MEDICAL GRAND ROUNDS
Parkland Memorial Hospital
October 3, 1963

Hospital-Acquired Urinary Tract Infections

Case Report:

[redacted])

This 70-year-old [redacted] male was admitted to [redacted] on [redacted] 1963, with the chief complaint of "being out of his mind" for three weeks.

Three years prior to admission, he began to have urinary frequency and increased nocturia, which progressively increased until three weeks prior to admission, when he developed disorientation. Frequency increased to approximately three to four times per hour with the passage of small quantities of urine. He became anorectic, and had intermittent fever and associated sweats.

Past History: The patient had a gonococcal infection many years earlier.

Physical Examination (on admission): Afebrile, pulse 76, respirations 12, blood pressure 180/80. The patient was well developed, but disoriented, uncooperative and agitated. Abnormalities on physical examination were limited to abdominal distention and a bladder palpated to the umbilicus. Prostate revealed hypertrophy.

Admission Laboratory Work: Chest film normal, electrocardiogram showed left axis deviation, hemoglobin 12.3 gm.%, BUN 111 mg.%, CO_2 12, potassium 6.7, sodium 144, chloride 102.

Course in Hospital: Gradual decompression of the bladder was instituted. The urine revealed no white cells, no red cells, no casts, and was negative for sugar and albumin. Following decompression, the patient developed hematuria. On the second hospital day, his temperature spiked to 103° and urine and blood cultures were obtained. These were subsequently recorded as showing no growth. He was then begun on tetracycline 1.5 gm. the first day and 1.0 gm. every other day for the next five days. KUB revealed poor psoas shadows. Bone films illustrated osteosclerotic lesions of the lumbar vertebrae compatible with carcinoma of the prostate, and acid phosphatase was recorded as 3.9 and 3.0 KA units.

On the 9th hospital day, the patient spiked a temperature to 106°; blood pressure fell to shock levels and his confusion increased. Electrocardiogram revealed sinus tachycardia. Lumbar puncture was normal. At that time his hemoglobin was 9.3 gm.%, WBC 14,300 with 94% PMNs. BUN was 49, CO_2 16, chloride 98, sodium 136, potassium 3.7. Urinalysis revealed 250 red cells and 10-20 white cells. The clinical impression was gram-negative rod bacteremia and he was begun on chloramphenicol, kanamycin and intravenous hydrocortisone. The blood pressure was stabilized with Aramine. Urine culture obtained on the fourth hospital day revealed Proteus vulgaris and blood cultures obtained at the time of the temperature elevation also revealed Proteus vulgaris sensitive to chloramphenicol, streptomycin, kanamycin, penicillin, and novobiocin. On the twelfth hospital day, the patient appeared to have a cerebrovascular accident and subsequently died.

Post-mortem examination revealed: a nodular prostate with no evidence of malignancy, a prostatic abscess from which Proteus vulgaris was cultured, hemorrhagic cystitis with bladder diverticulae and hydroureter, and acute pyelonephritis with no evidence of chronic pyelonephritis.

I. Prevalence of Bacteriuria

A. Non-hospital associated populations
B. Hospital associated populations
C. Role of catheterization

II. Significance

A. Acute
B. Chronic

III. Etiological Micro-organisms

Table I

Serotyping of Strains of Escherichia Coli Isolated From Urine Specimens With Significant Bacteriuria*

Serotype	No. Strains	Hospitalized Patients (%)	Out-Patients (%)	Total (%)
O-1	28	7.1	4.5	6.2
O-4	58	15.0	9.0	12.9
O-6	70	15.0	16.6	15.5
O-75	32	5.8	9.6	7.1
Non-typable or other types	262	57.1	60.2	58.3
Total No.	450	294	156	

