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A case of surgical site infection in a recipient after transplantation of the kidney infected with Klebsiella pneumoniae

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Abstract

Background. *A surgical site infection caused by bacterial flora of a bacteria-contaminated kidney graft is an exceedingly rare occurrence and is poorly described in the literature. However, such cases entail the*

risk of resulting in a graft loss and recipient death, and therefore should be attended to by a specialized team of experts.

Objective. *This Case Report presents a rare instance of a surgical site infection in a kidney recipient following the transplantation of an unintentionally Klebsiella pneumoniae-infected graft.*

Material and methods. *The clinical case was a 49-year-old male suffering from stage 5 chronic kidney disease who underwent kidney transplantation from a cadaveric asystolic donor. The clinical case was described using the results of laboratory tests, instrumental and pathomorphologic investigations obtained from the recipient medical history and observation chart, and the organ donor's passport.*

Results. *This Case Report has described a clinical presentation of the surgical site infection with K. pneumoniae bacteria in a recipient of the infected kidney graft, and the treatment outcome.*

Conclusions. *In the event of infection developing in a bacteria-contaminated kidney graft, it is imperative to be suspicious of a deep infection. In the event of progressively developing abscesses, phlegmon in the graft bed and other related localizations, or the course of infection by the type of necrotizing cellulitis/fasciitis with no effect from antibacterial therapy, it is imperative to perform urgent surgical intervention with a wide opening of the foci and removal of the kidney graft as a source of the infectious process. This should be combined with an adequate antibacterial therapy and the withdrawal of immunosuppression.*

Keywords: surgical site infection, infectious complications after kidney transplantation, deep skin and soft tissue infections caused by *Klebsiella pneumoniae* bacteria

Conflict of interest. The authors declare no conflict of interest

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Abbreviations

ABT, antibacterial therapy
BP, blood pressure
CKD, chronic kidney disease
CVA, (acute) cerebrovascular accident
HR, heart rate
SSI, surgical site infection
HLA, human leukocyte antigen

Introduction

Transplantation of organs unintentionally contaminated with bacterial flora is rare and does not exceed 5-6% of cases of the total number of transplants [1]. Considering the preventive antibiotic therapy in posthumous organ donors and antibacterial prophylaxis in recipients, such cases do not affect the outcome of postoperative treatment, provided that the microorganisms are sensitive to the drugs used [2, 3]. The incidence of infectious complications due to transplantation of a graft contaminated with bacteria is about 1% [4, 5]. However, each such case poses a significant threat to the life of the recipient, which arises in association with the forced suppression of the immune system and the peculiarity of the microorganisms that are most often the causative agents of nosocomial infections resistant to most antibacterial drugs [1, 6–8]. Studies conducted to date have shown that surgical site infections (SSI) after organ transplantation prolong the recovery period and can lead to the graft function loss of and recipient's death [9, 10]. The incidence of SSI among solid organ recipients ranges from 2% to 46.2%, with the lowest

rates noted among kidney transplant recipients and the highest ones among the multiple graft recipients [11–14]. Thus, SSIs caused by deep penetration of the infectious agent into the recipient's body lead to extremely severe conditions and require a timely and aggressive surgical treatment, since a conservative treatment is ineffective in most cases and is characterized by a recurrent severe course with the development of abscesses, phlegmon, and necrosis. Cavity or deep layer infection is the infection that affects any part of the body, spreading deeper the fascial/muscular layers, which should be opened or manipulated at surgery. There are very few studies that cover this topic in relation with transplantation [15].

Complicated infectious processes in organ recipients are the causes of sepsis [16]. According to various data, mortality ranges from 24% [17–19] to 70% [20] in organ recipients with sepsis, and from 50% [17, 21] to 85% [20] in those with septic shock, which requires an effective treatment of SSI in the early stages of its development.

Objective. To demonstrate a rare case of surgical site infection in a kidney transplant recipient who was inadvertently infected with donor graft-derived Klebsiella pneumonia.

