POCUS Conference:
Renal Imaging

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PATIENT F.M.

84M hx of CHF (EF 25%) on Lasix, pAfib, DM, and HTN p/w nausea, decreased PO intake, weakness, sore throat x 4 days.

Family called EMS, who noted him to be hypotensive to 80s/40s. Brought to the ED for further evaluation.

Mildly confused and lethargic in the ED.

PHYSICAL EXAM

Vitals: HR 79, BP **80/53** --> 108/48, RR 20, sat 99% on RA

- General: elderly man, NAD, **slightly agitated and difficult to redirect**
- HEENT: unremarkable
- CV: RRR, no m/r/g
- Resp: CTAB
- Abdomen: soft, nt nd, NABS
- Extremities: no edema b/l, wwp
- Skin: **excoriations over arms**

LABS

130	101	116
5.2	13	10.0

Lactate 3.04 --> 2.34

INR 1.6, PTT 33

VBG 7.34/27/20

	13.0	
10.8		150
	40.1	

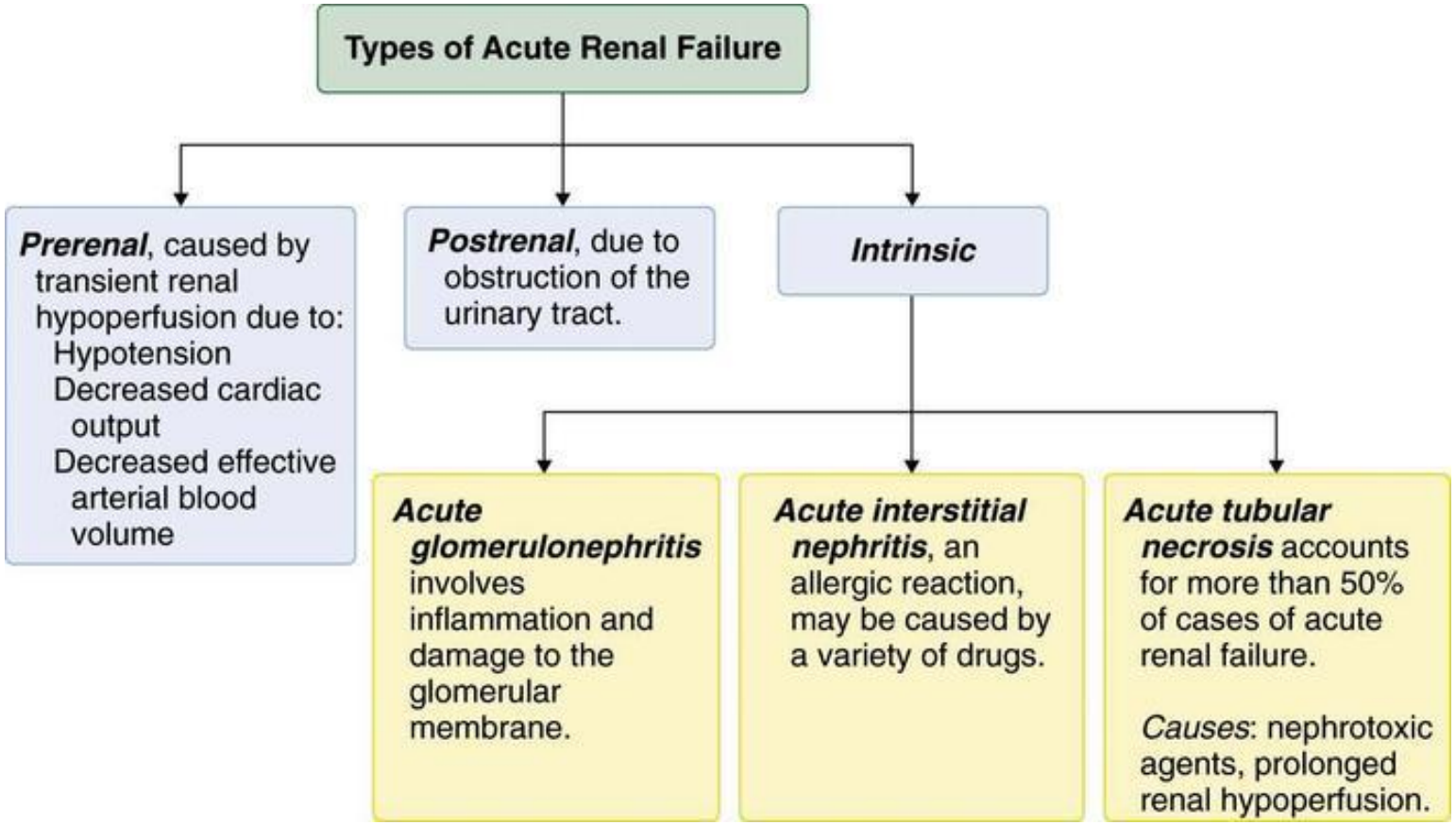
Baseline BMP:

