POCUS Conference

Kayley Ancy
PGY-3
December 13th, 2016

Case of pt KD—History

- 52yo F with PMH of HLD presented after an episode of chest pain
- Had presented day PTA to an OSH after an episode of chest pain → syncope while cycling, discharged from the ED
- Chest pain on night of presentation described as pressure-like & retrosternal, radiating to LUE and associated with dyspnea and nausea
  - Lasted 20 minutes
- 2.5 pack-year history of smoking

Case of pt KD—Physical exam

- T 36.7, HR 72, BP 120/70, 100% on RA
- A&Ox3, comfortable on room air
- No JVD
- RRR, no m/r/g
- Lungs CTAB
- no LE edema, WWP, 2+ pulses throughout

Case of pt KD—Labs/studies

- Troponin 0.2 → 0.82
- D-dimer 295
- Normal ECG

Differential diagnosis

- ACS?
  - Few risk factors
  - Young
- PE
  - Preceding syncopal episode the day prior to presentation

Bedside sono on admission to 4N

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Two questions

- How often does POCUS influence our differential diagnosis?
- How good are we as internists/residents at estimating systolic function (as measured by EF)?

Clinical question #1

HOW OFTEN DOES POCUS CHANGE OUR LEADING DIAGNOSIS?

Impact of Point-of-Care Ultrasound Examination on Triage of Patients With Suspected Cardiac Disease

Sergio L. Kobal, MD[a], Noah Liel-Cohen, MD[a], Sarah Shimony, MD[b], Yoram Neuman, MD[c], Yuval Konstantino, MD[a], Efrat Mazor Dray, MD[a], Itai Horowitz, MD[a], and Robert J. Siegel, MD[d,*]

- Multi-center, mostly inpatient ICU/ED
- 18 physicians
  - 8 cardiology fellows
  - 5 cardiology attendings
  - 5 echo attendings
- 207 subjects underwent bedside echo
- 43% of exams done for chest pain

Kobal, et al. *Am J Cardiol* 2016;118:1582-1587.

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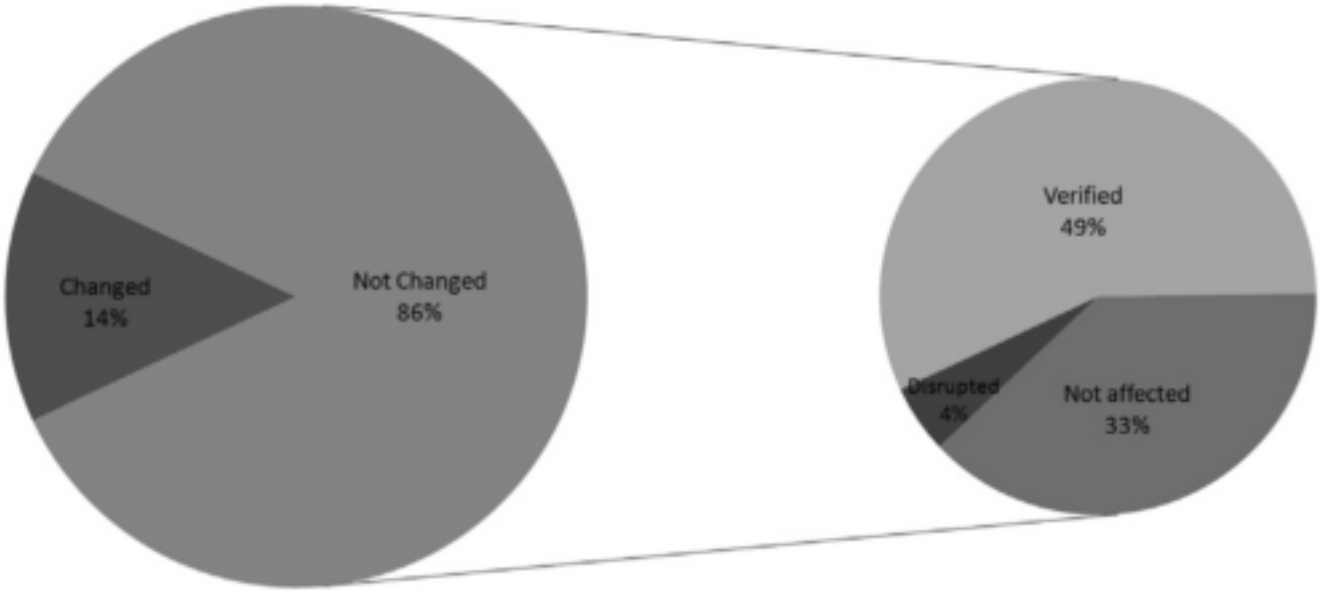

