

Kluyvera Species Soft Tissue Infection: Case Report and Review

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A soft tissue infection caused by *Kluyvera* species in a previously healthy woman is described. Successful treatment required incision and drainage of the wound in addition to administration of antibiotics. *Kluyvera* species are indole positive, Voges-Proskauer negative members of the family *Enterobacteriaceae*. Previous reports of infection due to *Kluyvera* species suggest that the organism is never more than an opportunistic pathogen; however, we report the first case of infection in a previously healthy host.

The genus *Kluyvera* is a new genus of motile, oxidase-negative, gram-negative rods which produce indole and fail to produce acetoin (6). These features are shared with certain other members of the family *Enterobacteriaceae*, i.e., *Citrobacter* spp., *Enterobacter agglomerans*, and *Escherichia coli*. Distinctive characteristics of *Kluyvera* species that help differentiate them from other indole-positive, Voges-Proskauer-negative members of the *Enterobacteriaceae* are the ability to utilize malonate and citrate and the ability to decarboxylate ornithine (in Moeller medium). In addition, these organisms are raffinose positive (6). The organism has been found in water, soil, sewage, and hospital environments and isolated from clinical specimens of urine, stool, sputum, throat, and blood (6). We report the first case, to our knowledge, of a wound infection and subcutaneous abscess due to *Kluyvera* species and review the literature concerning this organism.

Case report. A 37-year-old female was admitted to the hospital with an infected wound in the right forearm. Twelve days before admission, she cut her forearm while attempting to retrieve a wooden spoon from a garbage can. The cut was produced with the lid of an open can which had been in the garbage for several days. She was seen in the emergency department, the laceration was cleaned and sutured, and the patient was discharged. Her course was unremarkable until 8 days later when the wound became painful, red, and indurated. She was started on oral erythromycin without improvement, at which time she was referred to a surgeon.

Her medical history was unremarkable. Physical examination revealed a slightly obese female in no acute distress. On admission, temperature was 37°C and pulse was 68 per min. Her right forearm revealed a healing laceration on the ventral aspect with a 4- to 5-cm area of erythema, induration, and swelling around the incision, with lymphangitic streaking up to the axilla. No lymph nodes were palpable, and the remainder of the physical examination was normal. The leukocyte count was 9,200/mm³ with 61% polymorphonuclear neutrophils, 33% lymphocytes, and 6% bands. Radiographs of the right forearm revealed soft tissue swelling and air in the tissues, suggesting the presence of a gas-producing organism. Blood cultures were not obtained. The patient was started on cefoperazone, 1 g intravenously every 12 h. In the operating room, 10 to 15 ml of green purulent material was drained from the right forearm and cultured both aerobically and anaerobically. (The specimen was transported in anaer-

obic transport medium and cultured by using the Ana-pak System [Scott Laboratories, Fiskville, R.I.]) The abscess appeared to be limited to the muscle fascia without deep subfascial abscess compartments or tracts. A Penrose drain was placed in the wound, which was then packed. Consultation with an infectious diseases specialist was obtained at this point.

Initial Gram stain of the pus obtained during surgery revealed a few polymorphonuclear leukocytes and rare gram-negative rods. Aerobic cultures of the wound, taken on the day of admission (before surgery), revealed moderate growth of *Kluyvera* species and a few *Bacillus* species. Anaerobic cultures revealed no growth. Aerobic cultures at the time of surgery revealed moderate growth of both *Staphylococcus epidermidis* and *Kluyvera* species. The specimen was plated on both 5% sheep blood agar and Levine eosin-methylene blue agar but grew best on the sheep blood agar. *Kluyvera* species were identified by routine biochemical assay with the AutoMicrobic system (Vitek Systems, Inc., Hazelwood, Mo.). The organism was shown to be oxidase negative. Other reactions demonstrated included hydrolysis of esculin and *o*-nitrophenol- β -D-galactopyranoside; oxidation of glucose, lactose, maltose, mannitol, and xylose; fermentation of raffinose, rhamnose, L-arabinose, and glucose; decarboxylation of ornithine; utilization of malonate and citrate; positive plant indican reaction; and negative urease and tryptophan deaminase. Antimicrobial susceptibility was tested by using the AutoMicrobic system as follows: the growth rate of the organism in the presence of a particular antimicrobial agent was compared with the growth rate in a positive control well, and double nonlinear regression analysis was used to determine the MIC. Susceptibility to all broad-spectrum cephalosporins, aminoglycosides, aztreonam, trimethoprim-sulfamethoxazole, and imipenem was noted.

