

Background

With a reported incidence of up to 12%, periprosthetic joint infection (PJI) is a frequent complication of total elbow arthroplasty (TEA). Its microbiologic diagnosis is usually based on periprosthetic tissue culture (hereafter referred to as tissue culture), despite the poor sensitivity of this technique. Although implant sonication cultures have been shown to be superior to tissue cultures for hip and knee PJI diagnosis, only a single small study (including fewer than 10 infected implants) has assessed sonication of elbow arthroplasties.

Methods

Inclusion

Patients were included retrospectively if they underwent revision for TEA failure between June 2007 and September 2019, and if their implant was sent for sonication at Mayo Clinic, Rochester, MN.

Patients' characteristics

We gathered patient information from their computerized medical record.

Diagnosis of PJI

The definition of PJI was based on composite criteria from the Infectious Diseases Society of America (1): Definitive diagnosis of PJI was made if purulence was observed by the surgeon at the time of surgery, if a sinus tract developed in communication with the prosthesis, or if two or more intraoperative cultures or a combination of preoperative aspiration culture and an intraoperative culture grew with the same organism.

Tissue cultures

At least 2 tissue cultures were taken at the time of the index surgery. Tissue cultures were considered positive if at least 2 cultures grew the same organism, or if one was positive to a virulent pathogen like *Staphylococcus aureus*.

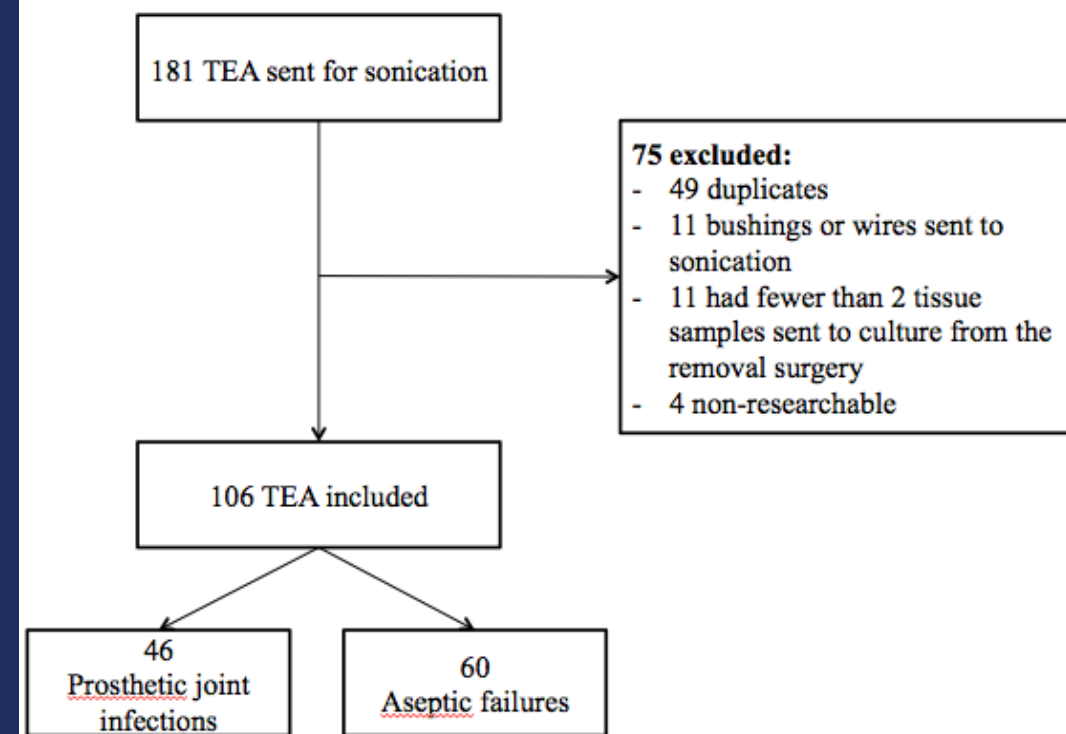
Sonication

Prosthetic components removed from patients who had surgery for PJI were collected in a solid sterile container and subjected to vortexing/sonication culture, as previously described (2, 4). For sonicate fluids, we considered a culture positive if there was growth of greater than 20 cfu/10 ml of sonicate fluid (3, 5), with the exception of virulent organism like *S. aureus* for which any growth was considered positive.

Objectives

1. Determine the accuracy of periprosthetic tissue culture compared to culture of samples obtained by implant sonication.
2. Compare the sensitivity of tissue culture to the combination of tissue and sonicate fluid culture.

