# Hafnia Alvei Urinary Tract Infection

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## ABSTRACT:

**BACKGROUND:**

The genus Hafnia , a member of the family Enterobacteriaceae, consists of Gram negative bacteria that are occasionally implicated in both intestinal and extraintestinal infections in human. This genus contains only a single species (Hafnia alvei).

**METHODS:**

The above bacterium was identified from 250 bacterial strains which were isolated from 220 urine samples of patients with urinary tract infection.

**RESULTS:**

One H. alvei strain was isolated from an elderly patient, and identified by conventional biochemical tests and API20E system at the first time in Iraq. Antimicrobial susceptibility test showed that this strain is sensitive to Cefotaxime, Ciprofluxacine, Chloramphenicol, Doxycycline and Trimethoprim-sulfamethaxzole, while it is resistant to Penicillin, Oxacillin and Amoxicillin plus clavulanic acid.

**CONCLUSION:**

H. alvei an important uropathogen that causing urinary tract infection in elderly and may be in immunocompromised patients.


***KEY WARDS:*** Hafnia alvei, urinary tract infections

## INTRODUCTION:

The genus Hafnia is one of more than 40 genera that currently comprise the family Enterobacteriaceae. Møller originally described this genus in 1954 and he suggested Hafnia alvei as the name of the species [1]. The specific epithet in the name H. alvei is derived from the Latin noun alveus meaning beehive, with "alvi" meaning "of a beehive" because these bacteria had something to do with bees or beehives although they did not[2].However, H. alvei has been recovered on occasion from the intestines of honeybees as well as from honey[3]. The genus name Hafnia is the historical name (Havn) for the city of Copenhagen, Denmark [4].

Most standard microbiology texts list mammals, birds, reptiles, fish, soil, water, sewage and foods as sources from which hafniae can be recovered(5,6). Food products commonly yield hafniae, meat, pork products, milk and milk products and freshwater fish, harbor H. alvei [7, 8, 9].

Over the past quarter of a century, there have been few studies that have systemically looked at the role of these bacteria [10]. There are two well-described outbreaks of H. alvei infection associated with the poultry industry [11, 12]. This bacterium is an uncommon human pathogen but it causes nosocomial and community-acquired infections [13]. Morever, H. alvei recovered from oropharyngeal specimens, from the gastrointestinal tract, less often from blood and variety of other anatomic sites, including tissue, urine and catheters [14, 15]. H. alvei can cause infection via a nosocomial route [15] associated with gasterointestinal disease [16], illnesses associated with wounds/abscesses, respiratory tact infections, including pneumonia [17], broncopneumonia [15], hepatic abscess, cholecystitis [18, 19], muscle abscess [20], septic arthritis [21], cervicovaginitis [22],and bacteremia seeded from the genitourinary tract [23] with majority cases occur in males (71%).

H. alvei have been isolated from community-acquired urinary tract infection and hemolytic uremic syndrome cases [24, 25], also from hospital-acquired urinary tract case in intensive care unit (10). This bacterium causes urinary tract infection and sepsis in infants [26]. A laboratory surveillance study showed that the most common focus of H. alvei isolation as nosocomial infection was urinary tract infection (81% of H. alvei) [27].

There is only a limited number of data presently available on disease states associated with this bacterium, so the aim of this study focused on isolation of H. alvei from urine samples. Very little is known about these organisms in regard to the role(s) they may play as human pathogens in general or urinary tract pathogens in specific.

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## PATIENTS AND METHODS:

### PATIENTS:

This study included 220 patients suffering from urinary tract infection (200 hospitalized patients and 20 outpatients, comprises all age groups and both gender) admitted to Al-Kindy Teaching Hospital, during 2 years (between January 2004 and December 2006).

**Urine Samples:** A mid-stream urine sample was collected from all patients and cultured on blood and MacConkey's agar plates for 24-48 hours at 37C°.

**Conventional Biochemical Tests:** All bacterial isolates were examined morphologically by Gram's stain and subjected to by some biochemical testes including: oxidase test, catalase test, IMVC tests, gas and $H_2S$ production, motility test, urease test, gelatinase test and the ability to grow in KCN (28, 29).

**API20E System:** The bacterial isolates suspected as Hafnia according to conventional biochemical tests results were re-examined by API20E system (BioMerieux Vitek, Inc.).

