

OL5 Infections of Upper and Lower Urinary Tract

Speaker: Barbara Trautner, MD, PhD



Urinary Tract Infections

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1




Disclosures of Financial Relationships with Relevant Commercial Interests

- **Current:** Shionogi (COVID trial)
- **Past:** Genentech, Pfizer, Abbvie, Abbott Laboratories, Bristol Myers Squibb, PhioGen, Peptilogsics

2

Topics to Cover

- Acute cystitis in women
- Recurrent cystitis in women
- Asymptomatic bacteriuria
- Catheter-associated UTI
- Pyelonephritis
- Urosepsis and worse



3



UTI Differs in Different Populations

UTI is not the same entity in these different populations

4

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The Great Divide

My patient populations

- Men
- Older adults in long-term care
- Persons who require urinary catheters for bladder drainage
- Persons with neurogenic bladders

UTI treatment evidence base

- Pre-menopausal women
- Female college students and university staff

5

Question #1

A 24-year-old woman is evaluated for cystitis symptoms of 3 days' duration. She reports no fever, chills, flank pain, or vaginal discharge. She had similar symptoms three months ago and was treated with trimethoprim-sulfamethoxazole, with relief of symptoms.

On physical examination, vital signs and other findings are unremarkable.

On microscopic urinalysis, leukocytes are too numerous to count, erythrocyte count is 10/hpf, 4+ bacteria are present, and rare squamous epithelial cells are seen. Urine pregnancy test is negative.

Which of the following is the most appropriate management?

- A. Nitrofurantoin
- B. TMP/SMX
- C. Fosfomycin
- D. Ciprofloxacin
- E. Ibuprofen

hpf, high-powered field; TMP/SMX, trimethoprim/sulfamethoxazole

6

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Which of the following is the most appropriate management?

- A. Nitrofurantoin—best choice for uncomplicated cystitis when TMP/SMX not an option
- B. TMP/SMX—she had this recently, so may now have resistance
- C. Fosfomycin—would be fine, not commonly used in US and may cost more
- D. Ciprofloxacin—avoid when other options available
- E. Ibuprofen—slower to relieve symptoms and does not prevent pyelonephritis

hpf, high-powered field; TMP/SMX, trimethoprim/sulfamethoxazole

7

Current Infectious Diseases Society of America (IDSA) UTI Guidelines*

These guidelines cover:

- Uncomplicated cystitis
- Uncomplicated pyelonephritis
- Premenopausal women
- Primarily outpatients

IDSA GUIDELINES

*Complicated UTI guidelines coming soon

International Clinical Practice Guidelines for the Treatment of Acute Uncomplicated Cystitis and Pyelonephritis in Women: A 2010 Update by the Infectious Diseases Society of America and the European Society for Microbiology and Infectious Diseases

Kellogg Spivey¹, Thomas M. Hooton², Karl E. Nelson³, Brian Morris⁴, Richard Grigori⁵, Loren B. Miles⁶, Gregory J. Morris⁷, Lindsay E. Nicolle⁸, Paul Ten⁹, Anthony J. Schuchter¹⁰, and David S. Singer¹¹

8

IDSA Cystitis Guidelines (2010)

First-line agents

- Nitrofurantoin
- Trimethoprim-sulfamethoxazole
- Fosfomycin

Alternative choices

- Fluoroquinolones
- Beta-lactams

Can one of the recommended antimicrobials* below be used considering: Availability Allergy history Tolerance
Nitrofurantoin monohydrate/macrocrystals 100 mg bid x 5 days (avoid if early pyelonephritis suspected)
OR
Trimethoprim-sulfamethoxazole 160/800 mg (one DS tablet) bid x 3 days (avoid if resistance prevalence is known to exceed 20% or if used for UTI in previous 3 months)
OR
Fosfomycin trometamol 3 gm single dose (lower efficacy than some other recommended agents; avoid if early pyelonephritis suspected)
OR
Pyrimethamine 400 mg bid x 5 days (lower efficacy than some other recommended agents; avoid if early pyelonephritis suspected)

bid, twice daily; DS, double strength

9

How long do you treat acute cystitis?