Figure 1. Impact of POCUS on primary diagnosis. POCUS findings resulted in a change in the primary diagnosis in 14% of patients. In patients whose diagnosis remained unchanged, POCUS results reinforced the initial diagnosis in 48% of the cases. Dx = diagnosis.

In 52% of cases POCUS resulted in changes to further diagnostic tests or treatment

Kobal, et al. *Am J Cardiol* 2016;118:1582-1587.

Diagnostic Influence of Routine Point-of-Care Pocket-size Ultrasound Examinations Performed by Medical Residents

Garrett N. Andersen, MD, Torbjørn Graven, MD, Kyrre Skjetne, MD, Ole C. Mjølstad, MD, PhD, Jens O. Kleinau, MD, Øystein Olsen, MD, Bjørn O. Haugen, MD, PhD, Håvard Dalen, MD, PhD

- 199 ED admissions
- 6 IM residents
- Cardiac + abdominal exams
- 4 hours of formal didactics
- Median of 95 exams done prior to study start IQR [80, 225]
  - Median of 32.5 IQR [20, 85] supervised by a cardiologist

Andersen, et al. *J Ultrasound Med* 2015;34:627-636.

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Table 3. Diagnostic Influence of Goal-Directed Point-of-Care Cardiovascular and Abdominal Examinations With the Pocket-size Imaging Device

Parameter	% (n)	95% CI, %
Change of primary diagnosis	6.5 (13)	3–10
Verification of primary diagnosis	10.5 (21)	6–15
Important additional diagnosis[a]	24.0 (48)	18–30
Unimportant additional diagnosis[b]	12.5 (25)	8–17
No diagnostic use	54.0 (108)	47–61

CI indicates confidence interval.

[a]Diagnosis influencing treatment or follow-up: eg, heart failure, hypertrophic obstructive cardiomyopathy, regional wall motion abnormalities, major valvular disease, dilated ascending aorta, ascites, pericardial and pleural effusions, urinary retention, hypovolemia, and fluid overload.

[b]Diagnosis not influencing treatment or follow-up: eg, minor valvular disease, gallstones, and simple renal cysts.

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Routinely adding ultrasound examinations by pocket-sized ultrasound devices improves inpatient diagnostics in a medical department

Ole Christian Mjolstad [a,b,*], Havard Dalen [a,c], Torbjorn Graven [c], Jens Olaf Kleinau [c], Oyvind Salvesen [d], Bjorn Olav Haugen [a,b]

- Same hospital as last study
- 196 subjects
- 3 cardiologists
- Cardiac + abdominal exam

Table 2
Diagnostic usefulness of bedside cardiovascular and abdominal ultrasound screening with the pocket-sized ultrasound device.

	Number (%)
Change of primary diagnosis	36 (18.4%)
Verification of primary diagnosis	38 (19.4%)
Additional diagnosis made	18 (9.2%)
No diagnostic usefulness	104 (53.1%)

Mjolstad, et al. *European Journal of Internal Medicine* 2012;23:185-191.

Clinical question #2

HOW GOOD ARE WE AS INTERNISTS/RESIDENTS AT ESTIMATING SYSTOLIC FUNCTION (AS MEASURED BY EF)?

