Assessing microbial colonization of peripheral intravascular devices

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Dear Editor,

We read with interest the recent paper by Molina J et al., which discussed mortality and hospital stay related to coagulase-negative *staphylococci* bacteraemia caused by intravascular devices (IVD) in non-critical patients.[1] The most frequently isolated bacteria on IVD are coagulase-negative *staphylococcus*,[2] it is, therefore, critical for researcher to assess IVD related infections and develop efficient strategies to prevent IVD-related infections.

Peripheral intravascular devices (PIVDs) are one of the most frequently used medical invasive devices in hospitals[3] and it is estimated that 200 million PIVDs are used annually in the USA.[4] PIVD-related infections occur at lower incidence than many other IVD types, but constitute serious and potentially life-threatening infections, exacerbated by the high frequency of use.[5] To reduce the incidence of PIVD-related infections, many strategies have been applied including hand hygiene, aseptic technique during PIVD insertion and skin preparation.[6] In many hospitals, peripheral catheters are inserted by medical staffs with limited experience in IV catheter care. Several studies have suggested that a dedicated IV therapy team may reduce catheter-related complications.[7] In addition, routine replacement of catheters was believed to be the critical factor in reducing the occurrence of complications. Furthermore, an intervention to reduce PIVD-related infection used in recent years has been to artifically shorten the dwell time of individual devices.[2] We conducted a randomized, prosepctive, controlled trial to assess how time *in situ* contributes to PIVD colonization; to assess the effectiveness of routine Day 3 removal of PIVDs in preventing microbial colonization; and to assess whether the use of IV team decreases PIVD complication.

After ethics committee approval, and patients' informed consent, the study was conducted at three teaching hospitals in Queensland, Australia. PIVDs were inserted and cared for in accordance with usual hospital practice except for the approach to catheter removal which was randomized to either removal on clinical indication (clinical change

group: CC), or routinely every three days (routine change group: RC). Randomization was a 1:1 ratio, computer generated after patient consent, and concealed until this time. Clinical staffs were then aware of allocation but the endpoint raters for colonization were blinded. IV teams inserted 40% of devices, with the remainder-inserted by general medical and nursing staff. PIVDs were Insyte Autoguard (BD Medical, Franklin Lakes, USA). Dressings (transparent semi-permeable) were used for 7 days, or changed earlier if loose or soiled. A 5% convenience sample was taken. When the PIVD was no longer required, the nurse removed the PIVD and distal 2 cm of the tip was cut. All PIVD tips were handled under aseptic conditions and immediately transported to laboratory and cultured by the semi-quantitative method.[8] Baseline characteristics of patients and devices, all of which are described as frequencies (%) except for age (mean and SD), were compared using a two-sided Fisher's exact test. Relative incidence rates (RR) of PIVD-related colonization per 100 devices/patients and also aggregated incidence rate ratio comparisons (IRRs) per 1,000 device days, both with 95% confidence intervals, were calculated to compare colonization rates. Median dwell times were compared using the Mann-Whitney test. Multivariate (Cox regression) modelling assessed possible associations between age, gender, number of comorbidities, study group, hospital, inserter type, insertion site, IV antibiotics or other IV medications with colonization rates. Statistical analysis was completed using StataSE (Version 10, College Station, TX). P values of <0.05 were considered statistically significant.

A total of 298 PIVDs were studied in 260 patients. The median patient age was 56 years and 64% were male. One hundred and forty six (55%) patients had multiple comorbidities. Of the 260 patients, 127 were randomised to receive routine PIVD change (RC group) and 133 patients were randomised to the clinical change group (CC group). Eight of 143 (6.3%) (CC) vs 6 of 155 (4.5%) (RC) PIVDs were colonized, and this was not statistically different between groups (see Table 1). The most frequently identified organism

was coagulase-negative *staphylococcus*. Others included *staphylococcus*, *bacillus*, *candida*, *corynebacterium* and *streptococcus* species. Median PIVD time *in situ* was significantly longer in colonized than uncolonized PIVDs, but this was not significant when viewed by study group as rates per 1000 PIVD days (CC 14.6/1000 PIVD Days vs RC 14.4/1000 PIVD Days, IRR 1.02, 95% CI 0.34-3.21, p=0.98, Table 1). Multivariate (time-adjusted per 1000 PIVD days) modelling found no significant variables (including study group) associated with colonization. The application of IV team might decrease PIVD-related infections but the difference was not statistically significant (p=0.06). No statistically significant differences were seen regarding the other evaluation criteria on PIVD colonization: gender, age, insertion site, hospital, antibiotic treatment and intravascular medications.

The results suggest that increased dwell time is significantly associated with colonization, and this is not prevented by routinely removing devices. Over the course of a treatment period, the rates of colonization are not significantly different when PIVDs are left *in situ* as long as clinically needed and they remain functional, compared to removal every 3-4 days. The observed colonization rate was 4.7 % at a threshold of 15 cfu. Few studies have been published that deal specifically with PIVD colonization. One French study of pre-hospital inserted PIVDs found a similar rate of 4.1% colonization, despite patient and analytic differences.[9] Our devices would not usually have been cultured in clinical practice and clinicians would assume that they were sterile, when our findings show that this is not the case. Insertion by an IV team appeared somewhat protective of colonization although was not remain predictive on the multivariate analysis. The most frequently isolated microbes in this study were coagulase-negative staphylococci, and this is consistent with the findings of colonization in many IVD types.[2] However, it has been shown that culture methods although commonly used, are of limited value for slow-growing or fastidious bacteria or intracellular pathogens.[10] The sensitivity of the semi-quantitative method might also be reduced if the

patient is receiving antibiotic treatment.[10] Therefore, many pathogenic bacteria might not have been isolated in this study because of the techniques used, and the true bacterial colonization rate may be higher than shown here.

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Potential conflicts of interest

All authors report no conflict of interest relevant to this article.

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Table 1. Peripheral intravascular device (PIVD) colonization according to patient and intervention characteristics.

Variable	14 colonized PIVD	284 uncolonized PIVD	Risk ratio or mean difference 95% CI	*P*
Study group				
Clinical change group	8	135	1.44 (0.51-4.06)	0.59
Routine change group	6	149		
Time *in situ*, median (quartiles)	118.5 (73, 173)	72.5 (55, 98)	44.5 (13.9-75.2)	0.004
Gender				
Male	10	191	1.33 (0.43-4.14)	0.78
Female	4	103		
Age (years) (mean ± SD)	51.0 ± 19.4	55.8 ± 18.3	4.8 (7.9-17.5)	0.46
Inserter type				
IV service	3	139	0.30 (0.09-1.05)	0.06
Other clinician	11	145		
Insertion site				
Ward	10	222	N/A	0.13
Emergency	0	27		
Operating theatre / Radiology	4	35		
Hospital				
1	3	96	N/A	0.52
2	7	100		
3	4	88		
IV antibiotics				
Yes	12	209	2.09 (0.48-9.13)	0.53
No	2	75		
IV medications				
Yes	5	126	0.71 (0.24-2.06)	0.59
No	9	158		

IV - intravenous.