First line choices (5, 3, 1)

Nitrofurantoin X 5

Trimethoprim/sulfamethoxazole X 3

Fosfomycin X1

IDSA Guidelines on Uncomplicated Cystitis, 2010

10

Nitrofurantoin: Clinical Use

- Interferes with several aspects of bacterial metabolism
- *E. coli* resistance uncommon
- Great for *E. coli* cystitis and prophylaxis
- Inadequate levels in tissue and blood
- Dyes urine yellow
- Intrinsic resistance in *Pseudomonas*, *Proteus*, *Serratia*
- Resistance frequent in *Klebsiella* and *Enterobacter*
- Renal excretion but OK to use if GFR >30 mL/min

Cunha et al, Eur J Clin Microbiol Infect Dis 2017; 36(7)
Singh, CMAJ 2015; 187(9)
AGS Beers Criteria 2019

GFR, glomerular filtration rate

11

Nitrofurantoin Adverse Events

- Pulmonary toxicity – RARE
 - Acute: reversible hypersensitivity reaction
 - Subacute or chronic: diffuse pneumonitis
 - Dose dependent?
 - Favors use of lowest possible dose/less frequent dosing for chronic prophylaxis
- Hepatitis – RARE
- Nausea – common
 - Worse with micro-(QID) than macro-crystalline (BID) formulation



QID, four times daily

Santos, JAGS 2016, PMID: 27100576

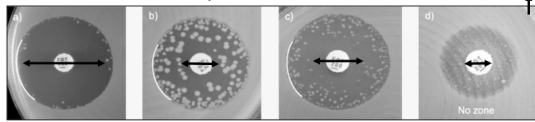
12

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Fosfomycin: Clinical Use for UTI

- High levels in urine for over 24 hours
- Single 3 gm dose for cystitis
- Developing niche for ESBL- and KPC- Enterobacterales
 - 3gm every 48-72 hours
- IV fosfomycin associated with hypokalemia and elevated LFTs (not approved in United States)



Photos from eucast.org; arrows (↔) reflect CLSI recommendations

CLSI, Clinical and Laboratory Standards Institute; ESBL, extended-spectrum beta-lactamase; IV, intravenous; KPC, Klebsiella pneumoniae carbapenemase; LFT, liver function tests

13

Potential Harms of Quinolones: FDA Warnings

- Dysglycemia
- Tendon rupture/damage
- Interstitial nephritis
- Neuropathy
- Diarrhea – with or without *C. diff*
- Aortic aneurysms?
- Arrhythmias



Safety Announcement

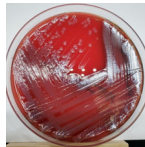
[05-12-2016] The U.S. Food and Drug Administration is advising that the serious side effects associated with fluoroquinolone antibacterial drugs generally outweigh the benefits for patients with acute sinusitis, acute bronchitis, and uncomplicated urinary tract infections who have other treatment options. For patients with these conditions, fluoroquinolones should be reserved for those who do not have alternative treatment options.

C. diff, *Clostridioides difficile*

14

New Oral Drugs for Cystitis: FDA Approved for Uncomplicated UTI

- Pivmecillinam
 - Pro-drug of mecillinam
 - Binds to PBP-2 in Gram-negative cell wall
 - Effective against ESBL+ Enterobacterales, *Staph saprophyticus*
- Gepotidacin
 - Blocks DNA topoisomerase
 - Effective against ESBL+ Enterobacterales, *S. saprophyticus*, and *E. faecalis*
 - Diarrhea as a side effect
- Sulopenem
 - Thiopenem – new beta-lactam class
 - Effective against ESBL+ Enterobacterales, *S. saprophyticus*
 - Did not get approval for complicated UTI



Not for *Pseudomonas* or VRE

15

Question #2

A 38-year-old woman comes in for recurrent UTI. This is her 3rd episode of symptomatic, culture-proven cystitis in the past 12 months. The recurrent UTIs are very inconvenient to her. She notes that her UTI symptoms usually begin within 2 days of sexual intercourse.

You offer an antibiotic prescription to allow her to self-treat when she feels the cystitis symptoms developing, but she travels internationally and would rather completely avoid developing a UTI.

Which of the following is the most appropriate strategy to prevent recurrent UTI in this woman?

- A. Nitrofurantoin daily for 24 months
- B. Nitrofurantoin one dose after intercourse for 6 months
- C. Ciprofloxacin daily for 6 months
- D. Trimethoprim-sulfamethoxazole twice daily for 6 months
- E. Cranberry tablets

16

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Which of the following is the most appropriate strategy to prevent recurrent UTI in this woman?