**Antibiotic Susceptibility Test:** H. alvei antimicrobial susceptibility was tested against the following antibiotics: Penicillin (10µg), Oxacillin (1µg), Amoxicllin plus clavulanic acid (20/10µg), Chloramphenicol (30 µg), Trimethoprim-sulfamethaxozole (5µg), Ciprofloxacine (5µg), Doxycycline (30µg), and Cefotaxime (30µg)(28,29, 30).

## RESULTES AND DISCUSION:

A total of250 bacterial isolates recorded from 220 urinary tract infected patients. The suspected Hafnia isolates according to the colony morphology on blood and MacConky's agars, Gram's stain and the results of conventional tests (Table-1), were also examined by API20E system. The colony morphology of **H. alvei** on MacConky's agar appears as large, smooth, convex, either pink or translucent colony of 2-3 mm in diameter with an entire edge (31, 32). H. alvei are Gram negative rods when stained by Gram' stain and examined under light microscope.

**Table-1: Conventional biochemical tests results of H. alvei suspected strains.**

| Tests | Results |
|---|---|
| Lactose fermentation | - or+ |
| Oxidase | - |
| Catalase | + |
| Motility | + |
| Indole | - |
| Citrate utilization | - or+ |
| Methyl red | - or+ |
| Vogus Proskuar | - or+ |
| Acid/Gas from glucose | +/- or +/+ |
| Urease | - |
| Gelatinase | - |
| Growth in KCN | + |
| $H_2S$ in TSI | - |

The resultes revealed in Table-1 showed that there is general agreement with the previous studies. The genus Hafnia consists of strains that conform to general characteristics, being Gram-negative, peritrichously flagellated rods that are oxidase negative, catalase positive and nonsporulating. They are facultatively anaerobes, producing acid with or without gas from the metabolism of D-glucose, indole negative, most strain are VogusProskaur test positive, methyl red positive, while invariably $H_2S$ negative in TSI, and are motile (5).

After examining suspected Hafnia isolates by API20E system only one bacterial isolate originally identified as H. alvei showed pattern results revealed in Table-2. There was an agreement between conventional biochemical tests and API20E system results, and recorded character trails in Bergey's Manual of Systematic Bacteriology (4).

**Table-2: API20E system results of H. alvei strain isolated from urinary tract infected patient.**

| Tests | Results | Tests | Results |
|---|---|---|---|
| ONPG | + | MAN | + |
| ADH | - | INO | - |
| LDC | + | SOR | - |
| ODC | + | RHA | - |
| CIT | - | SAC | - |
| $H_2S$ | - | MEL | - |
| URE | - | AMY | - |
| TDA | - | ARA | + |
| IND | - | OX | - |
| VP | - | $NO_3$-$NO_2$ | + |
| GEL | - | MOB | + |
| GLU | + | McC | + |
| | | OF-F | + |
| | | OF-O | + |

H. alvei strain obtained in this study, was isolated from urine sample of a 60-year old man suffering urinary tract infection, the above isolate gave heavy and pure growth on MacConky's agar and this finding agree with previous study showed that H. alvei can be isolated from urine of a community-based patient and elderly are at highest risk [27].

The antimicrobial susceptibility test results of H. alvei isolated strain are presented in Table(3), showed that this bacterium was sensitive to Cefotaxime, Ciprofloxacine, Chloramphenicol, Doxycycline and Trimethoprim-sulfamethaxzole, while it is resistant to Penicillin, Oxacillin and Amoxicillin plus clavulanic acid. Many studies on H. alvei antimicrobial susceptibility showed the same results obtained in this investigation [10, 27, 33]. The resistance of H. alvei may be due to the producing ß-lactamases, so that this bacterium is resistant to some Penicillins [34, 35, 36].

**Table-3: Antimicrobial susceptibility tests results of H. alvei strain isolated from urine of patient with urinary tract infection, R: Resistant; S: Sensitive.**

| Antibiotics | Results |
|---|---|
| Cefotaxime(30µg ) | S |
| Ciprofloxacine(5µg) | S |
| Chloramphenicol(30µg) | S |
| Doxycycline(30µg) | S |
| Trimethoprim-sulfomethaxzole(5µg) | S |
| Penicillin(10µg) | R |
| Oxacillin(1µg) | R |
| Amoxicillin plus Clavulanic acid(20/10µg) | R |

## CONCLUSION:

The present investigation recorded and for the first trial the isolation and identification of H. alvei from urinary tract infection in Iraq. The possibility of an extraintestinal invasive infection such as urinary tract infections, bacteremia or pneumonia caused by H. alvei should be taken into account in elderly, immunocompromized patients and even infants. There are many unanswered questions regarding this genus. Clearly, the most important issue concerns the frequency and type of human infections associated with H. alvei.

