The irrigation solution with povidone-iodine reduces the microbial contamination of the surgical field during reverse total shoulder arthroplasty

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INTRODUCTION:

Periprosthetic joint infection (PJI) in reverse total shoulder arthroplasty (RTSA) represents a challenging complication, with one of its main causes being intraoperative contamination. The aim of this study was to test the effectiveness of an irrigation solution containing povidone-iodine to reduce bacterial contamination of the surgical field in RTSA.

METHODS:

Sixty-five patients undergoing primary RTSA were prospectively included. Patients with fractures, osteonecrosis, tumors, or previous surgical treatment failures, as well as those who received antibiotic therapy in the two weeks prior to surgery or infiltrative therapy in the last six months, were excluded. Immediately prior to the preparation of the surgical field, the patient's shoulder and axilla were irrigated and scrubbed with a 7.5% povidone-iodine solution followed by water. The surgical field was then prepared with a 4% chlorhexidine gluconate solution for one minute. Both after the skin incision and the incision of the subcutaneous tissue, the scalpel blade was replaced. At the end of the surgery, prior to closing the surgical field, six different samples were drawn from the patient. The first set of three samples—one swab from the glenosphere, one from the humeral component, and one peri-prosthetic tissue sample—was collected before the irrigation of the surgical field (povidone-iodine diluted with saline to a concentration of 0.35% and left inside the joint for three minutes). The second set of three samples was taken from the same sites after the irrigation. The six specimens were processed within one hour to obtain both qualitative and quantitative assessments of the microbial load. For each bacterial isolate, biofilm-forming capacity and antibiotic susceptibility were evaluated.

RESULTS:

The only type of bacteria recovered under anaerobic conditions was *Cutibacterium acnes (C. acnes)* (120 isolates), whereas the aerobic flora included both gram-positive bacteria, primarily *Coagulase-Negative Staphylococci* (*CoNS*) (64 strains), and gram-negative bacteria. No fungi were isolated.

Povidone-iodine irrigation resulted in a significant reduction in both the positivity rates and microbial loads of both *C. acnes* and *CoNS* (**Table I**). A correlation between time to positivity and bacterial load was revealed, especially for *C. acnes*: when the *C. acnes* count was 10^3 CFUs/ml or higher, cultures became positive within 3–5 days, whereas when the count was 10^2 CFUs/ml or lower, positivity was observed only after more than 6 days. In contrast, for aerobes (characterized by lower counts), the mean time to positivity was 1–4 days.

No complications related to irrigation were observed. One patient developed a superficial infection, which was successfully treated with oral amoxicillin-clavulanate.

Regarding biofilm-forming capability, the majority of *C. acnes* strains prior to irrigation were classified as non-biofilm-forming (44%). Nonetheless, 20% of the strains exhibited biofilm formation, a proportion that significantly declined to 4% following irrigation ($p=0.03$). A similar pattern of biofilm production capability was demonstrated for CoNS: biofilm-forming isolates were more frequent before than after povidone-iodine irrigation (**Table II**), although the difference was not statistically significant.

About 3% of *C. acnes* strains were resistant to clindamycin, and most of these isolates were recovered before the povidone-iodine irrigation. *CoNS* were generally susceptible to antibiotics (55%), but, as depicted in **Figure 1**, a significant number of resistant isolates (45%) were identified. Antibiotic resistance rates did not show a significant change before and after irrigation.

DISCUSSION AND CONCLUSION:

Intraoperative irrigation with povidone-iodine is a safe and effective procedure that reduces the bacterial contamination rate in RTSA surgery. The irrigation significantly impairs the biofilm production capability of *C. acnes*, while it does not seem to play a role in antibiotic resistance. The time needed to obtain a positive culture appears to inversely correlate with the bacterial load. Even though *C. acnes* is less responsive than *CoNS* to irrigation, this strategy may decrease the risk of PJI.

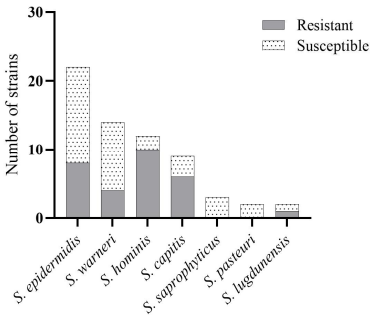

Table I. Effect of intraoperative povidone-iodine irrigation on *C. acnes* and CoNS positivity rates and bacterial loads, as colony-forming units (CFUs/ml).

	Microbial presence in intraoperative samples					
	Positive samples/total samples (%)			Mean CFUs/ml ± SEM		
	Preirrigation	Postirrigation	Fisher exact test	Preirrigation	Postirrigation	Paired T test
C. acnes						
Swabs	51/130 (39.23%)	30/130 (23.08%)	***p=0.0425***	$1.32*10^3 \pm 5.93*10^2$	$3.19*10^3 \pm 1.24*10^3$	***p=0.0335***
Periprosthetic tissue	27/65 (41.54%)	12/65 (18.46%)	***p=0.0436***	$9.63*10^2 \pm 3.49*10^2$	$1.92*10^3 \pm 7.83*10^2$	***p=0.0142***
CoNS						
Swabs	33/130 (25.38%)	9/130 (6.92%)	***p=0.0007***	48.39±16.03	2.93±2.12	***p=0.0016***
Periprosthetic tissue	19/65 (29.23%)	2/65 (3.08%)	***p=0.0004***	95.00±31.00	3.50±3.02	***p=0.0089***

Table II. Biofilm-forming capability

Strains		Pre-irrigation	Post-irrigation	Statistical analysis
C. acnes (n=120)	BF (n=29)	24 (20%)	5 (4%)	***p=0.03***
	NBF (n=91)	53 (44%)	38 (32%)	
CoNS (n=64)				
S. epidermidis (n=22)	BF (n=9)	7 (32%)	2 (9%)	N.S.
	NBF (n=13)	11 (50%)	2 (9%)	
S. warneri (n=14)	BF (n=2)	2 (14%)	0 (0%)	N.S.
	NBF (n=12)	10 (72%)	2 (14%)	
S. hominis (n=12)	BF (n=4)	4 (33%)	0 (0%)	N.S.
	NBF (n=8)	5 (42%)	3 (25%)	
S. capitis (n=9)	BF (n=5)	5 (56%)	0 (0%)	N.S.
	NBF (n=4)	3 (33%)	1 (11%)	
S. saprophyticus (n=3)	BF (n=1)	1 (33%)	0 (0%)	N.S.
	NBF (n=2)	2 (67%)	0 (0%)	
S. lugdunensis (n=2)	BF (n=2)	2 (100%)	0 (0%)	N.S.
	NBF (n=0)	0 (0%)	0 (0%)	
S. pasteuri (n=2)	BF (n=2)	1 (50%)	1 (50%)	N.S.
	NBF (n=0)	0 (0%)	0 (0%)	

BF: biofilm forming; NBF: biofilm not forming; N.S.: not significant