- A. Nitrofurantoin daily for 24 months – duration usually 3-6 months
- B. Nitrofurantoin one dose after intercourse for 6 months – use antibiotics specifically after her trigger situations
- C. Ciprofloxacin daily for 6 months – not a good drug for prophylaxis
- D. Trimethoprim-sulfamethoxazole twice daily for 6 months – dose is too high
- E. Cranberry tablets – minimal data to support

17

Prevention and Management of Recurrent UTI

- Self-treatment coupled with urine collection for culture is an appropriate strategy
- Use the most focused antibiotic and as sparingly as possible
- If the woman's episodes are related to sexual intercourse, one dose of antibiotics after intercourse is an effective strategy
- Guidelines suggest treating daily for 3-12 months
- No clarity on which antibiotic to use, other than to avoid fluoroquinolones given side effects and resistance

Recurrent Uncomplicated Urinary Tract Infections in Women: AUA/CUA/SUFU Guideline (2022)
<https://www.auanet.org/guidelines-and-quality/guidelines/recurrent-uti>

18

Non-antibiotic Strategies to Prevent Recurrent UTI

Likely helpful (FDA approved)

- Increasing fluid intake
- Vaginal estrogen in post-menopausal women
- Methenamine (?)

Uncertain benefit (not FDA approved)

- Other behavioral changes
- Cranberry products (?)
- D-mannose
- Probiotics
- Other supplement (liquid or other)

Fluid intake: Hooton TM, et al. *JAMA Intern Med.* 2018
Methenamine trials: Harding C, et al. *Health Technol Assess.* 2022
Botros C, et al. *Int Urogynecol J.* 2022
Systematic review of cranberry products: Williams G, et al. *Cochrane Database Syst Rev.* 2023

19

19

Question #3

A 69-year-old woman comes in for an annual checkup. No change in her baseline health status. When she coughs or sneezes, she notes slight leakage of urine. Her medical history is significant for three vaginal births, and she has hypertension and type 2 diabetes mellitus.

Her BMI is 30. Her vital signs and other physical examination findings are normal.

On dipstick urinalysis, urine is yellow and with a bad smell, specific gravity is 1.010, pH is 7.0, and moderate leukocyte esterase and nitrites are present; the urinalysis is negative for blood or glucose but 2+ for bacteria.

Which of the following is the most appropriate management?

- A. Nitrofurantoin
- B. Ciprofloxacin
- C. Cystoscopy
- D. Urine culture and sensitivities
- E. No further infectious workup

BMI, body mass index

20

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Which of the following is the most appropriate management?

- A. Nitrofurantoin
- B. Ciprofloxacin
- C. Cystoscopy
- D. Urine culture and sensitivities
- E. No further infectious workup – this is a case of asymptomatic bacteriuria

BMI, body mass index

21

Prevalence of Asymptomatic Bacteriuria

Population	Prevalence, %
Children	
Boys	<1
Girls	1–2
Healthy women	
Premenopausal	1.0–5.0
Pregnant	1.9–9.5
Postmenopausal (age 50–70 y)	2.8–8.6
Persons with diabetes	
Women	10.8–16
Men	0.7–11
Elderly persons in the community (age ≥70 y)	
Women	10.8–16
Men	3.6–19
Elderly persons in a long-term care facility	
Women	25–50
Men	15–50
Persons with spinal cord injury	
Intermittent catheter use	23–69
Sphincterotomy/condom catheter	57
Persons with kidney transplant	
First month posttransplant	23–24
1 mo–1 y post-transplant	10–17
>1 y post-transplant	2–9
Persons with indwelling catheter use	
Short-term	3%–5%/day catheter
Long-term	100

mo, month; y, year

Nicolle et al, IDSA Guidelines for Asymptomatic Bacteriuria, Clin Inf Dis 2019

22

Choosing Wisely®

An initiative of the ABIM Foundation



Five Things Physicians and Patients Should Question

Don't treat asymptomatic bacteriuria with antibiotics.