145	107	27
3.5	24	1.7

UA: colorless, clear, trace glucose, moderate blood, trace protein, no leuk esterase or nitrates, no bacteria

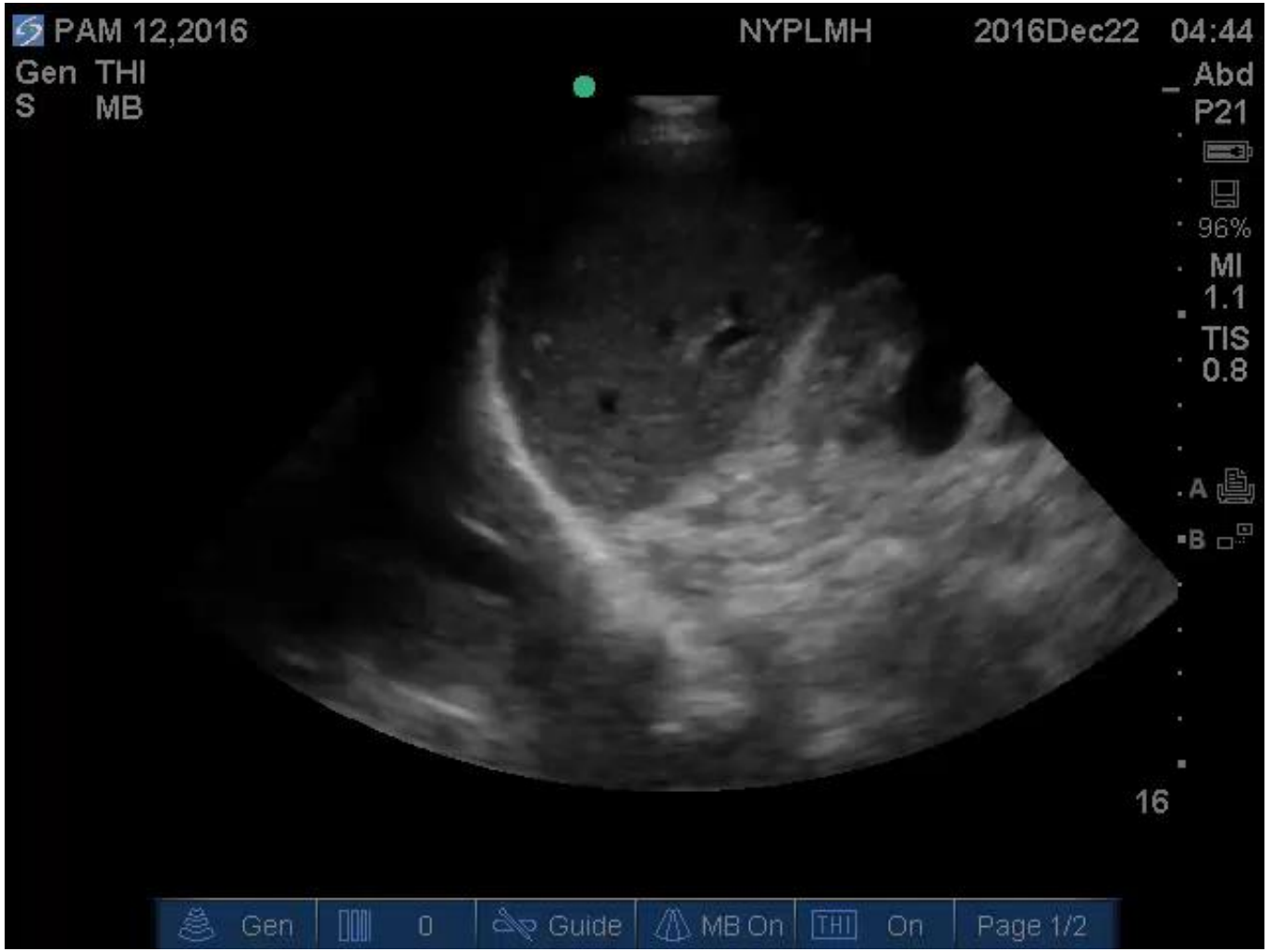
0-2 hyaline casts, 0-2 granular casts

DIFFERENTIAL DIAGNOSIS: AKI, CKD

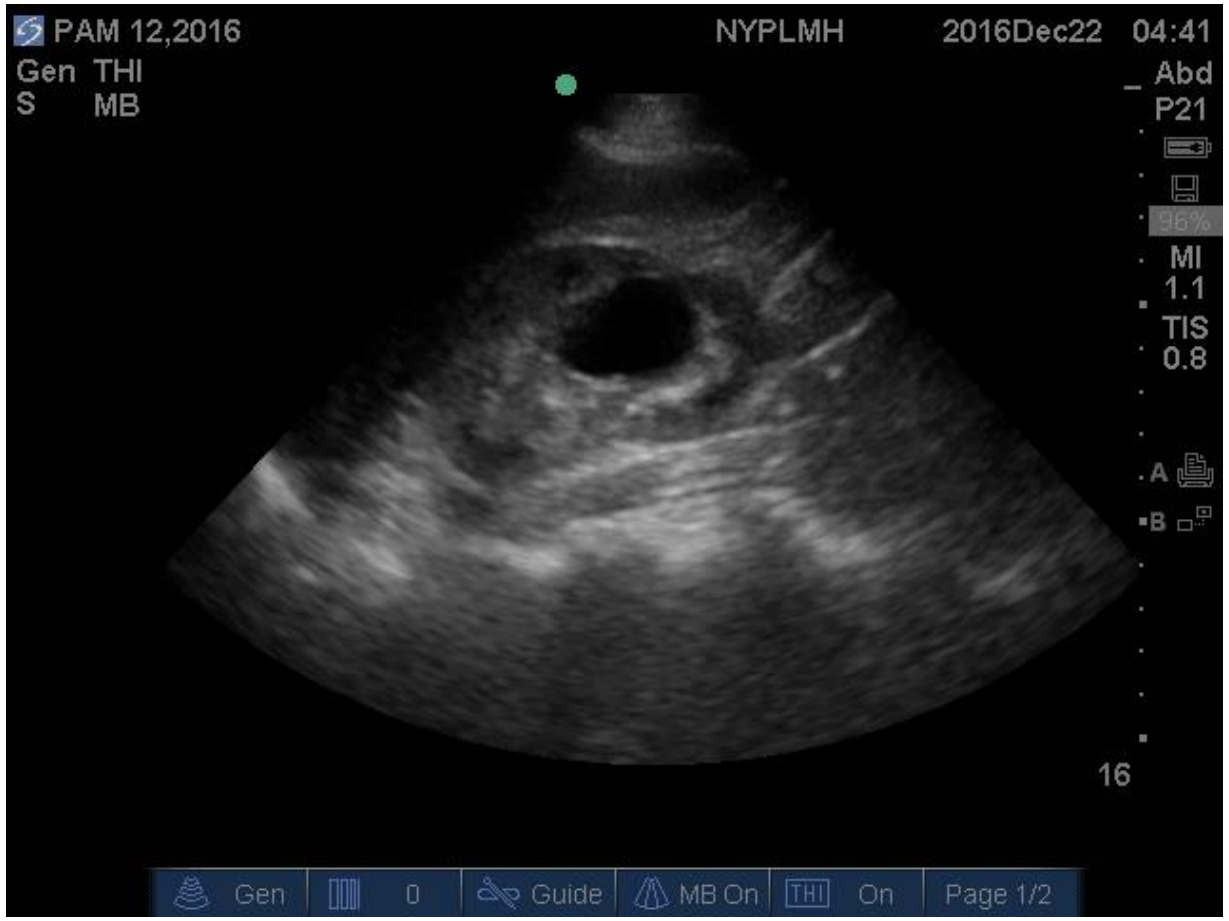