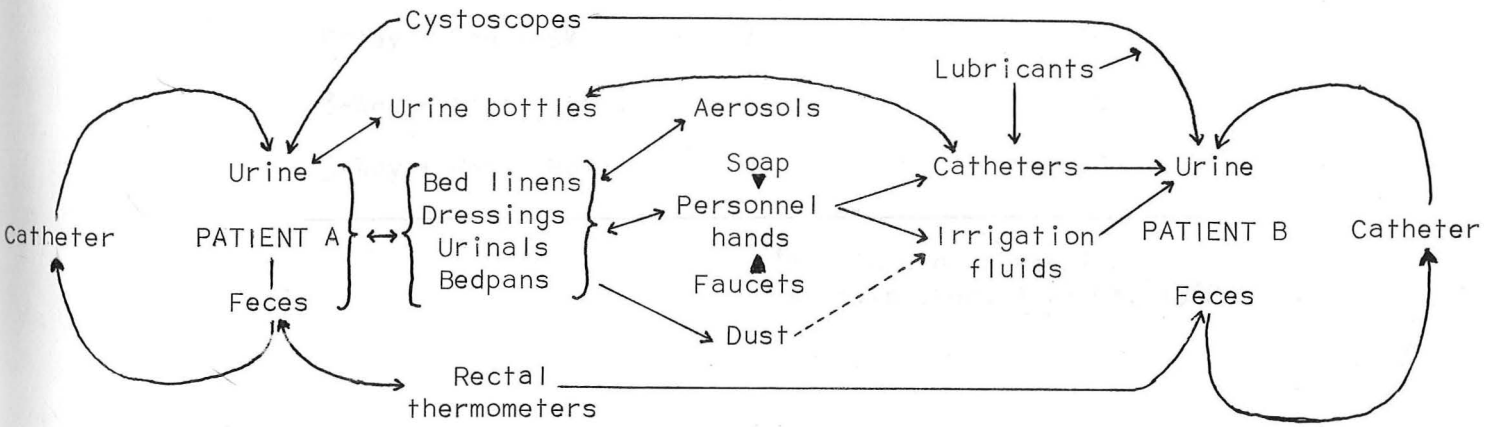
* Urine cultures submitted [redacted] 1963 contained $\geq 10^5$ bacteria/ml.

Table 2

Bacteria Commonly Responsible for Hospital Acquired Urinary Tract Infections

Bacterial Specie	Prevalent Serotypes	Source
E. coli	O-1,O-2,O-4,O-6,O-75	Autogenous
Klebsiella-Aerobacter	8,9,10	Autogenous
Proteus	mirabilis, vulgaris	Autogenous
Pseudomonas aeruginosa	not defined	Exogenous

IV. Mode of Spread



V. Spread Into Bladder

A. Direct inoculation
B. Catheter lumen
C. Mucus sheath

VI. Methods of Control

A. Systemic antibiotics
B. Improve technique of catheterization
C. 1) Exclusion from the bladder
   2) Prompt removal after entry

Table 3

Incidence of Bacteriuria After Indwelling Catheterization in 47 Non-Bacteriuric Patients*

Catheter Group	No. Pts.	Acquired (No.)	Bacteriuria (%)
Foley	11	11	100
Foley + Chlor.	13	10	80
Foley + Pen + SM	7	5	70
3-Way + acetic acid	6	1	20
3-Way + Neo + Poly B	10	0	0

*Martin and Bookrajian
Arch.Int.Med. 110:703, 1962

BIBLIOGRAPHY

1. Kass, E. H. Symposium on newer aspects of antibiotics: Chemotherapeutic and antibiotic drugs in management of infections of the urinary tract. Am. J. Med. 18: 764, 1955.

2. Sanford, J. P., Favour, C. B., Mao, F. H., and Harrison, J. H. Evaluation of the "positive" urine culture. Am. J. Med. 20:88, 1956.

3. Kass, E. H. Bacteriuria and diagnosis of infections of urinary tract with observations on the use of methionine as a urinary antiseptic. Arch. Int. Med. 100:709, 1957.

4. MacDonald, R. A., Levitin, H., Mallory, G. K., and Kass, E. H. Relation between pyelonephritis and bacterial counts in urine: Autopsy study. New Eng. J. Med. 256:915, 1957.

5. Effersoe, P., and Jensen, E. Urinary tract infection versus bacterial contamination. Lancet 1:1342, 1963.

6. Kunin, C. M., Southal, I., and Paquin, A. J. Epidemiology of urinary-tract infections: Pilot study of 3057 school children. New Eng. J. Med. 263:817, 1960.

7. Kunin, C. M., Zacha, E., and Paquin, A. J., Jr. Urinary-tract infections in school children. I. Prevalence of bacteriuria and associated urologic findings. New Eng. J. Med. 266:1287, 1962.