Inappropriate use of antibiotics to treat asymptomatic bacteriuria (ASB), or a significant number of bacteria in the urine that occurs without symptoms such as burning or frequent urination, is a major contributor to antibiotic overuse in patients. With the exception of pregnant patients, patients undergoing prostate surgery or other invasive urological surgery, and kidney or kidney pancreas organ transplant patients within the first year of receiving the transplant, use of antibiotics to treat ASB is not clinically beneficial and does not improve morbidity or mortality. The presence of a urinary catheter increases the risk of bacteriuria, however, antibiotic use does not decrease the incidence of symptomatic catheter-associated urinary tract infection (CAUTI), and unless there are symptoms referable to the urinary tract or symptoms with no identifiable cause, catheter-associated asymptomatic bacteriuria (CA-ASB) does not require screening and antibiotic therapy. The overtreatment of ASB with antibiotics is not only costly, but can lead to *C. difficile* infection and the emergence of resistant pathogens, raising issues of patient safety and quality.

23

IDSA Guidelines on ASB 2019

Screening and Treatment Indicated

- ✓ Pregnant women
- ✓ Prior to urologic surgery with mucosal trauma
 - Pre-operative urine culture recommended
 - Treat with 1-2 doses of antibiotics shortly prior to surgery

Screening and Treatment Discouraged

- X Infants and children
- X Non-pregnant women
- X Functionally-impaired older adults
- X Diabetic adults
- X Patients >1 month from kidney transplant
- X Neutropenic patients
- X Patients with solid organ transplant
- X Persons with spinal cord injury
- X Patients with indwelling catheters
- X Prior to non-urologic surgery

24

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Guidelines on Screening for ASB in Pregnant Women

Agency	Year	Recommended?	Strength?	When?	How?	Desired Outcomes
IDSA (United States)	2019	Yes	Strong	12-16 weeks	Culture	Decreased pyelonephritis, decreased low birth weight Possible decrease in preterm labor
CTFPHC (Canadian)	2018	Yes	Weak	1 st trimester	Culture	Decreased pyelonephritis, decreased low birth weight
USPSTF (United States)	2019	Yes	Grade B	12-16 weeks or first prenatal visit	Culture	Decreased pyelonephritis, decreased low birth weight

CTFPHC, Canadian Task Force on Preventive Health Care; USPSTF, United States Preventive Services Task Force

25



Warning: Myth-busting Ahead!

26

Myth-Busting (True Facts!)

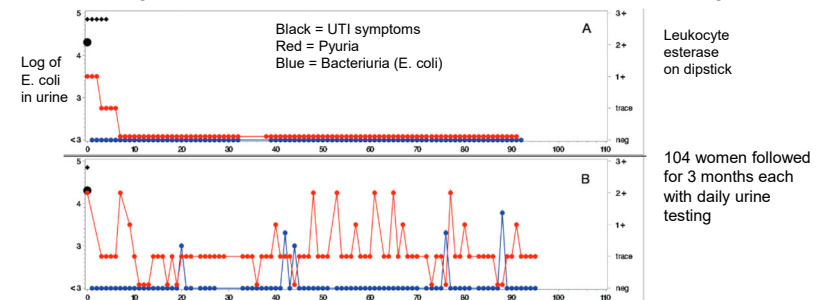
- Bacteriuria ≠ UTI
 - Bacteriuria in the urine can be bladder colonization **or** symptomatic urinary tract infection
- Pyuria ≠ UTI
 - The presence of WBC in the urine doesn't help much with diagnosis of UTI
 - Absence of pyuria suggests to look for a non-UTI diagnosis
- Foul smelling urine ≠ UTI
- Sediment or cloudy urine in catheter tubing ≠ UTI
 - All catheterized bladders develop high level bacteriuria
 - Flushing the catheter to make sure it is patent is a good idea
- Healthy bladders are not sterile in many people
- Take home points:
 - Order urine tests only in patients with urinary symptoms
 - The best thing you can do with asymptomatic bacteriuria is leave it alone
 - Pyuria is not a reliable marker for UTI
 - Changes in the urine are not reliable markers for UTI



WBC, white blood cell

27

Pyuria Not Very Predictive (Even in Non-catheterized Women)



Overall, the PPV (positive predictive value) of pyuria for *E. coli* bacteriuria was 4%