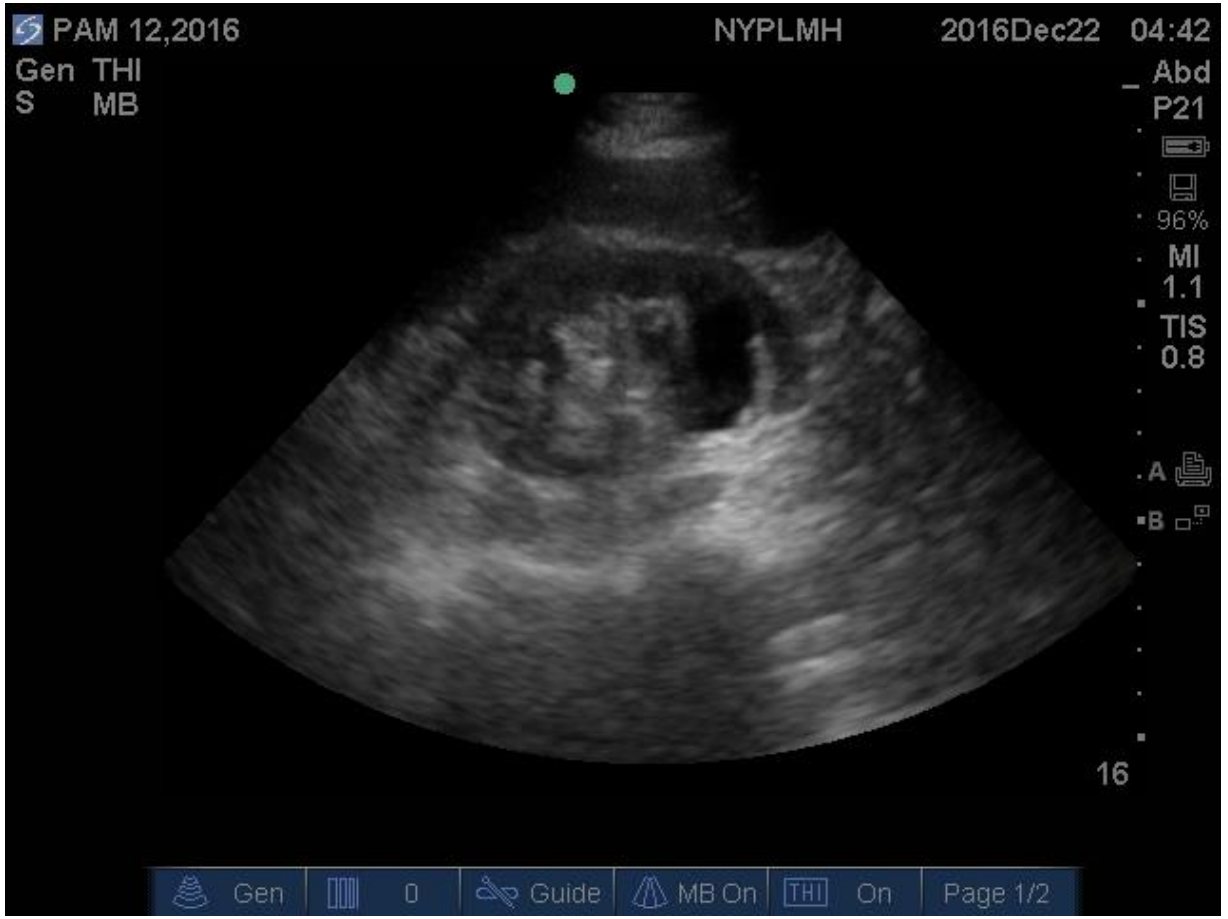
www.clevelandclinicmeded.com/medicalpubs/diseasemanagement/nephrology/acute-kidney-injury/