Material and methods

The patient and transplant data were obtained from the hospital medical records, observation chart, and donor organ passport. The clinical case was reported using the results of laboratory tests, instrumental and pathomorphological investigations.

In May 2017, a right kidney graft from a deceased donor was delivered for transplantation from the Organ Donation Center to the Kidney and Pancreas Transplantation Department. The donor was known

to be a 49-year-old man with a diagnosis of an acute cerebrovascular accident (CVA). According to the right kidney graft passport data, the donor biological death was stated in the hospital, i.e. the kidneys were removed in condition of asystole. A patient from the kidney transplant waiting list was urgently called having considered the blood type match and HLA antigen compatibility test results.

Case Report

Patient B., 49 years old, with the diagnosis: "Nephropathy of unknown etiology; chronic kidney disease (CKD) in end-stage 5; on renal replacement therapy with program hemodialysis since 2017. Nephrogenic anemia. Arterial hypertension, Grade 3 risk of cardiovascular complications Grade 4. Chronic viral hepatitis C.

From the medical history it was known that the patient had been hospitalized after a viral infection complicated by acute epididymo-orchitis; a hospital examination revealed an increased blood creatinine level and proteinuria. The patient received treatment and was discharged from hospital with recommendations for nephrologist's consultation, which the patient neglected. Six months later, the patient experienced an acute deterioration in his health, an increased blood pressure (BP) to 210/120 mm Hg, weakness, dizziness, headache. An ambulance team suspected CVA and delivered him to the hospital, where an examination revealed a significant excess of the blood creatinine range, and anemia; the patient was diagnosed with CKD, stage 5. The hypertensive crisis was controlled, CVA was not confirmed, and having a clinical presentation of uremic intoxication, the patient was transferred to the Nephrology Intensive Care Unit, where a hemodialysis treatment was started via a central venous catheter. After the patient's condition had been stabilized, an arteriovenous fistula was formed on the left forearm, through which

the hemodialysis treatment was later continued 3 times a week for 4-4.5 hours on an outpatient basis.

During the examination at the time of hospitalization, no contraindications to kidney transplantation were found in the patient. Visually, during the graft managing at the "back-table" stage, the organ was recognized as suitable for transplantation; the control tests of the perfusate from the transport package were taken for microbiological testing in a standard fashion.

The patient underwent kidney transplantation into the left iliac region using standard surgical technique. Graft cold ischemia time was 13 hours. The donor and recipient were incompatible for 3 HLA system antigens.

To prevent transplant rejection, the patient was administered a baseline immunosuppressive therapy: tacrolimus, mycophenolic acid, and methylprednisolone, as well as the induction therapy: intravenous basiliximab 20 mg intraoperatively and then on the 4th postoperative day, and intravenous methylprednisolone 500 mg intraoperatively and later on 250 mg intravenously on the first and second postoperative days. To prevent infectious complications, ceftriaxone was administered, according to the standard protocol, at a dose of 1 g intravenously 2 times a day daily from the time of surgery for 7 days and intravenous vancomycin 0.5 g as a single dose before surgery.

After the transplanted raft reperfusion, an immediate function was recorded. Daily diuresis was 2000–3000 ml per day with a rapid decrease in blood creatinine by 100–150 μmol per day. During 4 postoperative days, the clinical signs, laboratory tests results and instrumental examination data were consistent with a typical course for patients with immediate kidney graft function. Blood parameters and Doppler

ultrasound signs of the kidney graft were monitored daily, intrarenal blood flow parameters were recorded as satisfactory (Fig. 1).