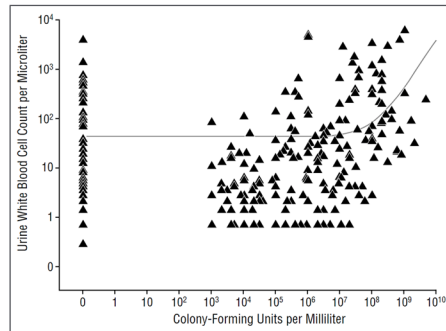
Hooton et al., Clin Infect Dis. 2021 Apr 26;72(8):1332-1338²⁸

28

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Relationship Between Pyuria and Bacteriuria/Candiduria in Catheterized Patients



1,497 newly catheterized patients followed daily with urine testing and symptom diaries

235 developed bacteriuria with at least 1,000 CFU/mL

No significant differences in fever or urinary symptoms between patients who did/did not develop bacteriuria

No correlation between pyuria and bacteriuria (flat line) until colony counts are over 10⁸

Tambyah and Maki, Arch Intern Med. 2000 Mar 13;160(5):678-82 and 673-7
CFU, colony-forming unit

29

Question #4

A 75-year-old man is seen in the pre-operative clinic. He is scheduled to undergo cystoscopy and possible biopsy for persistent hematuria. He is also scheduled for elective left total knee replacement, shortly after the urinary procedure. Other than the hematuria, he denies urinary-specific symptoms. He underwent kidney transplantation 3 years earlier, related to complications of diabetes.

On physical examination, vital signs are normal. His left knee has an effusion but is not red or excessively painful. No change in his baseline creatinine clearance.

On urinalysis, leukocyte count is 10/hpf, erythrocyte count is 100/hpf, 4+ bacteria are present, and no squamous epithelial cells are seen. Urine culture grew >10,000-<100,000 colony-forming units of *Klebsiella pneumoniae*.

Kidney ultrasonography is unremarkable.

Which of the following is the primary indication for antimicrobial therapy in this patient?

- A. Cystoscopy and biopsy
- B. Diabetes mellitus
- C. Kidney transplant
- D. Knee prosthesis placement

30

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Kidney ultrasonography is unremarkable.

Which of the following is the primary indication for antimicrobial therapy in this patient?

- A. Cystoscopy and biopsy – will breach the mucosa, and bacteriuria would contaminate the surgical field
- B. Diabetes mellitus – no, see ASB guidelines
- C. Kidney transplant – not necessary to treat ASB after >1 month post transplant
- D. Knee prosthesis placement – not fully addressed in the 2019 ASB guidelines

31

Question #5

A 46-year-old man is admitted to the hospital for urgent repair of aortic dissection. An indwelling urinary catheter is inserted prior to surgery. Endovascular aortic aneurysm repair is successful, and he is transferred to the surgical intensive care unit. He has underlying diabetes and systolic heart failure.

In addition to removing the urinary catheter as soon as possible, which of the following will decrease this patient's risk of catheter-associated urinary tract infection?

- A. Daily cleansing of the meatal area of the catheter with antiseptics
- B. Routine catheter change every 3 days
- C. Screening for and treatment of bacteriuria
- D. Keeping the collecting bag below the level of the bladder
- E. Use of antiseptic- or antibiotic-coated urinary catheters

32

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In addition to removing the urinary catheter as soon as possible, which of the following will decrease this patient's risk of catheter-associated urinary tract infection?

- A. Daily cleansing of the meatal area of the catheter with antiseptics
 - Ineffective
- B. Routine catheter change every 3 days
 - Ineffective
- C. Screening for and treatment of bacteriuria
 - Ineffective AND confers excess antibiotic use
- D. **Keeping the collecting bag below the level of the bladder**
 - Gravity helps prevent reflux to the kidneys
- E. Use of antiseptic- or antibiotic-coated urinary catheters
 - Minimal impact and approved only for short-term use



33

Question #6

A 37-year-old woman with a history of recurrent UTIs developed typical symptoms of urgency, frequency, and dysuria five days ago. On the advice of her close friend, she decided to treat this UTI with a nutritional supplement instead of antibiotics. Symptoms did not resolve, and she developed worsening low back pain. This morning, she vomited once. In the office, her temperature is 100.5F, BP 135/70, HR 110, RR 16. She is not currently vomiting and can sip water.

You do not have any prior urine cultures to guide your therapy. She took some antibiotics for UTI 3 months ago but doesn't know what she took.

Assuming you can manage her as an outpatient, what empiric treatment would you offer?