ABDOMINAL IMAGING



RIGHT KIDNEY





LEFT KIDNEY

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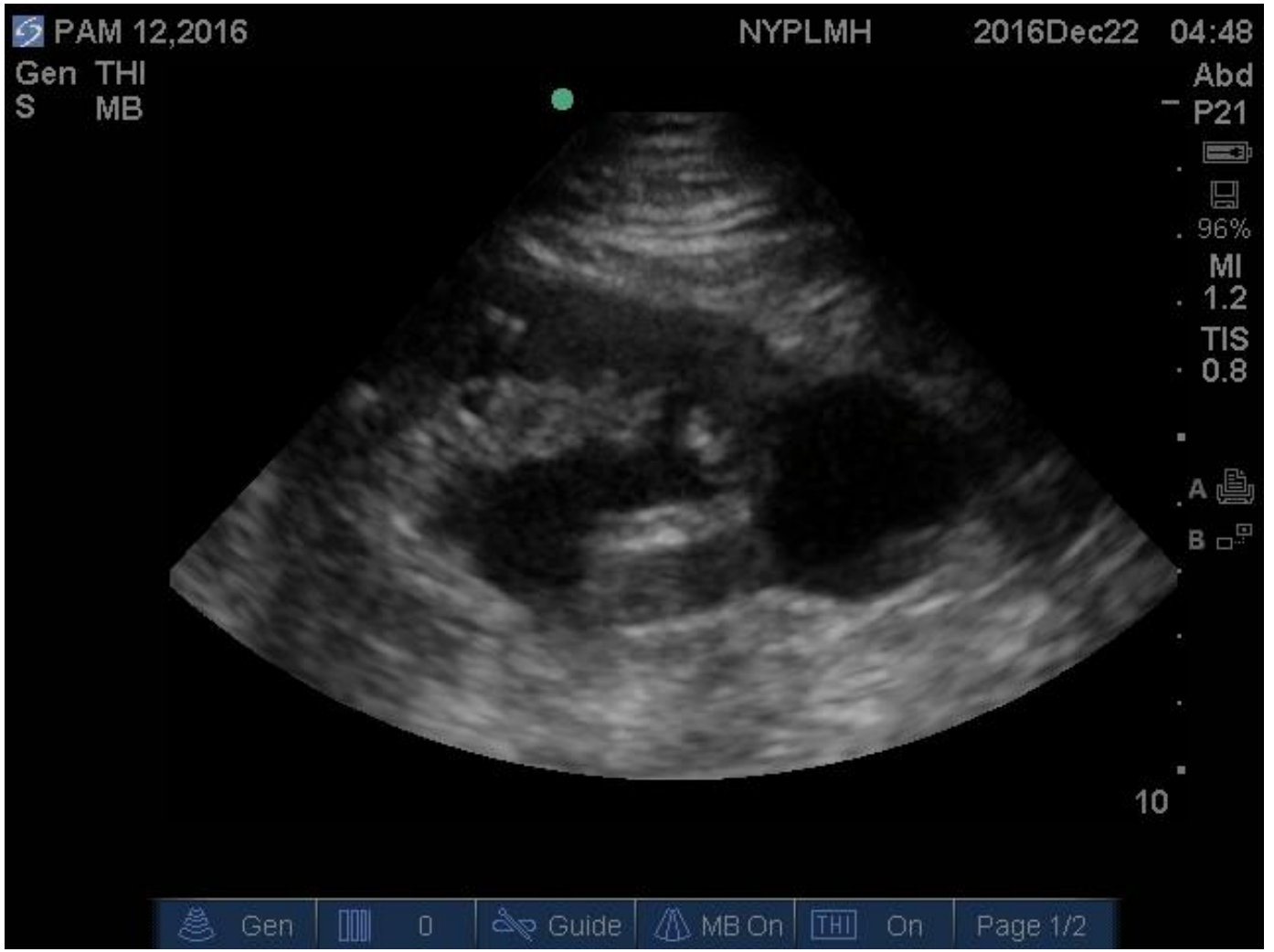

FORMAL IMAGING

Renal U/S

- **Moderate left hydronephrosis** with a **calculus** in the proximal left ureter measuring approximately 1.3 cm in diameter.
- No right hydronephrosis. **Multiple right renal cysts.** Mildly elevated right arterial resistive index suggestive of intrinsic medical renal disease.