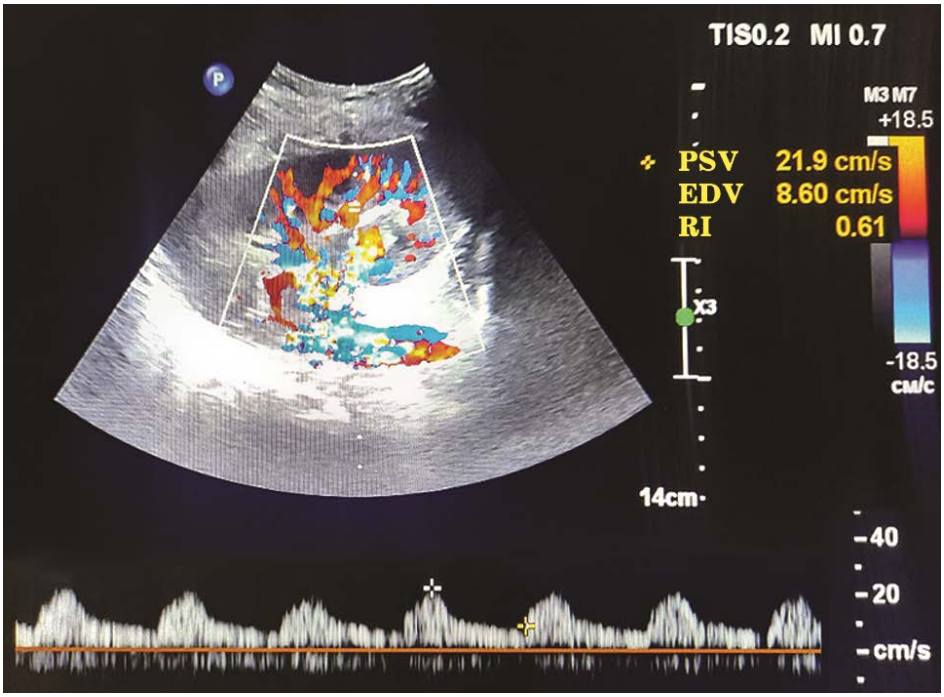

Fig. 1. Ultrasonogram of the kidney graft in the left iliac region of recipient B. shows satisfactory values of the resistive index of the segmental artery in the kidney graft

On the 4th postoperative day, the patient complained of pain in the upper third of the left hip and an increase in body temperature. On physical examination, the patient's condition was assessed as moderately severe, clear conscious, the body temperature was 37.5ºC, heart rate (HR) was 90 per minute, blood pressure was 140/80 mm Hg, the abdomen was soft and painless, the renal graft in the left iliac region was not enlarged, painless on palpation, the skin above it had minor traumatic hematomas caused by stretching of the soft tissues with a retractor during surgery. However, hemorrhagic rashes that had not been previously identified were detected on the skin in the left inguinal region and on the anterior surface of the left hip. Skin and soft tissue infection caused by surgical

intervention was suspected. The patient underwent an ultrasound examination of the soft tissues of the interested area and the graft, but no pathology was found. For diagnostic purposes, the rubber drains were placed along the suture, but no purulent discharge was obtained (Fig. 2).

Fig. 2. Photograph showing the body part in patient B:
A, postoperative suture in the left iliac region after kidney transplantation with the placed rubber drains. B, hemorrhagic rash (infectious exanthema) of the left inguinal region and the anterior surface of the left upper leg

Considering our experience with the cases of a rapid SSI development with an increased area of hemorrhagic rashes in the hip area on the side of the transplanted kidney, the development of phlegmon of the subcutaneous fat and cellular spaces, massive skin necrosis and sepsis during transplantation of a primarily infected kidney graft, patient B. was taken under careful dynamic monitoring. The obtained blood test results showed increasing leukocytosis of $14.04x10^9$/L with the leukocyte formula shift, and an increase in C-reactive protein to 126 mg/L. With those signs, the transplant function parameters were satisfactory: blood nitrogen continued to decrease dynamically; creatinine was 197 μmol/L,

urea 11.2 mmol/L. The second component of immunosuppression, mycophenolic acid, was discontinued; the antibacterial therapy (ABT) was converted from ceftriaxone to meropenem 500 mg at intravenous drip 3 times a day, the dose of vancomycin was selected individually in accordance with the calculation of creatinine clearance. By 12:00 o'clock of the same day, the result of a microbiological study of the kidney graft perfusate was obtained, where the *Klebsiella pneumonia* bacterial growth was detected with moderate sensitivity to carbapenems. However, the patient's condition showed negative dynamics over 6 hours of observation, with increasing symptoms of intoxication and progressive development of inflammatory infiltration of soft tissues at the level of the entire surface of the left hip, and an increased area of hemorrhagic rashes. The medical council made a decision to perform an immediate transplantectomy in order to save the patient's life, despite the adequately functioning transplanted kidney graft.