- A. Oral trimethoprim-sulfamethoxazole
- B. Oral ciprofloxacin
- C. One dose of ceftriaxone or gentamicin followed by oral ciprofloxacin
- D. Cephalexin
- E. Nitrofurantoin

BP, blood pressure; HR, heart rate; IM, intramuscular; RR, respiratory rate

34

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- A. Oral trimethoprim-sulfamethoxazole
- B. Oral ciprofloxacin
- C. **One dose of ceftriaxone or gentamicin followed by oral ciprofloxacin – safest empiric options without cultures to guide you and with known prior antibiotic exposure**
- D. Cephalexin
- E. Nitrofurantoin

BP, blood pressure; HR, heart rate; IM, intramuscular; RR, respiratory rate

35

Management of Pyelonephritis

- Many clinical trials included pyelonephritis with complicated UTI
- Complicated UTI increasingly means urinary tract infection that has spread beyond the bladder (to kidneys, bloodstream)
- Empiric oral therapy
 - Trimethoprim-sulfamethoxazole 7 days
 - Fluoroquinolones 5-7 days
 - Consider a one-time dose of IM ceftriaxone or gentamicin while awaiting cultures
 - Oral beta-lactams (cephalosporins, amoxicillin-clavulanate)
- Empiric intravenous therapy
 - Cephalosporins, piperacillin-tazobactam, carbapenems, fluoroquinolones
- To avoid: nitrofurantoin and fosfomycin



Johnson and Russo, NEJM 2018. 378:1

36

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Case #7

68-year-old diabetic man with CHF, vascular disease, BPH presented with 2 days of vomiting, abdominal pain, and confusion.

Vital signs: T 99.9 BP 47/39, HR 110, RR 22

Physical exam: patient was obtunded but appeared to have tenderness in the epigastric area

Labs: WBC 23.7 (94% segs), platelets 96K; Creatinine 3.1 (from 1.7 baseline)

UA: WBC 250, RBC too numerous to count, no bacteria

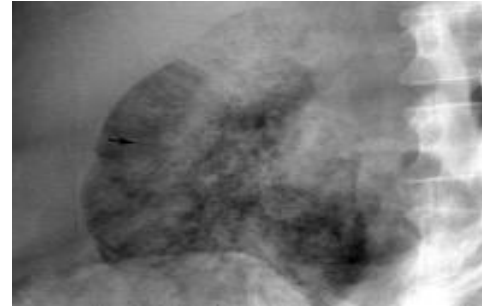
Troponin 7.2, EKG with ST elevations; HgB A1c 10.5

He was admitted to the CCU and initiated on therapy for an ST elevation myocardial infarction. His blood pressure was labile, and he required pressor support. He required intubation. On hospital day 2, his blood cultures grew 4/4 bottles of *Klebsiella pneumoniae*.

The next slide shows an abdominal radiography (KUB) that had been performed at admission.

37

Question #7



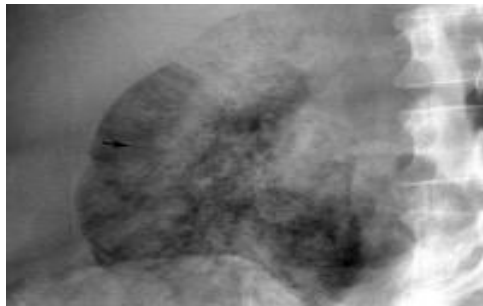
X-ray of Abdomen

What would you order next?

- A. Abdominal ultrasound
- B. Abdominal CT
- C. Nasogastric tube
- D. Stool for *C. diff* testing

38

Question #7



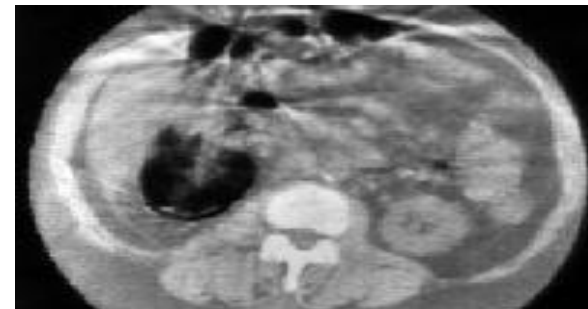
X-ray of Abdomen

What would you order next?