CT abd/pelvis w/o contrast confirmed the above

- Also noted **multiple bilateral simple appearing renal cysts** and 3 additional urinary tract calculi

HOSPITAL COURSE

- Foley placed. Minimal UOP and no improvement in Cr.
- Lactic acid ↑ 4
- Nephrology consult
  "Mild CKD c/b AKI due to unilateral obstruction. Degree of renal insufficiency from unilateral insult suggests minimal function of contralateral kidney"
- L nephrostomy tube placed by IR due to high risk for sepsis / general anesthesia

HOSPITAL COURSE

- Sxs and Cr improved. On discharge, BUN/Cr was 16.0/1.7 (baseline)
- Unfortunately, recently pt came back for urosepsis 2/2 possible L PCN dislodgement
- Now s/p left ureteral stent but suffered cardiac arrest

CLINICAL QUESTIONS

- How useful is bedside renal sono in guiding ddx and tx?
- What are the limitations of bedside renal sono?
- How does renal sono compare to CT?

UTILITY OF BEDSIDE RENAL SONOGRAPHY

- Important to avoid missing diagnosis of hydronephrosis in real time
- Detecting pre-existing renal disease
- No radiation, repeatable, & can be used in critically ill patients

International Urology and Nephrology **32:** 591–596, 2001.

Bedside ultrasound: a useful tool for the on-call urologist?

R.S. Surange[1], N.S. Jeygopal[2], S.D. Chowdhury[1] & N.K. Sharma[1]
[1]*Department of Urology;* [2]*Department of Radiology, The Royal Oldham Hospital, Oldham, UK*

- Prospective study to assess accuracy of urgent bedside sono by urology trainees who had received training by consultant radiologist
- 109 patients (18-92 yo) bedside scanned then with formal imaging (3 types: CT scan 2, IVU 55, U/S 21)
- Abnormalities in 46 patients
- In 11 patients, beside sono significantly influenced initial management (e.g., obstruction, referral to medicine team)

Table 3. Results of bedside ultrasound compared to the definitive diagnosis of consultant radiologist

Findings on bedside ultrasound	Abnormality found on imaging by radiologist	Normal study on imaging by radiologist	Total no. of renal units
Abnormality noted	63 (true positive)	11 (false positive)	74
Normal study	15 (false negative)	132 (true negative)	147
Total	78	143	221

Sensitivity of bedside ultrasound: 80.7%.
Specificity of bedside ultrasound: 92.3%.
Positive Predictive Value of bedside ultrasound: 85.6%.
Negative Predictive Value of bedside ultrasound: 89.7%.

LR+ = 11

LR - = 0.20

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Limitations:

- Unclear level of training of trainees (urologists)
- Small N
- Comparison of bedside sono with different imaging modalities
- Non-ideal conditions: rapid a.m. rounds, poor lighting, etc.

Effect of Provider Experience on Clinician-Performed Ultrasonography for Hydronephrosis in Patients With Suspected Renal Colic

Meghan K. Herbst, MD; Graeme Rosenberg, MS; Brock Daniels, MD; Cary P. Gross, MD; Dinesh Singh, MD; Annette M. Molinaro, PhD; Seth Luty, MS; Christopher L. Moore, MD*

- Prospective observational study at Yale of 679 patients receiving CT scan
- POCUS done by ED clinicians with varied levels of training

Table 3. Sensitivity and specificity (with 95% CIs estimated by using results clustered by operators), and likelihood ratios, with 95% CIs for the presence of hydronephrosis: all hydronephrosis and moderate or greater hydronephrosis compared with any hydronephrosis on CT.*