After the patient's consent for the operation had been obtained, the transplantectomy was performed. During the operation, 30 ml of turbid fluid was evacuated from the graft bed. Cultures were taken from the wound for the widest possible range of pathogens, including anaerobic infection, and the wound was cleansed: loose packing with gauze moistened in 3% hydrogen peroxide solution, with copious rinsing with an antiseptic solution with exposure, and installation of drainage tubes in the bed of the removed kidney graft and subcutaneous fat. The graft was sent for pathomorphological examination.

The immunosuppressive therapy was discontinued. ABT was adjusted. Due to the risk of anaerobic and gram-positive flora in the wound, vancomycin (500 mg 2 times a day) was administered and imipenem with cilastatin (500 mg 3 times a day) instead of meropenem as the best in terms of sensitivity in this case. Renal replacement therapy

with hemodialysis was resumed through an arteriovenous fistula of the left forearm on the 3rd day after the graft removal. For nutritional support, the patient was given amino acids for parenteral nutrition, and anti-ulcer, hypotensive and symptomatic therapies were also administered. According to the results of microbiological examination of the wound contents, the growth of *K. pneumonia* with sensitivity to imipenem was again detected. Previously prescribed ABT was continued with a decreased daily dose of vancomycin. Due to the absence of discharge through the drainage tubes placed in the bed of the removed graft, they were removed on the 4th postoperative day (on a dialysis-free day). The investigation of the bacteriology culture of the content from the distal part of the removed drainage tube showed no microbial growth.

During the control ultrasound examination of the removed kidney graft bed, no extra fluid or fluid collections were detected, the postoperative wound healed by primary intention. The histological examination of the removed kidney graft showed a perivascular infiltrate of the phlegmonous type at the border with the suture material, and the signs of interstitial nephritis were found in the graft itself.

The patient was discharged from hospital on day 14 after transplantectomy for outpatient hemodialysis treatment.

One year later, patient B. underwent a repeat kidney transplant without complications.

Discussion

The reported clinical case is rare due to the relatively low SSI incidence in kidney recipients, especially due to an infected graft. It was interesting that the initial local manifestations of the infectious process were in the form of hemorrhagic rashes: exanthema localized below the surgical intervention zone rather than in the form of edema and

hyperemia of soft tissues and later flow of pus through the rubber drains from the surgical wound. That was probably associated with hematogenous spread. Such rashes can be precursors of hemorrhagic infarction and skin necrosis due to disseminated intravascular coagulation [10]. Skin rashes caused by gram-negative bacteria, in particular *K. pneumonia,* have been described in newborns with septicemia in the form of maculopapular exanthema [22]; we have not encountered such a clinical signs in kidney recipients. SSIs caused by multidrug-resistant microbial flora significantly worsen the treatment prognosis [23] and can occur as necrotizing cellulitis, necrotizing fasciitis, or gas gangrene [24]. The results of a study conducted in Taiwan and published in 2023 showed that Gram-negative bacteria, including *K. pneumoniae*, were the cause of 40–50% of monomicrobial necrotizing fasciitis cases [25, 26] and are associated with a high risk of bacteremia and the threat of developing concomitant distant abscesses (via hematogenous spread), which can affect vital organs such as the central nervous system or eyes [25, 27]. Taking into account an elevated risk of SSI development associated with the multidrug-resistant pathogens in organ recipients, a perioperative antibiotic prophylaxis for recipients should be optimized for preventing and minimizing the risk of these infections, and should be personified, basing in individual cases on the infection/colonization history of the donor or recipient [28]. The complexity of the treatment lies in the need to balance the prevention or pathogen resistance development to antimicrobial drugs, on the one part, and high risk mortality in recipients associated with using improperly selected antibiotics, on the other part [29]. For the recent decades, the treatment outcomes in renal transplant recipients have improved, and complications, including surgical infection, have be seen less often than at in other abdominal organ transplants. Considering small amount of data, the treatment of SSI in kidney

