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Case Series

Skin Flora Isolates in Organ-Space Surgical Site Infections After Hepatectomy: A Single-Center Retrospective Case Series

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Abstract

Background: The clinical relevance of skin flora isolates (e.g., Cutibacterium acnes, coagulase-negative staphylococci) in post-hepatectomy organ-space surgical site infections (SSIs) remains unclear.

Methods: A retrospective, observational analysis of a single-center database was conducted. We analysed patients developing organ-space SSIs following hepatectomy, stratifying them by microbiological culture results.

Results: Among 278 hepatectomies (140 open, 138 laparoscopic), 17 clinically and radiologically defined organ-space SSIs occurred. Of the 13 culture-positive SSIs, 7 (53.8%) yielded skin flora predominantly, while 6 (46.2%) yielded classical intra-abdominal or non-skin pathogens. Four cases were culture-negative. Skin flora SSIs presented later (median POD 12 vs POD 8) and were associated with longer prophylactic drain durations (7.5 vs 6.0 days). Skin flora SSIs occurred slightly more often following open surgery (5/140) compared to laparoscopic (2/138), though this remains a purely exploratory observation given the small sample size and potential confounders. Both skin flora and non-skin flora SSIs were managed successfully with percutaneous drainage and antibiotics, with 0% reoperation and 0% infection-related mortality in both subgroups.

Conclusions: Skin flora organisms frequently colonize or infect post-hepatectomy fluid collections. Given the uniformly high success rate of conservative management (drainage and antibiotics) in this cohort, these isolates might represent a distinct, less virulent clinical entity, though distinguishing true infection from drain contamination remains challenging. Prospective validation is required.

Keywords: Hepatectomy, Surgical site infection, Skin flora, Postoperative infection

Introduction

Post-hepatectomy organ-space surgical site infections (SSIs) pose a significant challenge, often necessitating prolonged antibiotic therapy and percutaneous drainage. While enteric flora and biliary pathogens are traditionally implicated, the recovery of skin flora such as Cutibacterium acnes and coagulase-negative staphylococci from these deep collections is increasingly recognized. However, whether these represent true pathogens, retrograde drain colonization, or specimen contamination remains intensely debated. This retrospective case series aims to describe the clinical characteristics and outcomes of post-hepatectomy organ-space SSIs, descriptively comparing those associated with skin flora against classical non-skin pathogens. [1-5]

Methods

Study Design and Ethics

This is a single-center, retrospective, observational cohort study. All data were extracted from the institutional clinical database and fully anonymized prior to analysis. Data was systematically extracted from the hospital's integrated digital medical records, laboratory databases, and verified surgical registries. The primary inclusion criterion was the development of a confirmed postoperative organ-space SSI within the target population. The study was approved by the Ethics Committee of the Saxon Physicians' Chamber. Because the study is purely observational, retrospective, and relies entirely on anonymized registry data patient informed consent was waived.

We conducted a single-center retrospective analysis of 278 consecutive patients who underwent elective liver resection between January 2020 and December 2025 at our institution. The cohort comprised 140 patients (50.4%) who underwent open laparotomy and 138 patients (49.6%) managed via laparoscopic resection. Standard institutional perioperative care dictated a single-shot intravenous aminopenicillin/beta-lactamase inhibitor combination (Ampicillin/Sulbactam 3g) administered within 60 minutes prior to skin incision. In patients with documented severe beta-lactam allergies, intravenous Clindamycin (600mg) was utilized as the prophylactic alternative. Non-suction abdominal drains were positioned at the operating surgeon's discretion, typically placed within the subhepatic space adjacent to the transection plane, and managed postoperatively according to daily fluid volume, color, and biochemical character (e.g. bilirubin levels).