Internal Medicine Point-of-Care Ultrasound Assessment of Left Ventricular Function Correlates with Formal Echocardiography

Benjamin K. Johnson, MD,[1] David M. Tierney, MD, FACP,[1] Terry K. Rosborough, MD, FACP,[1]
Kevin M. Harris, MD, FASE,[2] Marc C. Newell, MD[2]

- 178 subjects who underwent formal TTE within 48 hours
- POCUS done by residents, supervised by attendings
- Fairly extensive training
- Classified EF as:
  - Normal (>50%)
  - Mild to moderately reduced (31-50%)
  - Severely reduced (<31%)

Johnson, et al. *Journal of Clinical Ultrasound* 2016;44:92-99

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- Sensitivity 0.91 [0.80, 0.97]
- Specificity 0.88 [0.81, 0.93]
- +LR 7.6, -LR 0.1
- κ = 0.77 [0.67, 0.87]
  - Agreement for POCUS and formal TTE for any impairment and agreement between individual categories

Johnson, et al. *Journal of Clinical Ultrasound* 2016;44:92-99

Internal Medicine Point-of-Care Ultrasound Assessment of Left Ventricular Function Correlates with Formal Echocardiography

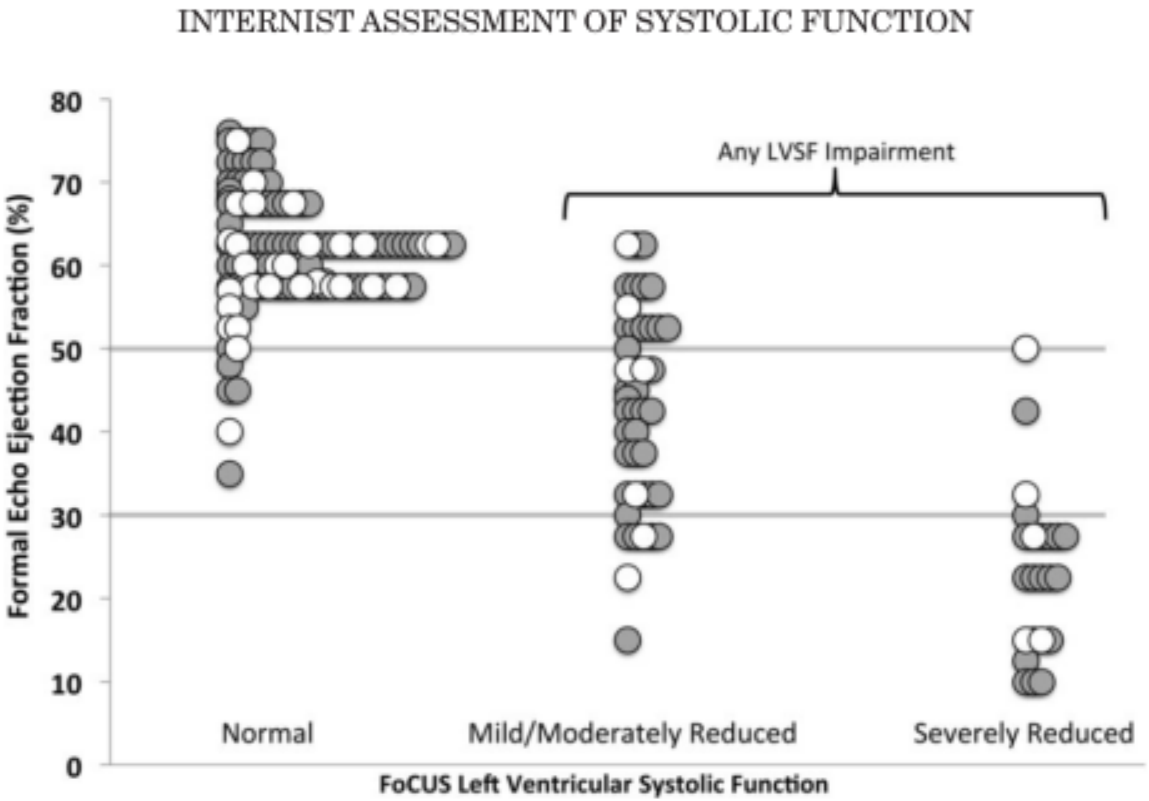

FIGURE 1. Internal medicine bedside ultrasound qualitative assessment of left ventricular systolic function (LVSF) compared with formal echocardiography left ventricular ejection fraction (LVEF) (n = 178). Formal echocardiography LVEF cutoffs (horizontal gray lines) were set as "normal ≥50%," "mild/moderate dysfunction 31–49%," "severe dysfunction ≤30%." White data points represent "technically limited" formal studies per cardiologist interpretation. FoCUS, focused cardiac ultrasound.