- A. Abdominal ultrasound
- B. Abdominal CT – You are looking at gas in the kidney
- C. Nasogastric tube
- D. Stool for *C. diff* testing

39

Abdominal CT with Emphysematous Pyelonephritis



CT showing gas within the renal parenchyma

40

Clinical Course of Case #7

- Percutaneous drainage of the right kidney
- Renal drainage grew *Klebsiella*
- After weeks in the ICU was stable enough for nephrectomy
- 9 months later had then coronary artery bypass surgery

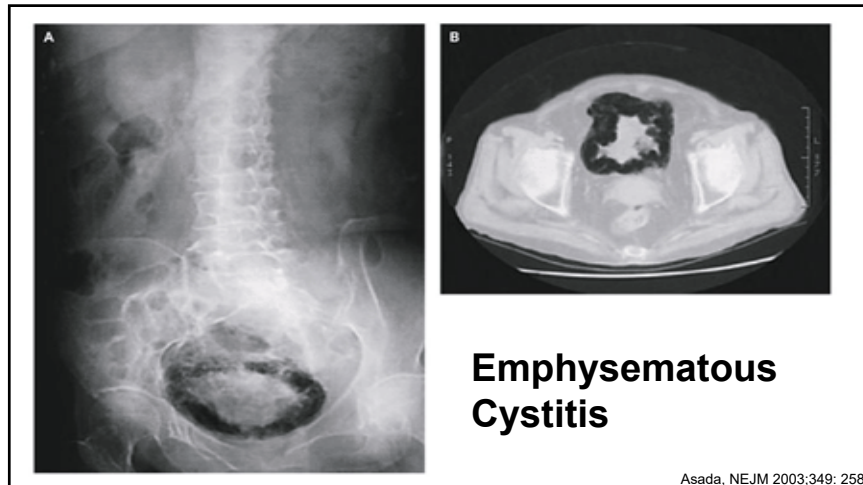
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Diagnosis and Management of Emphysematous Pyelonephritis

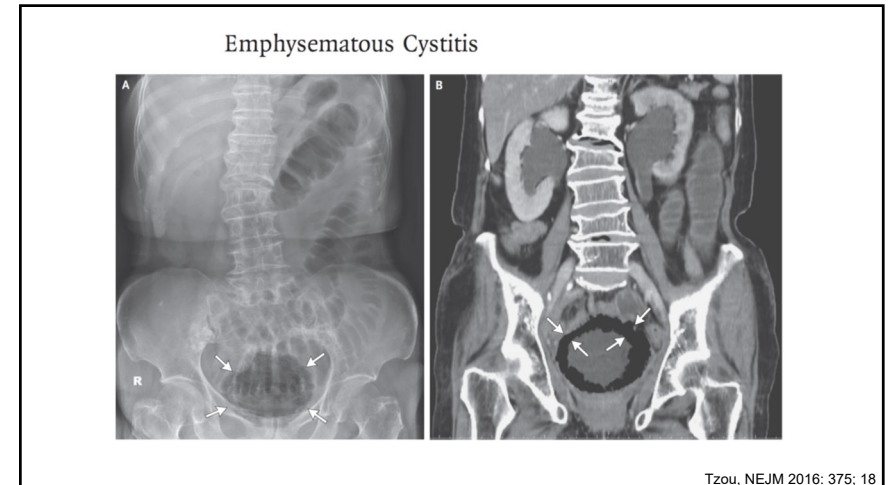
- 95% of cases in patients with diabetes (poorly controlled)
- Negative prognostic factors: shock, impaired consciousness, thrombocytopenia, renal failure
- Organisms: *E. coli*, *Klebsiella*, *Proteus*
- Diagnosis often delayed
- Differential: renal abscess, papillary necrosis
- Radiological diagnosis
- **Managed initially by drainage** – percutaneous nephrostomy or ureteral stent
- Nephrectomy for non-responders, severe cases

Kamei, J Infection and Chemotherapy 2021

42



43



44

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Diagnosis and Management of Emphysematous Cystitis

- Female predilection
- Most cases in diabetics
- Commonly caused by *E. coli*, *Klebsiella* (*Candida* reported)
- Organisms produce gas in the bladder wall and lumen
- Can present with lower abdominal pain
- Diagnosed radiologically
- Relieve bladder obstruction if present
- Typically responds well to **medical management**

45

Question #8

57-year-old man with spinal cord injury (T12) and a chronic indwelling urinary catheter. Two years prior he had a fever, and his blood grew *S. aureus* and *Pseudomonas*. Urine grew lactose negative GNR and gram-positive organisms.

