.001
High risk DIVA (Red)	22/30 (73.3%)	1/27 (3.7%)	69.6 (52.3 to 87.0) <0.001

Secondary outcomes – Device (ITT)	USG N=84	Standard N=80	RD (95% CI); p value
Number of insertion attempts, median (IQR)	1 (1–1)	2.5 (1–3)	MedD = -1.0 (-1.4– -0.6); <0.001**
Insertion failure	0 (0)	2 (2.5)	Not calculable due to zero cells
Dwell time (hours), median (IQR)	47.1; 24.2–77.0	47.7; 22.3–74.1	MedD = -1.5 (-19.1–16.2)
Total device days (median; IQR)	2.0; 1.0–3.2	2.0; 0.9–3.1	MedD = -0.1 (-0.8–0.7)
Device failure	20 (24.1)	20 (25.3)	0.95(0.56-1.63)
Additional VAD	11 (13.1)	15 (18.8)	-5.7 (-16.8–5.5)
Healthcare cost (mean cost per person)	\$16.55	\$14.33	\$14.13
95% CrI	(\$11.59-\$21.51)	(\$9.39-\$18.87)	(\$9.39-\$18.87)
Patient reported insertion pain , mean (SD)			
FLACC	4.98(2.1)	4.6 (2.4)	MD = 0.5 (-0.48–1.44); 0.32
Faces (Wong-baker)	6.5 (2.1)	4.8 (3.1)	MD = 1.8 (-2.07–5.57); 0.33
Numerical	3.8 (2.1)	5.6 (3.1)	MD = -1.8 (-3.37– -0.3); 0.02**
Patient satisfaction with insertion, mean (SD)	9.5 (1.1)	5.6 (3.4)	MD = 4.0 (3.11–4.87); <0.001**

Conclusion

Ultrasound-guidance for PIVC insertion improved first-time PIVC insertion success across all risk categories in children