recipients is based on the tactics used in general surgery in patients without immunosuppression. The principal guidelines for the treatment of renal and perirenal abscesses after kidney transplants include drainage and antibiotics administration, taking into account the sensitivity of the pathogenic microorganisms isolated in culture. Necessity of mandatory prevention of anaerobic infection in such cases remains indefinite. The duration of treatment should be individual, and, if necessary, transplantectomy may be required [30].

A timely detection of infections in the organ donor, the prevention, diagnosis, and treatment of infectious diseases in the recipient are the main factors influencing the transplantation results.

Conclusion

If a hemorrhagic rash is detected in the area of the postoperative wound and the hip area on the side of the kidney transplant, it is necessary to differentiate the diagnosis from infectious exanthema. In case the transplanted organ is contaminated with microbes, the developing infection is considered deep. In case of progressive development of abscesses and phlegmons in the graft bed and other associated locations or infection progression as necrotic cellulitis/fasciitis in terms of the lacking effect from antibacterial therapy, we consider it necessary to perform an urgent surgical intervention with wide opening of foci and removal of the kidney graft as a source of the infectious process in combination with adequate empirical antibacterial therapy with broad-spectrum agents as for an unknown pathogen and taking into account sensitivity as for a known microorganism together with complete withdrawal of immunosuppression, since the rapid generalization of the process is life-threatening for the recipient. Local treatment of the wound

should be pursued in accordance with the Russian National Guidelines for the treatment of surgical infections of the skin and soft tissues.

References

1. Ison MG, Nalesnik MA. An update on donor-derived disease transmission in organ transplantation. *Am J Transplant.* 2011;11(6):1123–1130. PMID: 21443676 https://doi.org/10.1111/j.1600-6143.2011.03493.x

2. Kovacs Jr CS, Koval CE, van Duin D, de Morais AG, Gonzalez BE, Avery RK, et al. Selecting suitable solid organ transplant donors: reducing the risk of donor-transmitted infections. *World J Transplant.* 2014;4(2):43–56. PMID: 25032095 https://doi.org/10.5500/wjt.v4.i2.43

3. Fischer SA, Lu K. AST Infectious Diseases Community of Practice. Screening of donor and recipient in solid organ transplantation. *Am J Transplant.* 2013;13(Suppl 4):9–21. PMID: 23464994 https://doi.org/10.1111/ajt.12094

4. TSANZ The Transplantation Society of Australia and New Zealand. *Clinical Guidelines for Organ Transplantation from Deceased Donors Version 1.11 – May 2023.* Available at: https://tsanz.com.au/storage/documents/TSANZ_Clinical_Guidelines_Version-111_13062023Final-Version.pdf [Accessed September 04, 2024]

5. Kaul DR, Vece G, Blumberg E, La Hoz RM, Ison MG, Green M, et al. Ten years of donor-derived disease: a report of the disease transmission advisory committee. *Am J Transplant.* 2021;21(2):689–702. PMID: 32627325 https://doi.org/10.1111/ajt.16178

6. Wendt JM, Kaul D, Limbago BM, Ramesh M, Cohle S, Denison AM, et al. Transmission of methicillin-resistant Staphylococcus aureus infection through solid organ transplantation: confirmation via whole genome sequencing. *Am J Transpl.* 2014;14(11):2633–2639 PMID: 25250717 https://doi.org/10.1111/ajt.12898