H. alvei is usually considered as moderately or nonpathogenic for humans. However, recent descriptions of sever community or nosocomial infections due to H. alvei have challenged this belief. The actual role of H. alvei in human disease remains to be defined.

## REFERENCES:


1. Møller, V. 1954. Distribution of amino acid decarboxylases in Enterobacteriaceae. Acta Pathol. Microbiol. Scand. 35:259-277. (Medline)
2. Ewing, W. H. 1986. Identification of Enterobacteriaceae. Elsevier, New York, N.Y.
3. Salimov, R. M. 1978. Study of the Hafnia isolated from honey. Veterinariia 1978(April):44-46. (In Russian/Abstract.)
4. Sakazaki, R. 1984. Hafnia, p. 484-486. In N. R. Krieg, and J. G. Holt (ed.), Bergey's manual of systematic bacteriology, vol. 1. Williams & Wilkins, Baltimore, Md.
5. Farmer, J. J., III. 2003. Enterobacteriaceae: introduction and identification, p. 636-653. In P. R. Murray, E. J. Baron, J. H. Jorgensen, M. A. Pfaller, and R. H. Tolken (ed.), Manual of clinical microbiology, 8th ed. ASM Press, Washington, D.C.
6. Farmer, J. J., III, B. R. Davis, F. W. Hickman-Brenner, et al . 1985. Biochemical identification of new species and biogroups of Enterobacteriaceae isolated from clinical specimens. J. Clin. Microbiol. 21:46-76.
7. Gamage, S. D., J. B. Luchansky, and S. C. Ingram. 1998. Pulsed-field gel electrophoresis typing of Hafnia alvei isolated from chub-packed and retail ground beef. Lett. Appl. Microbiol. 26:105-109.
8. Lindberg, A.-M., Å. Ljungh, S. Ahrné, et al . 1998. Enterobacteriaceae found in high numbers in fish, minced meat and pasteurized milk or cream and the presence of toxin encoding genes. Int. J. Food Microbiol. 39:11-17.
9. Ridell, J., and H. Korkeala. 1997. Minimum growth temperatures of Hafnia alvei and other Enterobacteriaceae isolated from refrigerated meat determined with a temperature gradient incubator. Int. J. Food Microbiol. 35:287-292.
10. Janda, J. M., and S. L. Abbott. 2006. The genus Hafnia: from soup to nuts. Clin. Microbiol. Rev. 19:12-18.
11. Proietti, P. C., F. Passamonti, M. P. Franciosini, et al . 2004. Hafnia alvei infection in pullets in Italy. Avian Pathol. 33:200-204.
12. Real, F., A. Fernández, F. Acosta, et al .1997. Septicemia associated with Hafnia alvei in laying hens. Avian Dis. 41:741-747.
13. Günthard, H., and A. Pennekamp. 1996. Clinical significance of extraintestinal Hafnia alvei isolates from 61 patients and review of the literature. Clin. Infect. Dis. 22:1040-1045.
14. Washington, J. A., II, R. J. Birk, and R. E. Ritts, Jr. 1971. Bacteriologic and epidemiologic characteristics of Enterobacter hafniae and Enterobacter liquefaciens. J. Infect. Dis. 124:379-386.
15. Ratnam, S., R. W. Butler, S. March,et al . 1979. Enterobacter hafniae—Newfoundland. Can. Dis. Wkly. Rep. 5:231-232.
16. Redonodo, J., E. Maseda, A. Riquelme, et al. 2005. Hafnia alvei in a rare case of severe pneumonia in a postanesthesia recovery unit. Rev. Esp. Anestesiol. Reanim. 52:359-62. (Abstract.)
17. Barry, J. W., E. A. Dominguez, D. J. Boken, et al . 1997. Hafnia alvei infection after liver transplantation. Clin. Infect. Dis. 24:1263-1264.
18. Wiström, J., T. Myrnäs, C. Lundgrren, et al . 1998. A case of acute cholecystitis due to Aeromonas sobria and Hafnia alvei from northern Europe. Clin. Microbiol. Infect. 4:607-609.
19. Pulcini, C., S. Roth, E. Bernard, et al . 2003. Hafnia alvei bacteremia with liver and muscle abscess: a case report. Presse. Med. 32:1026-7. (In French/Abstract).
20. Lutz, B., R. Ratard, D. Dodson, et al . 2001. Septic arthritis following anterior cruciate ligament reconstruction using tendon allografts—Florida and Louisiana, 2000. Morb. Mortal. Wkly. Rep. 50:1081-1083.
21. Ozturk, C. E., I. Ozdemir, T. Yavuz,et al . 2006. Etiologic agents of cervcovaginitis in Turkish women. Saudi Med. J. 27:1503-7.