Test and Reference Standard	Sensitivity (95% CI), %	Specificity (95%CI), %	Positive Likelihood Ratio (95% CI)
Hydronephrosis on ultrasonography vs hydronephrosis on CT			
All	72.6 (65.4–78.9)	73.3 (66.1–79.4)	2.72 (2.25–3.27)
Attending physician with fellowship training	92.7 (83.8–96.9)	81.4 (63.8–91.5)	4.97 (2.90–8.51)
Attending physician	61.5 (40.5–79.0)	77.9 (59.9–89.2)	2.78 (1.86–4.15)
Experienced resident	70.4 (59.3–79.5)	70.6 (59.6–79.7)	2.39 (1.74–3.28)
Inexperienced clinician	72.7 (54.4–85.7)	65.0 (45.3–80.6)	2.07 (1.49–2.88)
Moderate hydronephrosis on ultrasonography vs any hydronephrosis on CT			
All	31.3 (19.3–46.1)	94.6 (90.3–97.1)	5.76 (3.61–9.19)
Attending physician with fellowship training	38.2 (4.9–88.2)	98.3 (82.8–99.9)	22.52 (3.13–161.8)
Attending physician	23.1 (7.2–53.7)	97.1 (89.7–99.2)	8 (2.44–26.2)
Experienced resident	37.0 (19.6–58.7)	90.8 (80.4–96.0)	4.03 (2.12–7.65)
Inexperienced clinician	26.0 (10.4–51.6)	93.8 (83.2–97.9)	4.15 (1.64–10.51)
Hydronephrosis on ultrasonography vs hydronephrosis on CT: clinician directly involved in care of the patient			
All	72.3 (61.8–80.8)	73.9 (63.8–82.1)	2.78 (2.25–3.42)
Attending physician with fellowship training	95.2 (85.8–98.5)	86.8 (66.5–95.6)	7.24 (3.19–16.4)
Attending physician	61.0 (39.9–78.7)	77.7 (59.5–89.2)	2.73 (1.83–4.09)
Experienced resident	70.4 (57.3–80.8)	70.7 (57.7–81.0)	2.40 (1.64–3.50)
Inexperienced clinician	73.3 (51.0–87.9)	64.7 (41.0–82.9)	2.08 (1.46–2.97)

*Test characteristics of studies conducted by sonographers directly involved in the care of the patient are also shown.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Ultrasonography versus Computed Tomography for Suspected Nephrolithiasis

R. Smith-Bindman, C. Aubin, J. Bailitz, R.N. Bengiamin, C.A. Camargo, Jr., J. Corbo, A.J. Dean, R.B. Goldstein, R.T. Griffey, G.D. Jay, T.L. Kang, D.R. Kriesel, O. J. Ma, M. Mallin, W. Manson, J. Melnikow, D.L. Miglioretti, S.K. Miller, L.D. Mills, J.R. Miner, M. Moghadassi, V.E. Noble, G.M. Press, M.L. Stoller, V.E. Valencia, J. Wang, R.C. Wang, and S.R. Cummings

- Multicenter comparative effectiveness trial
- 2759 patients (18-76 yo) in 15 EDs with flank/abd pain