Results



Patients

- 46 PJI and 60 AF were included.
- Pain was more common in the AF (97%) compared to the PJI group (72%, $p=0.0004$). In the AF group, pain and swelling (15%) were the two notable clinical findings described. In the PJI group, fever was uncommon (9%), but swelling (61%) and wound drainage (48%) were frequently encountered. Erythema (26%) and skin dehiscence (33%) were also described.
- C-reactive protein (CRP) was higher in PJI compared to AF cases ($p=0.0001$) with a median of 0 in the AF group.

Culture-based testing (Table 1.)

- Sensitivity of tissue culture was 63% and sensitivity of sonicate fluid culture was 76% ($p=0.109$).
- The sensitivity of both tests combined (85%) was significantly higher than the sensitivity of tissue culture (63%), ($p=0.002$).
- Unfortunately, for 7 patients with PJI, both tissue and sonicate fluid cultures were negative. Among those 7 patients, 3 (43%) had received antibiotics within 4 weeks of resection surgery.

Species identification (Figure 2.)

- Coagulase-negative staphylococci were found in 19 (49%), and *S. aureus* in 5 (13%)
- 8 (21%) polymicrobial cultures.
- Among the 8 polymicrobial cultures, 6 pathogens were identified in sonicate fluid culture only which led to a modification of treatment in 4 cases (Table 2.).

Comparison of test

	Prosthetic Joint Infection (n=46)	Aseptic Failure (n=60)	Sensitivity (%) (95% CI)	Specificity (%) (95% CI)	Positive Predictive Value (%) (95% CI)	Negative Predictive Value (%) (95% CI)
Periprosthetic tissue culture ¹	29	4	63 (48-77)	93 (83-98)	88 (73-95)	77 (69-83)
Sonicate fluid culture ²	35	0	76* (61-87)	100 (94-100)	100 (100-100)	86 (77-90)
Sonicate fluid and/or periprosthetic tissue culture	39	4	85** (71-94)	93 (84-98)	90 (79-96)	89 (80-94)

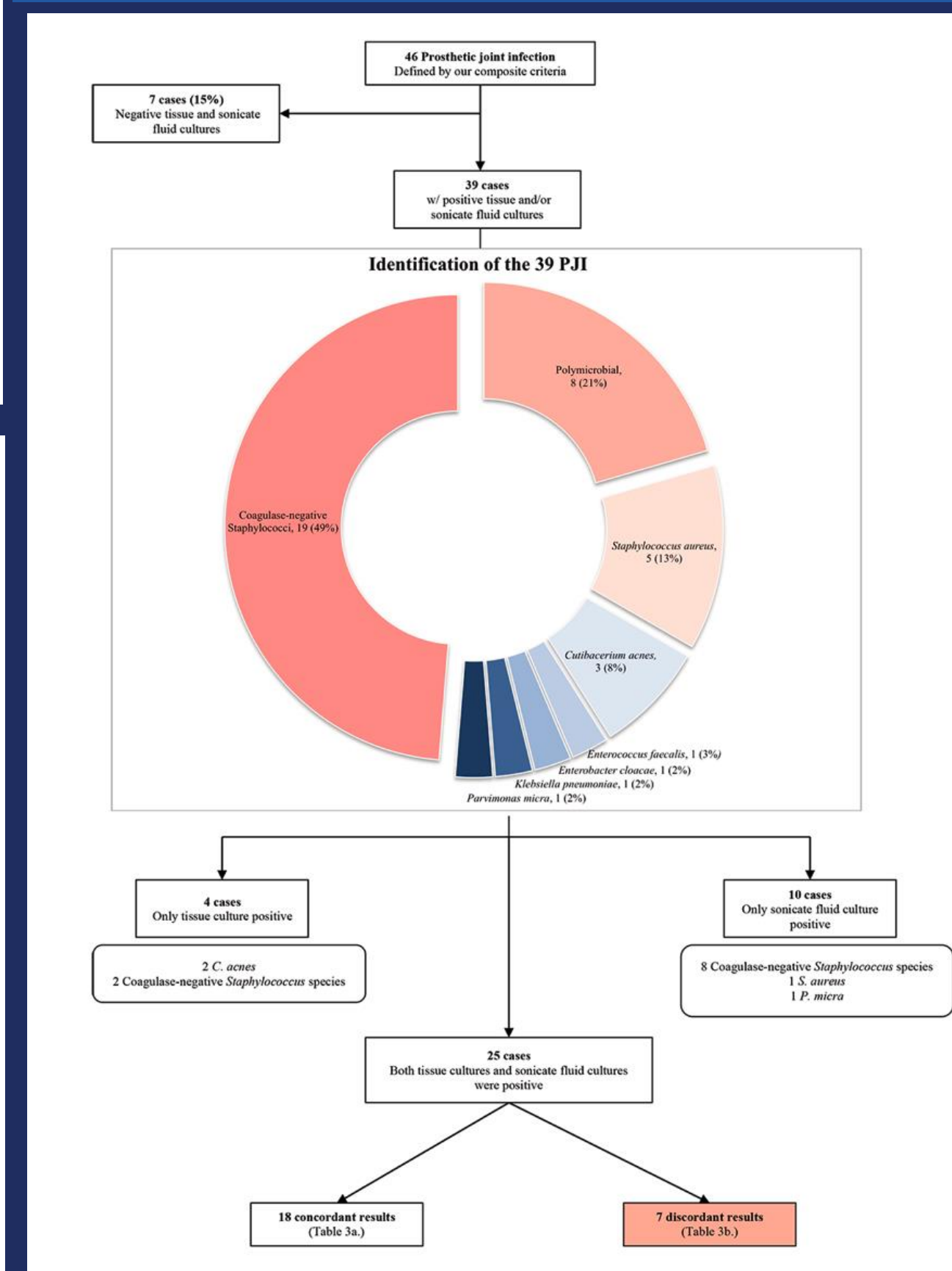
¹Positive tissue culture was defined as ≥ 1 positive tissue for *Staphylococcus aureus* and ≥ 2 positive tissues for less virulent organisms

