The Presence of Subcutaneous Gas on Postoperative Radiographs Following Total Shoulder Arthroplasty does not Influence Rates of Periprosthetic Joint Infection

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Background

- Periprosthetic joint infection (PJI) is a serious complication following total shoulder arthroplasty (TSA) with a high associated morbidity, including need for further surgery[1]
- Early diagnosis of shoulder PJI remains elusive, and many previously identified biomarkers have poor sensitivity and specificity.[2,3] Non-virulent organisms comprise a majority of shoulder PJIs, adding to the complexity of diagnosis[2,3]
- Radiographs are standard of care following TSA and are often the first imaging modality to assess for PJI
- Many patients have subcutaneous gas present on postoperative and follow up radiographs following TSA, the significance of which remains unknown, though the presence of which has raised concern for PJI
- The purpose of this study was to evaluate the significance of subcutaneous gas on postoperative radiographs following total shoulder arthroplasty and assess whether it is associated with the ultimate development of a periprosthetic joint infection

Methods

- Retrospective review of all TSA's performed at the University of Colorado between January 2010 and March 2020 (n = 624 patients)
- Inclusion criteria: all patients undergoing primary TSA with postoperative radiographs and clinic follow up (n = 582 patients), including all patients who developed an eventual PJI (n = 13 infections)
- Radiographs were evaluated by two musculoskeletal fellowship-trained radiologists with a Cohen's kappa test for interrater reliability.
- Demographic variables included in the analysis were gender, age, type of surgery (anatomic TSA (TSA) vs. reverse TSA (RTSA)), and previous ipsilateral shoulder surgery (yes vs. no)
- A logistic regression was performed to determine the effect of postoperative subcutaneous gas, and the overall time to resolution of subcutaneous gas, on infection rate
- A correlation was calculated between age and time to gas resolution, and t-tests were used to determine whether gender, type of surgery, and previous shoulder surgery presented any differences in time to gas resolution

Results

Table 1. Demographic Characteristics of Study Population

Patient Characteristics	Frequency (%)
Gender	
Female	287 (49.3)
Male	295 (50.7)
Age, y	
Mean (SD)	68.0 (9.9)
Surgery Type	
TSA	235 (40.4)
RTSA	347 (59.6)
Prior Ipsilateral Shoulder Surgery	
Yes	155 (26.6)
No	427 (73.4)
Periprosthetic Joint Infection	
Yes	13 (2.2)
No	569 (97.8)

Table 2. Rates of Periprosthetic Joint Infection Stratified by Subcutaneous Gas Status

	Immediate Postoperative Radiographs, N (%)			First Follow-Up Visit Radiographs, N (%)		
Periprosthetic Joint Infection	Gas Present (N= 576)	Gas Absent (N= 6)	P-value	Gas Present (N= 195)	Gas Absent (N= 377)	P-value
Yes	13 (2.3%)	0 (0.0%)	0.87	5 (2.6%)	8 (2.1%)	0.771
No	563 (97.7%)	6 (100%)		190 (97.4%)	369 (97.9%)	
Time between immediate postoperative and follow up radiograph, days (SD)				10.5 (2.91)	16.565 (23.41)	<0.0001

Overall Time to Gas Resolution, days		
Periprosthetic Joint Infection	Mean (SD)	P-value
Yes	34.38 (27.39)	0.421
No	41.54 (97.196)	

Discussion

- There was no association between the presence of subcutaneous gas on immediate postoperative or follow-up radiographs and development of an eventual PJI
- Time to gas resolution was also not associated with development of a PJI
- Patients undergoing reverse TSA had significantly higher presence of subcutaneous gas on follow-up radiographs and significantly longer time to resolution
- Only one known previous study in the orthopedic literature identified an association between presence of soft-tissue gas and development of PJI following total knee arthroplasty[4]

Conclusions/Limitations

- Limitations:
  - Differences in method and timing of radiographs- immediate versus follow-up have different number of image views, later follow-up demonstrated lower rates of subcutaneous gas
  - Relatively small sample size with overall low rate of PJI
- Given the high rate of postoperative subcutaneous gas, likely a normal postoperative finding
- Mere presence of subcutaneous gas has limited clinical utility at this time- no clear association with development of PJI
- However, if re-emergence of the subcutaneous gas is observed at long-term follow-up after initial resolution, investigation for PJI by a gas producing organism may be warranted. This was not evaluated in the current study.
- Future studies may attempt to better quantify the subcutaneous gas and improve standardization of postoperative imaging

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