Johnson, et al. *Journal of Clinical Ultrasound* 2016;44:92-99

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TABLE 2
Test Characteristics of Internal Medicine Bedside Cardiac Ultrasound Compared with Formal Cardiologist Interpreted Echocardiography

Left Ventricular Systolic Function (Ejection Fraction %)	Exams (n = 178)	LR(+)	LR(-)	Sensitivity	Specificity
Normal (≥50%)	111	11	0.13	0.88 (95% CI 0.81, 0.93)	0.92 (95% CI 0.80, 0.97)
Mild/moderate LV dysfunction (31–49%)	44	5	0.35	0.70 (95% CI 0.51, 0.84)	0.86 (95% CI 0.79, 0.91)
Severe LV dysfunction (≤30%)	22	24	0.29	0.72 (95% CI 0.50, 0.88)	0.97 (95% CI 0.92, 0.99)
Any LV dysfunction (<50%)	67	8	0.10	0.91 (95% CI 0.80, 0.97)	0.88 (95% CI 0.81, 0.93)

Abbreviation: LV, left ventricular.

Johnson, et al. *Journal of Clinical Ultrasound* 2016;44:92-99

Feasibility of point-of-care echocardiography by internal medicine house staff

John H. Alexander, MD, MS,[a] Eric D. Peterson, MD, MPH,[a] Anita Y. Chen, MS,[b] Tina M. Harding, BSN,[b] David B. Adams, RDCS,[a] and Joseph A. Kisslo, Jr, MD[a] *Durham, NC*

- 3-hour training
- 533 subjects
- 20 IM residents

Table II. Agreement and κ statistics between POC echocardiography and standard echocardiography and between 2 interpretations of standard echocardiography

	Agreement	κ
LV function		
POC echocardiography	75%	0.51
Standard echocardiography	83%	0.63
Mitral regurgitation		
POC echocardiography	79%	0.31
Standard echocardiography	92%	0.68
Aortic valve disease		
POC echocardiography	92%	0.32
Standard echocardiography	95%	0.62
Pericardial effusion		
POC echocardiography	98%	0.51
Standard echocardiography	97%	0.53

"Indeterminate" responses are excluded.

Alexander, et al. *Am Heart J* 2004;147:476-81.

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Table III. Sensitivity, specificity, positive predictive value, and negative predictive value of POC echocardiography compared to standard echocardiography

	Sensitivity	Specificity	LR(+)	LR(-)	Positive predictive value	Negative predictive value
LV dysfunction (%)	82	71	3	0.25	67	85
Mitral regurgitation (%)	48	85	3	0.61	40	89
Aortic valve disease (%)	29	97	10	0.73	46	95
Pericardial effusion (%)	54	99	54	0.46	50	99

Alexander, et al. *Am Heart J* 2004;147:476-81.

Common Pitfalls

- Not using enough views to gather data
- Inappropriately interpreting results
  - Answering inappropriate clinical questions
  - EF as a definite measure of systolic function

Conclusions

- POCUS can have a big impact on diagnosis
  - Greater influence with greater uncertainty after initial H&P
- With adequate training, we are pretty good as estimating EF
  - Practice makes better
  - Better when EF is at ends of the spectrum (normal vs severely reduced)

References

- Alexander, et al. “Feasibility of Point-of-care Echocardiography by Internal Medicine House Staff”. *Am Heart J* 2004;147:476-81.
- Andersen, et al. “Diagnostic Influence of Routine Point-of-care Pocket-size Ultrasound Examinations Performed by Medical Residents”. *J Ultrasound Med* 2015;34:627-636.
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