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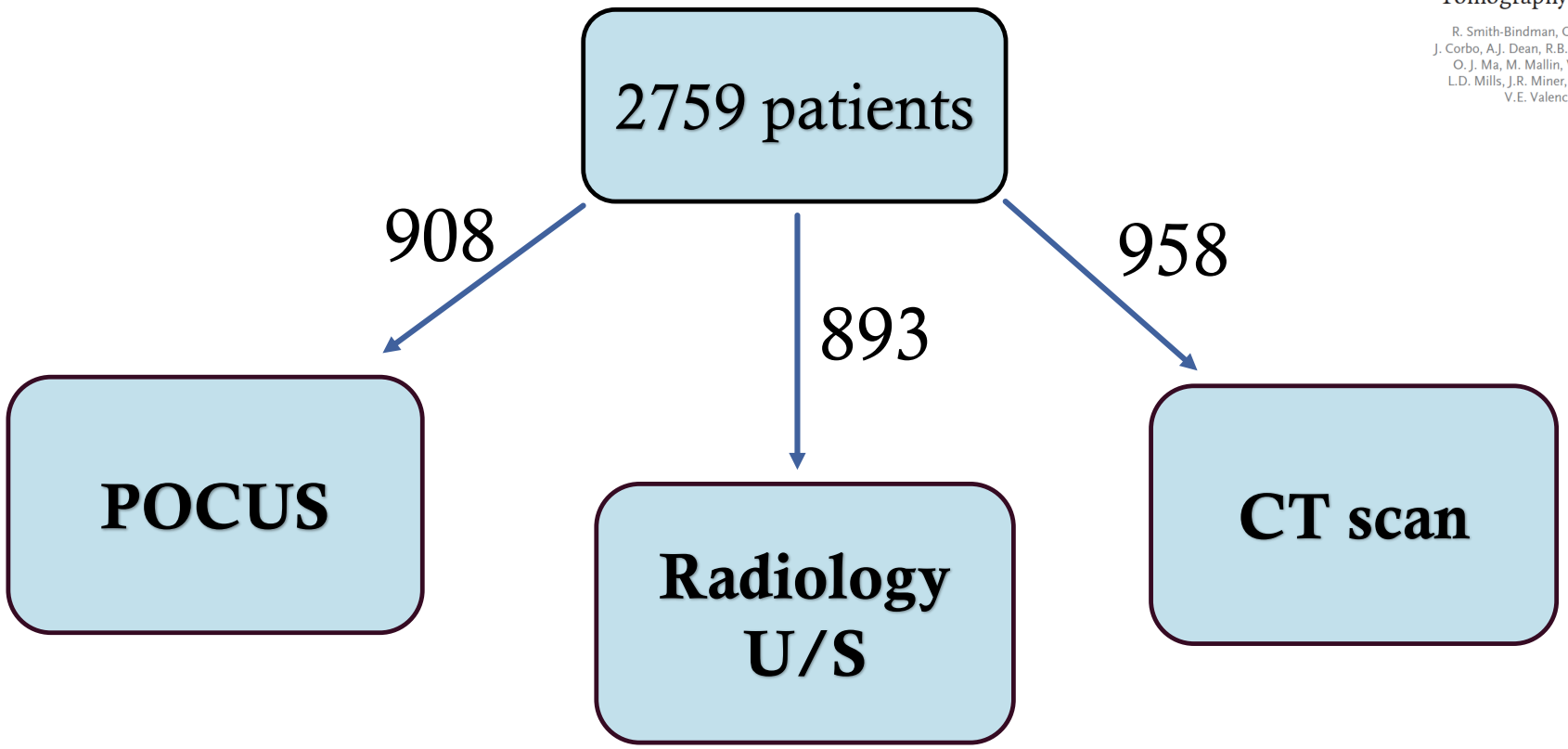

Table 3. Primary and Secondary Study Outcomes According to Study Group.*

Outcome	Point-of-Care Ultrasonography (N = 908)	Radiology Ultrasonography (N = 893)	Computed Tomography (N = 958)	P Value
Primary Outcomes				
High-risk diagnosis with complication — no. of patients (%)	6 (0.7)	3 (0.3)	2 (0.2)	0.30
Radiation exposure — mSv	10.1±14.1	9.3±13.4	17.2±13.4	<0.001

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Secondary Outcomes				
Serious adverse events — no. of patients (%)	113 (12.4)	96 (10.8)	107 (11.2)	0.50
Related serious adverse events — no. of patients (%)†	3 (0.3)	4 (0.4)	5 (0.5)	0.88
Emergency department length of stay — hr‡				
Median	6.3	7.0	6.4	<0.001

No significant differences

1) return ED visits, 2) hospital admissions after ED discharge, 3) pain scores

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Accuracy for diagnosis of nephrolithiasis‖				
Sensitivity — % (95% CI)	54 (48-60)	57 (51-64)	88 (84-92)	<0.001
Specificity — % (95% CI)	71 (67-75)	73 (69-77)	58 (55-62)	<0.001

First imaging study only

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Accuracy for diagnosis of nephrolithiasis‖				
Sensitivity — % (95% CI)	85 (80–89)	84 (79– 89)	86 (82–90)	0.74
Specificity — % (95% CI)	50 (45–54)	53 (49–57)	53 (49–58)	0.38

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CONCLUSIONS:

- U/S should be used as initial test (not only test)
- Outcomes similar in all 3 groups

LIMITATIONS:

- Not blinded
- ED MDs trained in POCUS

SUMMARY

- Bedside renal sono can be a useful tool and can be used as first imaging modality (particularly in cases of stones)
- More training is (of course) better

REFERENCES

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