8. Windom, R. E., Bass, R. K., McBride, R. B., and Sanford, J. P. Routine urine cultures in private practice. Am. J. Med. Sci. 241:56, 1961.

9. Marple, C. D. Frequency and character of urinary tract infections in unselected group of women. Ann. Int. Med. 14:2220, 1941.

10. Loopuyt, L. Infections of the urinary tract. I. Frequency of urinary infections. Acta Med. Scand. 125:245, 1946.

11. Sanford, J. P. Inapparent pyelonephritis—The missing link? J.A.M.A. 169:1711, 1959.

12. Guze, L. B., and Beeson, P. B. Observations on the reliability and safety of bladder catheterization for bacteriologic study of the urine. New Eng. J. Med. 255:474, 1956.

13. Dukes, C. Urinary infections after excision of the rectum: Their cause and prevention. Proc. Royal Soc. Med. 22:259, 1928.

14. Prince, C. L. The prevention of urinary tract infection following transurethral prostatic resection by combined use of sulfadiazine and penicillin. J. Urology 56:121, 1946.

15. Lunt, R. L., Dutton, W.A.W., Dewhurst, C. J., and Russell, C. S. The incidence of infection following gynecological operations. Lancet 1:1240, 1957.

16. Miller, A., Gillespie, W. A., Linton, K. B., Slade, N., and Mitchell, J. P. Post-operative infection in urology. Lancet 2:608, 1958.

17. Beeson, P. B. The case against the catheter. Am. J. Med. 24:1, 1958.

18. Rantz, L. A. Serological grouping of Escherichia coli. Study in urinary tract infection. Arch. Int. Med. 109:37, 1962.

19. Finland, M., Jones, W. F., Jr., and Barnes, M. W. Occurrence of serious bacterial infections since introduction of antibacterial agents. J.A.M.A. 170:2188, 1959.

20. Martin, C. M., and Bookrajian, E. N. Bacteriuria prevention after indwelling urinary catheterization. A controlled study. Arch. Int. Med. 110:703, 1962.

21. Kass, E. H. Pyelonephritis and bacteriuria. A major problem in preventive medicine. Ann. Int. Med. 56:46, 1962.

22. Clarke, B. G., and Joress, S. Quantitative bacteriuria after use of indwelling catheters. Incidence in genito-urinary surgery. J.A.M.A. 174:1593, 1960.

23. Tyler, C. W., and Oseasohn, R. The relationship of in-lying catheterization to persistent bacteriuria in gynecologic patients. Am. J. Obst. & Gynec. 86:998, 1963.

24. Turck, M., Browder, A. A., Lindemeyer, R. I., Brown, N. K., Anderson, K. N., and Petersdorf, R. G. Failure of prolonged treatment of chronic urinary-tract infections with antibiotics. New Eng. J. Med. 267:999, 1962.

25. Turck, M., and Petersdorf, R. G. The epidemiology of non-enteric Escherichia coli infections: Prevalence of serological groups. J. Clin. Invest. 41:1760, 1962.

26. Kunin, C. M., and Halmagyi, N. E. Urinary-tract infections in school children. II. Characterization of invading organisms. New Eng. J. Med. 266:1297, 1962.

27. Ørskov, I. Nosocomial infections with klebsiella in lesions of the urinary tract. Acta Path. et Microbiol. Scand. Suppl. 93:259, 1952.

28. Ørskov, I. Nosocomial infections with klebsiella in lesions of the urinary tract. II. Acta Path. et Microbiol. Scand. 35:194, 1954.

29. Lattimer, J. K., Seneca, H., Zinsser, H. H., and Troc, O. Increasing seriousness of resistant urinary infections with Aerobacter aerogenes. Current effectiveness of kanamycin. J.A.M.A. 170:938, 1959.

30. Dutton, A.A.C., and Ralston, M. Urinary tract infection in a male urological ward, with special reference to the mode of infection. Lancet 1:115, 1957.

31. Edebo, L., and Laurell, G. Hospital infection of the urinary tract with proteus. A clinical-bacteriologic study with special reference to modes of infection. Acta Path. et Microbiol. Scand. 43:93, 1958.

