Evaluation of the IRIDICA system to diagnose prosthetic implant infection

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Introduction

Early diagnosis of orthopaedic prosthetic implant (PI) infection is key to ensuring correct and optimal antimicrobial treatment. However PI is difficult to diagnose by traditional microbiological culture techniques due to poor sensitivity and sample contamination.

Suboptimal sensitivity is partly a consequence of bacteria being present in biofilms and the effect of previous antimicrobial treatment. Multiple surgical samples are usually collected to increase the sensitivity, each requiring several sets of culture plates and enrichment broths. In our laboratory an average of 5 samples are received per patient - each inoculated onto 7 different microbiological plates and broths – a process which is highly labour intensive. Sample contamination can easily occur during collection and / or microbiological processing. In our laboratory, the same pathogen must be isolated from at least two samples for the result to be considered indicative of infection.

The IRIDICA BAC assay® (Abbott Molecular) uses a semi-automated platform for DNA extraction, PCR and electrospray ionisation - mass spectrometry (PCR/ESI-MS) to identify detected pathogens directly from specimens (Fig.1). Early studies suggested that PCR/ESI-MS may be a useful tool to detect pathogens where antimicrobial therapy had previously been administered[1]. This study evaluates whether the BAC assay would be a useful aid for the diagnosis of PI.

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Materials & Methods

Design: Non – interventional clinical test validation study.

Surgical samples from patients who had suspected PI infection at the time of surgery were collected following the routine microbiological workup. Samples were collected between August 2014 and May 2015 from Leeds Teaching Hospitals.

Explanted prosthetic material removed during orthopaedic and spinal surgery and normally discarded, was sonicated to disrupt biofilms and inoculated onto microbiological media (Fig.2).

Individual samples and sonicates were anonymized and stored at -20˚ C until processed on the IRIDICA system.

Once routine microbiological culture results had been reported back to the clinicians, samples were processed using the IRIDICA BAC SFT (sterile fluid and tissue) assay® according to the manufacturers instructions. The system was not CE marked at the time of the study and data from the assay was not reported back to physicians.

Laboratory culture data was collected from the laboratory information system at the end of the study.

A PI infection episode was defined when the same pathogen was isolated in at least two samples. The BAC assay® result was compared against the episode result – pathogens not detected or where a different pathogen was identified were scored as negative.

Figure 2. Workflow for prosthetic implant samples

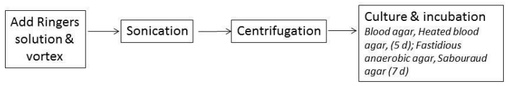
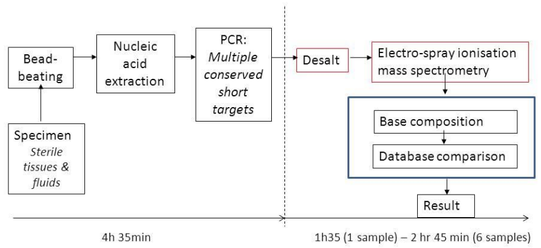


Figure 1. Workflow summary for the IRIDICA BAC assay® (SFT)



Results

Table 1. Distribution of surgical samples examined

Surgical site (patients)	Implants received	Samples sent for microbiology[1]	Cultured samples included in study[2]
Orthopaedic joint (3)	3	15	10
Trauma (8)	11[3]	47	23
Spinal (8)	10	29	9
No associated implant (31)	/	/	97[4]
(n=50)	25[3]	91	139

[1] Number of samples sent for microbiology investigation
[2] Number of samples retrieved from routine laboratory
[3] 1 sample not tested due to extended transportation
[4] Includes 84 specimens from orthopaedic joint revision

Table 2. Comparison of BAC assay with PI infection episodes

PI infection episode	Same pathogen	Not detected / different pathogen
Positive	46	11
Negative	14	75

Sensitivity of BAC assay: 46/57 = 81%

Specificity of BAC assay: 75/89 = 84%

- Fungi were not isolated or detected.
- 1/139 samples had a failed BAC assay

Reference

1. J.J. Farrell, et al. (2013). PLoS ONE 8(6): e66349.

Table 3. Most commonly identified bacteria

Species (single species)	Culture	BAC assay (single pathogen)	BAC assay + other pathogen
Staphylococcus aureus	24	24	2
S. capitis, S.epidermidis, "CNS"	9	7	8
Propionibacterium acnes	4	6	5
Pseudomonas aeruginosa	3	4	
E.coli	3	3	

Table 4. Discrepancies in identification

Discrepency	Comment	n
Culture positive; Not detected by BAC assay	Culture positive in enrichment broth only	5
	Propionibacterium spp not detected	1
Culture positive; BAC assay different result	Same species identified with additional species	8
	Different species identified (enrichment broth only)	2
	Complex mixed bacteria grown/detected	1
No growth; BAC assay positive	Identified organism not confirmed by other cultures	17
	Identified organism consistent with other cultures (may include mixed pathogens)	4
	Other specimens with same BAC assay result (no culture confirmation)	5
	S. aureus would not be reported in CE versions of the assay	1

Conclusions

Despite small numbers of samples, these findings suggest that the BAC assay® could be helpful in the diagnosis of PI infection.

- Data is consistent with microbiology
- Consistent data within a PI infection episode
- May be more sensitive than culture
- Detects *P.acnes* more frequently than culture, sometimes co-reported with staphylococci
- As with culture, it may be necessary for pathogens detected at low levels to be detected in >2 samples to indicate infection.