Patient Selection and Microbiology

We included patients who underwent planed hepatectomy (open or laparoscopic) and subsequently developed an organ-space SSI meeting Centers for Disease Control and Prevention (CDC) criteria within 90 days postoperatively. Organ-space SSI was strictly defined according to the CDC guidelines as an infection occurring within 90 days post-surgery involving deep manipulated anatomical spaces, verified via cross-sectional computed tomography (CT). Crucially, all microbiological specimens were recovered exclusively via targeted sterile percutaneous needle aspiration of CT-confirmed deep abscesses, effectively distinguishing them from superficial or deep incisional wound infections. Samples were processed using standard aerobic and anaerobic transport media and incubation protocols (including extended anaerobic incubation for up to 14 days for C. acnes). Patients were stratified descriptively into three groups: Culture-Negative, Skin Flora (including C. acnes, coagulase-negative staphylococci, and S. aureus), and Non-Skin Flora (enteric/biliary pathogens).

Statistical Analysis

Due to the small number of events, the analysis is strictly descriptive. No formal statistical comparative tests were applied to avoid unsupported causal claims. Continuous variables are presented as medians, and categorical variables as frequencies.

Results

Among 278 hepatectomies (140 open, 138 laparoscopic), 17 patients developed a clinically and radiologically defined organ-space SSI. The overall incidence of organ-space SSI was 6.12% (17/278). Of these 17 cases, 4 cases were culture-negative (23.5%). These cases met full clinical and CT criteria for organ-space SSI but yielded sterile cultures, likely due to ongoing perioperative antibiotic coverage. Of the 13 culture-positive cases, 7 (53.8%) were categorized as skin flora infections, and 6 (46.2%) as non-skin flora infections. Integrated Clinical, Surgical, and Microbiological Profiles of Post-Hepatectomy Organ-Space SSIs are summarized in Table 1. Skin flora isolates were recovered from 5 patients following open hepatectomy and 2 following laparoscopic surgery. Both patients who had laparoscopic surgery underwent successful, uncomplicated laparoscopic resections but subsequently developed significant, high-volume postoperative ascites due to underlying parenchymal remodeling by cirrhosis. To manage the high fluid output, their abdominal subhepatic drains were maintained in situ for prolonged periods (>5 days). Clinically, skin flora and non-skin flora groups presented with elevated inflammatory markers (CRP and leukocytes) and clinical symptoms such as fever or abdominal discomfort, with detailed patient-level metrics provided in Table 2. The isolated skin flora species consisted of Cutibacterium acnes, Staphylococcus epidermidis, Staphylococcus aureus, Staphylococcus capitis, and Cutibacterium avidum.

The enteric group presented with Escherichia coli, Serratia marcescens, Enterococcus species, and mixed gastrointestinal flora. Both skin flora and non-skin flora infections were successfully managed with appropriate antibiotic therapy and percutaneous drainage. Notably, neither group required surgical re-exploration, and there was no infection-related mortality in either group.

Groups comparison:

A direct comparison of the data from Table 1 and Table 2 reveals distinct clinical profiles between the two primary subgroups:

- **Demographics and Comorbidities:** The Skin Flora group is older, with a median age of 73 years, compared to 68 years in the Non-Skin Flora group. Diabetes is notably more prevalent in the Non-Skin Flora cohort (50%) than in the Skin Flora cohort (14%).
- **Timeline and Drain Management:** Infections involving skin flora occur later in the postoperative course, diagnosed at a median of Postoperative Day (POD) 12, versus POD 8 for non-skin flora. This aligns with the observation that the Skin Flora group experienced a longer median postoperative drain duration (7.5 days) compared to the Non-Skin Flora group (6.0 days).
- **Clinical Severity and Systemic Response:** The Non-Skin Flora group exhibited a more severe systemic inflammatory response, with a higher median peak CRP (181.5 mg/L) compared to the Skin Flora group (122 mg/L). Clinically, 66.6% (4 of 6) of the Non-Skin Flora patients required ICU admission for septic shock, whereas 0% of the Skin Flora patients progressed to septic shock or required ICU admission.
- **Microbiology:** The Skin Flora isolates were predominantly Cutibacterium acnes and coagulase-negative staphylococci, whereas the Non-Skin Flora group yielded classic enteric and biliary pathogens such as E. coli and Enterococcus species.
- **Treatment Trajectory:** Despite the differing severity profiles, 100% of patients in both groups were successfully managed with definitive percutaneous drainage and targeted antibiotics, with no surgical re-operations required in either cohort.