**22.** Englund, G. W. 1969. Persistent septicemia due to Hafnia alvei. Am. J. Clin. Pathol. 51:717-719.

**23.** Andronova, N. I. 1978. Characteristics of the enterobacteria strains isplated from the urine in urinary tract infections. Zh. Mikrobiol. Epidemiol. Immunobiol. 12:55-9. (In Russian/Abstract).

**24.** Crandall, C., S. L. Abbott, Y. Q. Zhao,et al . 2006. Isolation of toxigenic Hafnia alvei from a probable case of hemolytic uremic syndrome. Infection. 34:227-9.

**25.** Liu, C. H., W. J. Lin, C. C. Wang, et al . Young-infant sepsis combined with urinary tract infection due to Hafnia alvei. J. Formos. Med. Assoc. 106(3Suppl):S39-43.

**26.** Laupland, K. B., D. L. Church, T. Ross, et al .2006. Population-based laboratory surveillance of Hafnia alvei isolation in a Canadian health region. Ann. Clin. Microbiol. Antimicrob.18:12.

**27.** Clinical and Laboratory Standards Institute. 2006. Performance standards for antimicrobial disk susceptibility tests. Approved standard, 9th ed. Performance standards for antimicrobial susceptibility testing; 16th informational supplement, 7th ed. Clinical and Laboratory Standards Institute, Wayne, Pa..

**28.** Collee, J. G., R. S. Miles, and B. Watt. 1996. Test for the identification of bacteria. In: Macki and McCartney Practical Medical Microbiology. Cruickshank, R., J. G. Collee, B. P. Marmion, and A. Simmons. 14th ed. Vol.1, Churchill Livingstone, New York, pp. 133-49.

**29.** Phsicians Genrx. 1996. The Complete Drug Reference. Mosby-Yearbook.

**30.** Sakazaki, R. 2005. Genus Hafnia Møller 1954, p. 681-685. In D. Brenner, N. Krieg, J. T. Staley, and G. Garrity (ed.), Bergey's manual of systematic bacteriology, 2nd ed. Springer, New York, N.Y.

**31.** Sakazaki, R., and K. Tamura. 1991. The genus Hafnia, p. 2816-2821. In A. Balows, H. G. Trüper, M. Dworkin, W. Harder, and K.-H. Schleifer (ed.), The prokaryotes: a handbook on the biology of bacteria ecophysiology, isolation, and identification, applications. Springer-Verlag, Berlin, Germany.

**32.** Stock, I., M. Rahman, K. J. Sherwood, et al . 2005. Natural antibiotic susceptibility patterns and biochemical identification of Escherichia albertii and Hafnia alvei strains. Diagn. Microbiol. Infect. Dis. 51:151-163.

**33.** Girlich, D., T. Naas, S. Bellais, et al . 2000. Heterogeneity of AmpC cephalosporinases of Hafnia alvei clinical isolates expressing inducible or constituitive ceftazidime resistance phenotypes. Antimicrob. Agents Chemother. 44:3220-3223.

**34.** Piddock, L. J. V., R. N. Walters, Y.-F. Jin, et al . 1997. Prevalence and mechanism of resistance to 'third-generation' cephalosporins in clinically relevant isolates of Enterobacteriaceae from 43 hospitals in the UK, 1990-1991. J. Antimcrob. Chemother. 39:177-187.

**35.** Thomson, K. S., C. C. Sanders, and J. A. Washington II. 1993. Ceftazidime resistance in Hafnia alvei. Antimicrob. Agents Chemother. 37:1375-1376.