7. Anesi JA, Blumberg EA, Han JH, Lee DH, Clauss H, Climaco A, et al. Risk factors for multidrug-resistant orga-nisms among deceased organ donors. *Am J Transpl*. 2019;19(9):2468–2478. PMID: 31162785 https://doi.org/10.1111/ajt.15488

8. Watkins AC, Vedula GV, Horan J, Dellicarpini K, Pak SW, Daly T, et al. The deceased organ donor with an “open abdomen”: proceed with caution. *Transpl Infect Dis*. 2012;14(3):311–315. PMID: 22283979 https://doi.org/10.1111/j.1399-3062.2011.00712.x

9. Hellinger WC, Crook JE, Heckman MG, Diehl NN, Shalev JA, Zubair AC, et al. Surgical site infection after liver transplantation: risk factors and association with graft loss or death. *Transplantation*. 2009;87(9):1387–1393. PMID: 19424041 https://doi.org/10.1097/TP.0b013e3181a25133

10. Schreiber PW, Hoessly LD, Boggian K, Neofytos D, van Delden C, Egli A, et al. Surgical site infections after kidney transplantation are independently associated with graft loss. *Am J Transplant*. 2024;24(5):795–802. PMID: 38042413 https://doi.org/10.1016/j.ajt.2023.11.013

11. Capocasale E, De Vecchi E, Mazzoni MP, Dalla Valle R, Pellegrino C, Ferretti S, et al. Surgical site and early urinary tract infections in 1000 kidney transplants with antimicrobial periope-rative prophylaxis. *Transplant Proc*. 2014;46(10):3455–3458. PMID: 25498071 https://doi.org/10.1016/j.transproceed.2014.07.071

12. Perdiz LB, Furtado GH, Linhares MM, Gonzalez AM, Pestana JO, Medeiros EA. Incidence and risk factors for surgical site infection after simultaneous pancreas-kidney transplantation. *J Hosp Infect*. 2009;72(4):326–331. PMID: 19592136 https://doi.org/10.1016/j.jhin.2009.04.016

13. Carugati M, Arif S, Sudan DL, Collins BH, Haney JC, Schroder JN, et al. Epidemiology of surgical site infections after solid organ transplants in the period 2015–2019: a single-center retrospective cohort study. *Am J Transplant.* 2022;22(12):3021–3030. PMID: 36056456 https://doi.org/10.1111/ajt.17189

14. Wong RBK, Minkovich M, Famure O, Li Y, Lee JY, Selzner M, et al. Surgical site complications in kidney transplant recipients: incidence, risk factors and outcomes in the modern era. *Can J Surg.* 2021;64(6):E669–E676. PMID: 34933944 https://doi.org/10.1503/cjs.015820

15. Candel FJ, Grima E, Matesanz M, Cervera C, Soto G, Almela M, et al. Bacteremia and septic shock after solid-organ transplantation. *Transplant Proc.* 2005;37(9):4097–4099. PMID: 16386636 https://doi.org/10.1016/j.transproceed.2005.09.181

16. Fishman JA. Infection in organ transplantation. *Am J Transplant.* 2017;17(4):856–879. PMID: 28117944 https://doi.org/10.1111/ajt.14208

17. Moreno A, Cervera C, Gavaldá J, Rovira M, de la Cámara R, Jarque I, et al. Bloodstream infections among transplant recipients: results of a nationwide surveillance in Spain. *Am J Transplant.* 2007;7(11):2579–2586. PMID: 17868067 https://doi.org/10.1111/j.1600-6143.2007.01964.x

18. Camargo LF, Marra AR, Pignatari AC, Sukiennik T, Behar PP, Medeiros EA, et al. Nosocomial bloodstream infections in a nationwide study: comparison between solid organ transplant patients and the general population. *Transpl Infect Dis.* 2015;17(2):308–313. PMID: 25726707 https://doi.org/10.1111/tid.12356