One year prior, he again had a fever, and his blood grew *Serratia*, *E. coli*, and *Pseudomonas*. Urine grew *Serratia* and *Pseudomonas*.

Both times he was treated with appropriate antibiotics, with resolution of fever and stabilization.

He has had many urine cultures, all of which grew multiple urinary pathogens.

Prior to entry in a research protocol, he had a screening abdominal ultrasound, which showed a hypoechoic mass in right kidney.

In addition to CT scan, what will be the definitive therapy?

- A. Renal biopsy
- B. 3-6 months of antibiotics based on current urine culture
- C. Percutaneous drainage
- D. Nephrectomy

46

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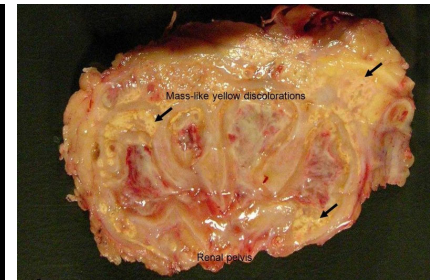
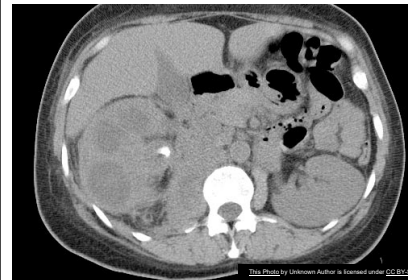
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- B. 3-6 months of antibiotics based on current urine culture
- C. Percutaneous drainage
- D. **Nephrectomy – Can you name the diagnosis?**

47



Xanthogranulomatous Pyelonephritis

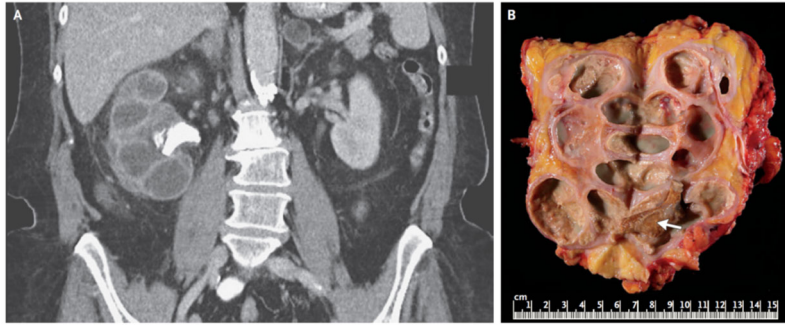
<https://www.aunet.org/education/auauniversity/education-products-and-resources/pathology-for-urologists/kidney/inflammatory/necrotic-renal-lesions/xanthogranulomatous-pyelonephritis>

48

OL5 Infections of Upper and Lower Urinary Tract

Speaker: Barbara Trautner, MD, PhD

Xanthogranulomatous Pyelonephritis



Bear Paw Sign

Marinacci, New England Journal of Medicine 2018; 378:10

49

Xanthogranulomatous Pyelonephritis

- Chronic polymicrobial infection of renal parenchyma
- Often starts with stone/obstruction
- Frequently insidious and mistaken for tumor
- Renal tissue is destroyed and replaced by granulomatous tissue
- Yellow from the foam cells (macrophages) full of lipids
- **Requires nephrectomy** plus antibiotics
- Our patient underwent right nephrectomy, with finding of a variegated tan-white mass, large amount of inflammatory reaction, purulence in right renal fossa

50




To Re-Cap

- Acute and recurrent cystitis in women-nitrofurantoin
- Asymptomatic bacteriuria
 - Pregnant women-screen and treat
 - Urologic surgery – screen and treat
 - Everyone else – don't test the urine
- Catheter-associated UTI – ensure drainage
- Pyelonephritis – treat with tissue-active agent
- Urosepsis and worse
 - Emphysematous pyelonephritis-drainage
 - Emphysematous cystitis-medical management
 - Xanthogranulomatous pyelonephritis-removal

51

Is Everything Clear Now?

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52