²Positive sonicate fluid culture was defined as growth of ≥ 20 CFU/10 ml sonicate fluid

* $p > 0.05$ in comparison to positive tissue culture

** $p \leq 0.05$, in comparison to positive tissue culture

Species identification



Impact on antibiotic therapy

Tissue culture	Sonicate fluid culture	Impact on antibiotic therapy
1 Coagulase-negative staphylococci	<i>Pseudomonas aeruginosa</i> + <i>S. aureus</i>	Initially on vancomycin, addition of cefepim
2 Coagulase-negative staphylococci	<i>S. epidermidis</i> + <i>Flavobacterium meningosepticum</i>	Initially on vancomycin, addition of meropenem
3 <i>Staphylococcus epidermidis</i>	<i>S. epidermidis</i> + <i>Candida tropicalis</i>	Initially on vancomycin, addition of fluconazole
4 <i>Staphylococcus lugdunensis</i>	<i>S. lugdunensis</i> + <i>Escherichia coli</i>	Initially on cefazolin, <i>E. coli</i> susceptible to ceftazidime, no change of treatment
5 <i>Streptococcus agalactiae</i>	<i>Streptococcus agalactiae</i> + <i>S. epidermidis</i>	Initially on ceftriaxone, switched to vancomycin
6 <i>S. epidermidis</i> + <i>Enterobacter cloacae</i> + <i>Corynebacterium amycolatum</i>	<i>S. epidermidis</i> + <i>Enterobacter cloacae</i>	Initially on eripenem, no change of treatment
7 <i>S. aureus</i> + <i>Corynebacterium striatum</i>	<i>S. aureus</i> + <i>Enterococcus faecalis</i> + <i>Corynebacterium striatum</i>	Initially on daptomycin and cefepim, no change of treatment

Table 2. Discordant results between tissue and sonicate fluid cultures and impact on antibiotic therapy

Conclusions

Conclusions:

- The combination of sonicate fluid culture and tissue culture had a greater sensitivity than tissue culture alone for microbiologic diagnosis of elbow TEA infection.
- Sonication helped identified 6 polymicrobial infection leading to a change in antibiotic therapy in 4 cases.
- Coagulase-negative staphylococci were the most common species identified in this cohort of elbow PJI

References

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4. Vergidis P, Greenwood-Quaintance KE, Sanchez-Sotelo J, Morrey BF, Steinmann SP, Karau MJ, et al. Implant sonication for the diagnosis of prosthetic elbow infection. J Shoulder Elbow Surg. 2011;20(8):1275-81.
5. Cazanave C, Greenwood-Quaintance KE, Hanssen AD, Karau MJ, Schmidt SM, Gomez Urena EO, et al. Rapid molecular microbiologic diagnosis of prosthetic joint infection. J Clin Microbiol. 2013;51(7):2280-7.



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