19. Silva M Jr, Marra AR, Pereira CA, Medina-Pestana JO, Camargo LF. Bloodstream infection after kidney transplantation:

epidemiology, microbiology, associated risk factors, and outcome. *Transplantation.* 2010;90(5):581–587. PMID: 20585281 https://doi.org/10.1097/TP.0b013e3181e8a680

20. Schachtner T, Stein M, Reinke P. Sepsis after renal transplantation: clinical, immunological, and microbiological risk factors. *Transpl Infect Dis.* 2017;19(3). PMID: 28296035 https://doi.org/10.1111/tid.12695

21. Abbo LM, Grossi PA. AST ID Community of Practice. Surgical site infections: guidelines from the American Society of Transplantation Infectious Diseases Community of Practice. *Clin Transplant.* 2019;33(9):e13589. PMID: 31077619 https://doi.org/10.1111/ctr.13589

22. Drago F, Ciccarese G, Gasparini G, Cogorno L, Javor S, Toniolo A, et al. Contemporary infectious exanthems: an update. *Future Microbiol.* 2017;12:171–193. PMID: 27838923 https://doi.org/10.2217/fmb-2016-0147

23. Casacci M, Carpentier O, Truffert P, Piette F, Catteau B. Neonatal maculopapular exanthema revealing septicemia due to Klebsiella pneumoniae via maternofetal infection. *Ann Dermatol Venereol.* 2006;133(1):31–33. PMID: 16495848 https://doi.org/10.1016/s0151-9638(06)70839-0

24. Cheng NC, Cheng Y, Tai HC, Chien KL, Wang SH, Chen YH, et al. High mortality risk of type III monomicrobial gram-negative necroti-zing fasciitis: the role of extraintestinal pathogenic Escherichia coli (ExPEC) and Klebsiella pneumoniae. *Int J Infect Dis.* 2023;132:64–71. PMID: 37059297 https://doi.org/10.1016/j.ijid.2023.04.390

25. DiNubile MJ, Lipsky BA. Complicated infections of skin and skin structures: when the infection is more than skin deep. *J Antimicrob*

Chemother. 2004;53 Suppl 2:ii37-50. PMID: 15150182 https://doi.org/10.1093/jac/dkh202

26. Cheng NC, Yu YC, Tai HC, Hsueh PR, Chang SC, Lai SY, et al. Recent trend of necrotizing fasciitis in Taiwan: focus on monomicrobial Klebsiella pneumoniae necrotizing fasciitis. *Clin Infect Dis.* 2012;55(7):930–939. PMID: 22715175 https://doi.org/10.1093/cid/cis565

27. Bair MJ, Chi H, Wang WS, Hsiao YC, Chiang RA, Chang KY. Necrotizing fasciitis in southeast Taiwan: clinical features, microbiology, and prognosis. *Int J Infect Dis.* 2009;13(2):255–260. PMID: 18922719 https://doi.org/10.1016/j.ijid.2008.04.015

28. Fang CT, Lai SY, Yi WC, Hsueh PR, Liu KL, Chang SC. Klebsiella pneumoniae genotype K1: an emerging pathogen that causes septic ocular or central nervous system complications from pyogenic liver abscess. *Clin Infect Dis.* 2007;45(3):284–293. PMID: 17599305 https://doi.org/10.1086/519262

29. Haidar G, Green M; American Society of Transplantation Infectious Diseases Community of Practice. Intra-abdominal infections in solid organ transplant recipients: guidelines from the American Society of Transplantation Infectious Diseases Community of Practice. *Clin Transplant.* 2019;33(9):e13595. PMID: 31102546 https://doi.org/10.1111/ctr.13595

30. Tamma PD, Han JH, Rock C, Harris AD, Lautenbach E, Hsu AJ, et al. Carbapenem therapy is associated with improved survival compared with piperacillin-tazobactam for patients with extended-spectrum beta-lactamase bacteremia. *Clin Infect Dis.* 2015;60(9):1319–1325. PMID: 25586681 https://doi.org/10.1093/cid/civ003

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