32. Omland, T. Nosocomial infections caused by Proteus rettgeri. Acta Path. et Microbiol. Scand. 48:221, 1960.

33. Story, P. Proteus infections in hospitals. J. Path. & Bacteriol. 68:55, 1954.

34. Pyrah, L. N., Goldie, W., Parsons, F. M., and Raper, F. P. Control of Pseudomonas pyocyanea infections in a urological ward. Lancet 2:314, 1955.

35. McLeod, J. W. The hospital urine bottle and bedpan as reservoirs of infection by Pseudomonas pyocyanea. Lancet 1:394, 1958.

36. Lowbury, E.J.L. Contamination of cetrimide and other fluids with Pseudomonas pyocyanea. Brit. J. Indust. Med. 8:22, 1951.

37. Kirby, W.M.M., Corpron, D. O., and Tanner, D. C. Urinary tract infections caused by antibiotic-resistant coliform bacilli. J.A.M.A. 162:1, 1956.

38. Rocha, H., and Guze, L. B. Infections due to Bacterium anitratum. Arch. Int. Med. 100:272, 1957.

39. Daly, A. K., Postic, B., and Kass, E.H. Infections due to organisms of the genus herellea. Arch. Int. Med. 110:580, 1962.

40. Lancaster, L. J. Role of Serratia species in urinary tract infections. Arch. Int. Med. 109:536, 1962.

41. Miller, A., Linton, K. B., Gillespie, W. A., Slade, N., and Mitchell, J. P. Catheter drainage in infection in acute retention of urine. Lancet 1:310, 1960.

42. Wilson, M. G., Nelson, R. C., Phillips, L. H., and Boak, R. A. New source of Pseudomonas aeruginosa in a nursery. J.A.M.A. 175:1146, 1961.

43. Walter, C. W., Rubenstein, A. D., Kundsin, R. B., and Shilkret, M. A. Bacteriology of the bedside carafe. New Eng. J. Med. 259:1198, 1958.

44. Helmholz, H. F. Determination of the bacterial content of the urethra: A new method with results of a study of 82 men. J. Urology 64:158, 1950.

45. Gillespie, W. A., Linton, K. B., Miller, A., and Slade, N. The diagnosis, epidemiology and control of urinary infection in urology and gynecology. J. Clin. Path. 13:187, 1960.

46. Weyrauch, H. M., and Bassitt, J. B. Ascending infection in an artificial urinary tract. Stanford Med. Bull. 9:25, 1951.

47. Kass, E. H., and Schneiderman, L. J. Entry of bacteria into the urinary tracts of patients with inlying catheters. New Eng. J. Med. 256:556, 1957.

48. Durham, M. P., Shooter, R. A., and Curwen, M. P. Failure of sulfonamides to prevent urinary infections after vaginal surgery. Brit. Med. J. 2:1008, 1954.

49. Appleton, D. M., and Waisbren, B. A. Prophylactic use of chloramphenicol in transurethral resection of the prostate gland. J. Urology 75:304, 1956.

50. Petersdorf, R. G., Curtin, J. A., Hoeprich, P. D., Peeler, R. N., and Bennett, I. L., Jr. A study of antibiotic prophylaxis in unconscious patients. New Eng. J. Med. 257:1001, 1957.

51. Liedberg, C. F. Nosocomial urinary tract infections, with special reference to the role of the indwelling catheter. Acta Chir. Scand. 118:45, 1959.

52. Desautels, R. E., and Harrison, J. H. The mismanagement of the urethral catheter. Med. Clin. No. Amer. 43:1573, 1959.

53. Mulla, N. Indwelling catheter in gynecologic surgery. Obst. & Gynec. 17:199, 1961.

54. Desautels, R. E., Walter, C. W., Graves, R. C., and Harrison, J. H. Technical advances in the prevention of urinary tract infection. J. Urology 87:487, 1962.

55. Kass, E. H., and Sossen, H. S. Prevention of infection of urinary tract in presence of indwelling catheters. Description of electromechanical valve to provide intermittent drainage of the bladder. J.A.M.A. 169:1181, 1959.

56. Parker, R. H., and Hoeprich, P. D. In vitro effect of buffered salts of acetic acid, triclobisonium chloride, chlorhexidine diacetate, and chlorhexidine digluconate on urinary tract pathogens. In Antimicrobial Agents and Chemotherapy - 1962, p. 26, Braun-Brumfield, Inc., Ann Arbor, 1963.