PRIMARY BLOODSTREAM AND VENOUS INFECTIONS IN 12,942 PERIPHERAL INTRAVENOUS CATHETERS IN AUSTRALIA

Rickard CM^{1,2,3}, Larsen E^{1,2}, Marsh N^{1,2}, Webster J^{1,2}, Mihala G^{1,4}, Runnegar N³

1. Alliance for Vascular Access Teaching and Research (AVATAR), School of Nursing and Midwifery, Menzies Health Institute Queensland, Griffith University, Brisbane, Queensland, Australia
2. Nursing and Midwifery Research Centre, Royal Brisbane and Women's Hospital, Brisbane, Queensland, Australia 3. Princess Alexandra Hospital, Brisbane, Queensland, Australia
4. Centre of Applied Health Economics, Menzies Health Institute Queensland, Griffith University, Brisbane, Queensland, Australia

What did we do? And why?

Aim: To quantify risk of primary bloodstream and local infections associated with peripheral intravenous catheters (PIVCs) in adults, and to assess relationship to dwell time.

Methods: We synthesized data from multiple prospective research studies in Australia (12 studies; 12,942 PIVs) with rigorous prospective collection of dwell times and infection outcomes using National Health and Safety Network (NHSN) 2018 criteria. PIVCs were inserted in a range of clinical departments and by various inserters; ultrasound was not used, and IV insertion teams were rare. Post-insertion care was by bedside nursing staff using routine hospital policies. Infections were blind-adjudicated. Dwell times were calculated from insertion and removal times, and life tables constructed.

How did we define infection?

Primary endpoints: NHSN 2018 definitions

Local venous infection: NHSN VASC-Arterial or Venous Infection adult criteria, i.e. at least **one** of:

- Evidence of venous infection (gross anatomic or histopathologic exam)
- A least **one** of: pain, erythema, or heat at involved vascular site, **and** >15cfu cultured from PIVC tip using semi-quantitative method.
- Purulent drainage from PIVC site

PIVC Related BSI (PRBSI):

- NHSN Laboratory-confirmed bloodstream infection (LCBI) (recognised pathogen, or common commensal drawn on 2 or more occasions, with fever, chills or hypotension occurring no more than 3 calendar days before/after the first positive blood culture) that are not secondary to an infection at another body site, **and**,
- At least one of the VASC Criteria (above)

PIVC Line Associated BSI (PLABSI) (i.e. Primary BSI):

- These were defined as LCBI (above) cases that did not meet the VASC criteria.

Staphylococcus aureus BSI (SAB):

- Australian Commission of Safety and Quality in Healthcare criteria: The patient's first positive SAB blood culture was collected ≥48 hours after hospital admission and, SAB is a complication of the presence of an indwelling medical device (e.g. PIVC), and
- Stuart's criteria (Med J Aust, 2013): Isolation of *S. aureus* in ≥1 blood culture; and PIVC in situ or removed within the 7 days before the positive blood culture; and no other source of SAB identified; and physician or nurse documenting PIVC as source in medical record; and/or physical findings suggests PIVC as the source (redness, induration, phlebitis, tenderness).

What did we find?

Results:

PLABSI occurred in 6/12,942 (0.05%) PIVCs or 0.14 per 1000 PIVC days. This included one SAB (0.01%; 0.02/1000 PIVC days). Of these PLABSI cases, 3/12,942 (0.02%; 0.07 per 1000 PIVC days) met the criteria for PRBSI. In addition, there were 3/12,942 (0.02%) CVS-VASC local infections. PIVCs were in place for <1 to 42 days and primary BSIs occurred on dwell days 2 to 7, with no significant difference in risk by day of dwell ($p>0.05$). A life table (Table 1) displays PLABSI risk (95%CI) against interval (dwell) days.

Table 1. Life table of survival from PLABSI

Dwell (day)	Starting number	PLABSI	Removed	Day-specific risk (%)	95% CI
0-1	12,942	0	1,393	0.00	
1-2	11,549	1*	3,290	0.01	0.00-0.03
2-3	8,258	1*	3,317	0.01	0.00-0.04
3-4	4,940	0	2,380	0.00	
4-5	2,560	1	1,166	0.04	0.00-0.14
5-6	1,393	2	549	0.14	0.02-0.40
6-7	842	1*	337	0.12	0.00-0.44
7-8	504	0	209	0.00	
8-9	295	0	100	0.00	
9-10	195	0	70	0.00	
10-11	125	0	38	0.00	
11-12	87	0	27	0.00	
12-13	60	0	10	0.00	
13-14	50	0	11	0.00	
14-15	39	0	14	0.00	
15-16	25	0	3	0.00	
16-17	22	0	4	0.00	
17-18	18	0	4	0.00	
18-19	14	0	5	0.00	
19-20	9	0	1	0.00	
30-31	8	0	1	0.00	
35-36	7	0	2	0.00	
41-42	5	0	5	0.00	

Dwell = number in place at commencement of that interval day; * PLABSI met the criteria for PRBSI; Removed = devices removed that day; CI = confidence interval; blank CI values mean it cannot be calculated.

Figure 1. Sample sizes of included studies

Figure 2. PLABSI Organisms

Enterobacter cloacae
(n=2*) (n=1)

Pseudomonas aeruginosa
(n=1*)

Staphylococcus aureus (n=1)

Klebsiella oxytoca (n=1)

*PLABSI met the criteria for PIVC-related Bloodstream Infection

Three cases of CVS-VASC (local venous infections):

1. Staphylococcus aureus (Day 2)
2. Gram pos. cocci & gram pos. bacilli (Day 6)
3. Gram neg. bacilli (Day 8)

What does it mean?

Conclusion:

While infections can occur, and ongoing vigilance is required to prevent them, this prospective, rigorous follow up of PIVCs identified a low rate of associated BSI and local infections under typical Australian hospital conditions. There was no significant increase in BSI risk with dwell time. We caution that all PIVCs should be monitored daily and removed as soon as no longer needed, if there is any complication or suspicion of infection.