Table 1. Integrated Clinical, Surgical, and Microbiological Profiles of Post-Hepatectomy Organ-Space SSIs.

Variable Category / Clinical Factor	Skin Flora Group (n = 7)	Non-Skin Flora Group (n = 6)	Culture-Negative Group (n = 4)
Primary Isolated Pathogens	C. acnes (4), S. epidermidis (2), S. aureus (1), S. capitis (1), C. avidum (1)	E. coli (1), S. marcescens (1), Enterococcus spp. (1), Mixed Enteric (3)	No bacterial growth / sterile cultures (4)
Surgical Approach (Open / Lap)	5 (71.4%) / 2 (28.6%)	4 (66.7%) / 2 (33.3%)	4 (100%) / 0 (0%)
Median Age (Years)	73	68	65
Male sex	6 (86%)	4 (67%)	1 (25%)
Diabetes	1 (14%)	3 (50%)	0 (0%)
Cirrhosis (n)	2	1	0

Table 1. Continued...

Malignant Indication (n, %)	7 (100%)	5 (83.3%)	4 (100%)
Major Resection (>3 segments)	4 (57.1%)	4 (66.7%)	3 (75.0%)
Biliary reconstruction (n)	0	0	0
Median Operative Time (Minutes)	245	268	290
Median Postoperative Drain Duration (Days)	7.5	6.0	5.5
Median Day of Infection Diagnosis	POD 12	POD 8	POD 9
Median Peak CRP at Diagnosis (mg/L)	122	181.5	98
Median Leukocytes at Diagnosis (Gpt/l)	11.99	12.58	11.1
Median Peak Quick Time at Diagnosis	69	82	72
Cholangitis at diagnosis (n)	1	2	0
Positive Blood Cultures (n)	1	2	0
Mean Abscess Size (cm)	9,8	6,9	6,1
CT-guided drain placement	7 (100%)	6 (100%)	4 (100%)
Persistent bile leak after CT-guided drain (n, %)	2 (29%)	2 (33%)	0
Median CT-guided Drain Duration (Days)	12	14.5	10
ERC with Stent (n) after CT-guided drain placement (n, %)	2 (29%)	2 (33%)	0 (0%)
Septic Shock / ICU Admission (n, %)	0 (0%)	4 (66.6%)	0 (0%)
Definitive Percutaneous Drainage (n, %)	7 (100%)	6 (100%)	4 (100%)
Surgical Re-operation Rate (%)	0%	0%	0%
Infection-Related Mortality (%)	0%	0%	0%
All-Cause Postoperative Mortality (n)	0	*1 (16.7% - Small-for-Size)	0
Median Length of Hospital Stay (Days)	19	22	17

*Mortality in the non-skin flora group was not directly attributed to the SSI in primary clinical records.

Table 2. Patient-Level Microbiology and Clinical Features (Culture-Positive SSIs)

Group	Microbiology Isolates	Clinical Symptoms	CRP (mg/L) / Trend	Leukocytes / Trend	Antibiotic Therapy
Skin Flora	S. epidermidis, C. avidum	None initially	89 / Regredient	5.19 / normal	Ampicillin/Sul bactam
Regredient	S. epidermidis, S. hominis	Fever	118 / progredient	Leukopenia	Linezolid
Skin Flora	Cutibacteriu m acnes	Fatigue, upper abdominal pain	135 / progredient	11.99 / progredient	Piperacillin/T azobactam
Skin Flora	Cutibacteriu m acnes	Pain, tension in abdomen	319 / progredient	17.0 / progredient	Piperacillin/T azobactam
Skin Flora	Cutibacteriu m acnes	Fever, chills	122 / progredient	7.2 / normal	Piperacillin/T azobactam
Skin Flora	Staphylococc us aureus	Fever, declining general status	196 / progredient	15.0 / progredient	Ceftriaxone / Metronidazol e
Skin Flora	S. capitis, C. acnes	Fever, declining general status	74 / progredient	12.0 / progredient	Piperacillin/T azobactam
Non-Skin Flora	Enterobacter cloacae	None initially	232 / progredient	9.5 / normal	Piperacillin/T azobactam
Non-Skin Flora	E. marmotae, R. ornithinolytic a, Bacteroides	Fever, right abdominal pain	124 / progredient	11.48 / progredient	Piperacillin/T azobactam
Non-Skin Flora	E. coli, K. pneumoniae	None initially	321 / progredient	4.07 / normal	Ampicillin/Sul bactam
Non-Skin Flora	Serratia marcescens	Fever	120 / regredient	14.45 / progredient	Piperacillin/T azobactam
Non-Skin Flora	E. faecalis, E. faecium	Liver failure symptoms	175 / progredient	27.0 / progredient	Piperacillin/T azobactam
Non-Skin Flora	E. faecalis, R. ornithinolytic a, Streptococcu s	Declining general status	188 / progredient	13.68 / progredient	Linezolid / Piperacillin/ Tazobactam