Cefoperazone was continued for 5 days postoperatively and then changed to oral trimethoprim-sulfamethoxazole. The patient became afebrile 48 h after the drainage procedure. The Penrose drain was removed on postoperative day 5, but on the same day, another small area around the incision was noted to be swollen and fluctuant. This was drained at the bedside; both aerobic and anaerobic cultures showed no growth. The patient was discharged on hospital day 11 on oral trimethoprim-sulfamethoxazole and had no further problems.

Discussion. In 1936, A. J. Kluyver and C. B. Van Niel (7) postulated that there may be a group of polarly flagellated organisms in the tribe *Pseudomonadeae* which have a

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mixed-acid type of fermentation similar to that of the genus *Escherichia*. Asai and Okumura (2) in 1956 described five such polarly flagellated organisms and proposed the genus name *Kluyvera* in honor of A. J. Kluyver (2, 3). However, Asai et al. (1) in 1962 established that their *Kluyvera* strains had peritrichous rather than polar flagella and proposed that the genus *Kluyvera* be transferred to the genus *Escherichia*. Farmer et al. (6) in 1981 repropoed the genus name *Kluyvera* for a group of organisms previously referred to as enteric group 8. These organisms were gram-negative, oxidase-negative, fermentative bacteria which were similar to, but did not fit, the defined species in the family *Enterobacteriaceae* and were therefore given the vernacular name enteric group 8. It was found, however, that the enteric group 8 organisms were biochemically identical to the genus *Kluyvera* described earlier by Asai and Okumura (2, 3).

Organisms of the genus *Kluyvera* are of two known species, *Kluyvera cryocrescens* and *Kluyvera ascorbata*. The former is able to ferment D-glucose after 21 days at 5°C but gives a negative result in the ascorbate test, whereas the latter species gives the converse reactions in these tests. A third group in addition to *K. ascorbata* and *K. cryocrescens* was delineated by DNA homology studies by Farmer et al. (6) and was designated *Kluyvera* species group 3 until more strains become available for further study.

A search of the literature documents only a few clinical syndromes of *Kluyvera* infection. Wong (8) described *K. cryocrescens* bacteremia in a 17-month-old male with a congenital heart defect; a Broviac catheter was implicated as the site of infection. The organism was isolated in pure culture from two blood cultures drawn through the Broviac catheter. The patient was treated with ampicillin and gentamicin. *Kluyvera* spp. could not be isolated from repeat blood cultures taken 3 days later, although *Candida albicans* was recovered. The patient subsequently died; no evidence of disseminated bacterial or candidal infection was noted at postmortem.

Fainstein et al. (5) described five patients, four with underlying malignancy, with mild to severe diarrhea in whom *Kluyvera* species were isolated from stool specimens. Symptomatic treatment alone was successful. *Kluyvera* species were isolated from stool specimens from five additional asymptomatic cancer patients; clearance of the organism was noted over a 3- to 11-day period.

Schwach (Clin. Microbiol. Newsl. 1:4-5, 1979) reported three isolates from the upper respiratory tract which were identified as *K. ascorbata* but not considered to be clinically significant. Braunstein and co-workers (4) reported *Kluyvera* colonization of the sputum of a 6-year-old male with pulmonary tuberculosis. They also reported isolation of *Kluyvera* species from gallbladder fluid from a 63-year-old female with acute pancreatitis; this was considered clinically significant. Aevaliotis et al. (Clin. Microbiol. Newsl. 7:51, 1985) re-

ported a case of a previously healthy 3-week-old Brazilian girl (adopted by a Belgian couple) who developed profuse diarrhea. The stool specimen revealed a heavy growth of *K. ascorbata*. The baby was treated symptomatically and recovered.

Kluyvera species are susceptible to many antibiotics in common use against infection by gram-negative strains (6); 100% of strains tested by Farmer et al. were gentamicin susceptible (MIC for 90% of the strains of 0.5 µg/ml). Most strains were ampicillin, cephalothin, and carbenicillin resistant. Interestingly, the size of the zone of complete inhibition around carbenicillin and cephalothin has been shown by Farmer et al. (6) to be useful in differentiating *K. ascorbata* and *K. cryocrescens*: *K. ascorbata* usually has a smaller zone of inhibition than *K. cryocrescens*. Systematic studies of susceptibility of *Kluyvera* species to newer cephalosporins, monobactams, quinolones, ureidopenicillins, and carbipenems have not been done. Wong (8) used gentamicin and ampicillin to treat bacteremia, while Fainstein et al. (5) successfully used trimethoprim-sulfamethoxazole in the treatment of diarrhea. Our patient was treated initially with cefoperazone and switched to trimethoprim-sulfamethoxazole after incision and drainage of the forearm.

Kluyvera species appear capable of causing serious infection; the compromised host is most often affected. Infection in the healthy host is rare and is usually manifested as diarrhea. Serious soft tissue infection, as occurred in our patient, can occur after breach of the normal cutaneous barrier.

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