Discussion

This descriptive series highlights that skin flora can be frequently isolated from post-hepatectomy organ-space SSIs. While often dismissed as mere contamination, their association with symptomatic fluid collections and elevated inflammatory markers suggests they may act as opportunistic pathogens in the susceptible post-surgical bed. Crucially, because these bacteria were recovered via direct percutaneous needle aspiration from large, thick-walled, CT-verified fluid collections in symptomatic patients, they cannot be dismissed as mere superficial contaminants or technical artifacts of sampling. The presence of these isolates following open surgery and in patients with prolonged primary drainage raises the hypothesis of an ascending, retrograde infection pathway along drain tracts. In the 2 laparoscopic skin flora cases, both patients experienced a prolonged postoperative course complicated by high-volume sterile ascites, requiring drain retention in situ for over 5 days prior to the onset of infectious symptoms. This sequence is chronologically compatible with a retrograde ascending translocation mechanism along the drain tract, although a definitive causal relationship cannot be verified in this retrospective series. Clinically, skin commensals in the peritoneal cavity exhibit biological behavior that diverges sharply from classic enteric pathogens. While enteric organisms frequently trigger robust inflammatory responses and hemodynamic instability, isolates such as Cutibacterium acnes a slow-growing, obligate anaerobe tend to generate an indolent, low-toxicity fluid collection. These collections often present later in the postoperative period (median POD 12) and lack overt signs of systemic shock. Despite these pathophysiological differences, clinical trajectories were highly favorable across both groups. Skin flora and non-skin flora infections were safely and effectively managed with image-guided percutaneous drainage and tailored antimicrobial therapy. The single mortality in the non-skin flora group (16.7%) was confirmed to be a result of irreversible post-hepatectomy liver failure (small-for-size syndrome) rather than uncontrolled abdominal sepsis. [1-20]

Limitations

This study is severely limited by its retrospective, single-center design and the very small number of events (n=17). Consequently, we cannot definitively differentiate true infection from colonization. Prospective studies with standardized microbiological sampling are needed to validate these exploratory findings.

Conclusion

Recovery of skin commensals from deep intra-abdominal spaces following liver surgery represents a frequent descriptive entity, accounting for over 50% of culture-positive complications in this series. While these infections are numerically more frequent following open laparotomy and prolonged drainage, our low event count precludes multivariable models, meaning these findings remain strictly exploratory. Both skin flora and enteric cohorts demonstrated excellent outcomes via image-guided drainage and targeted antimicrobials, emphasizing that aggressive surgical re-exploration can be safely avoided in stable patients. Early drain removal policies advocated by Enhanced Recovery After Surgery (ERAS) protocols remain supported to limit potential retrograde colonization windows. The isolation of Cutibacterium and Staphylococcus species from deep intra-abdominal spaces following liver resection might represent a frequent and under-recognized clinical phenomenon Prospective, multicenter registries are required to definitively map confounding elements and optimize clinical management guidelines. Future studies are required to debate if these skin flora abscesses are a distinct entity following liver resections.

Conflict of Interest Statement

The authors declare no conflicts of interest associated with this manuscript.

Data Availability Statement

Data supporting the study findings are available from the corresponding author upon request.

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