

Brain Natriuretic Peptide Monitoring: An Opportunity for Early Intervention to Prevent Heart Failure Rehospitalization

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I have no financial interest or affiliations concerning material discussed in this presentation.

Clinical case

Part One

My Patient

48 YO AAF PRESENTS TO THE OFFICE TO ESTABLISH CARE. C/O DRY COUGH AND 'RETAINING FLUID' SINCE AN ILLNESS ABOUT 1 MONTH AGO. HAS DEVELOPED HIGH BLOOD PRESSURE AND FEET SWELLING ON AND OFF FOR THE PAST FEW WEEKS.

TREATED OUTPATIENT FOR BRONCHITIS X3 OVER THE PRIOR THREE MONTHS WITH ANTIBIOTICS AND STEROIDS PER URGENT CARES WITHOUT IMPROVEMENT.

PMH: Class I Obesity

FH: Unremarkable

SH: Unremarkable

ROS:

- *Negative*: Fevers, rhinorrhea, sore throat, PND, no acute viral illness preceding, no chest pain, no palpitations
- *Positive*: Orthopnea, dyspnea on exertion

My Patient (continued)

Vital signs

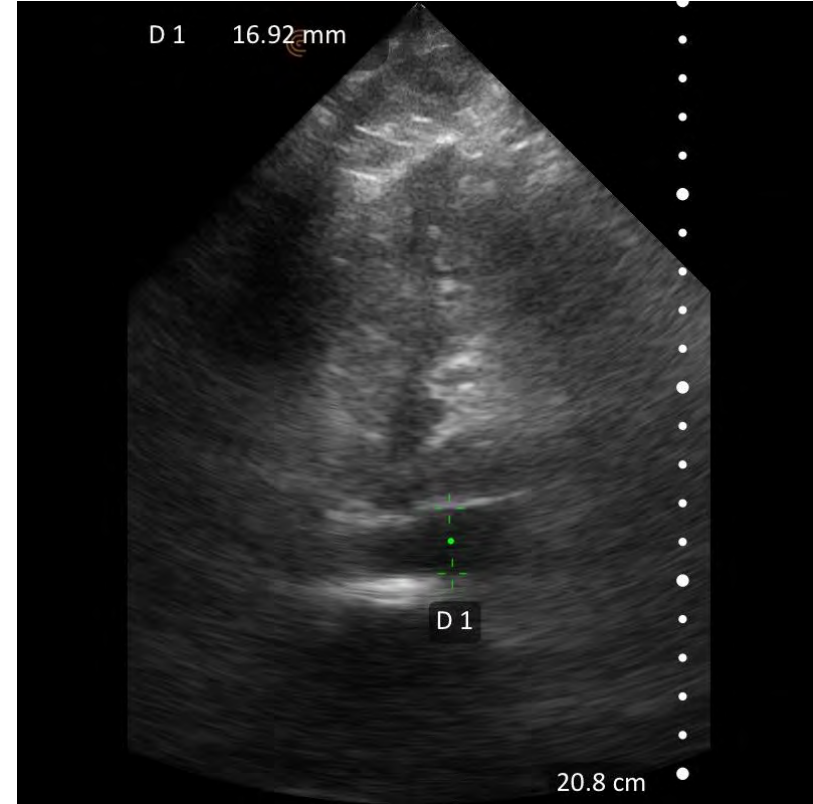
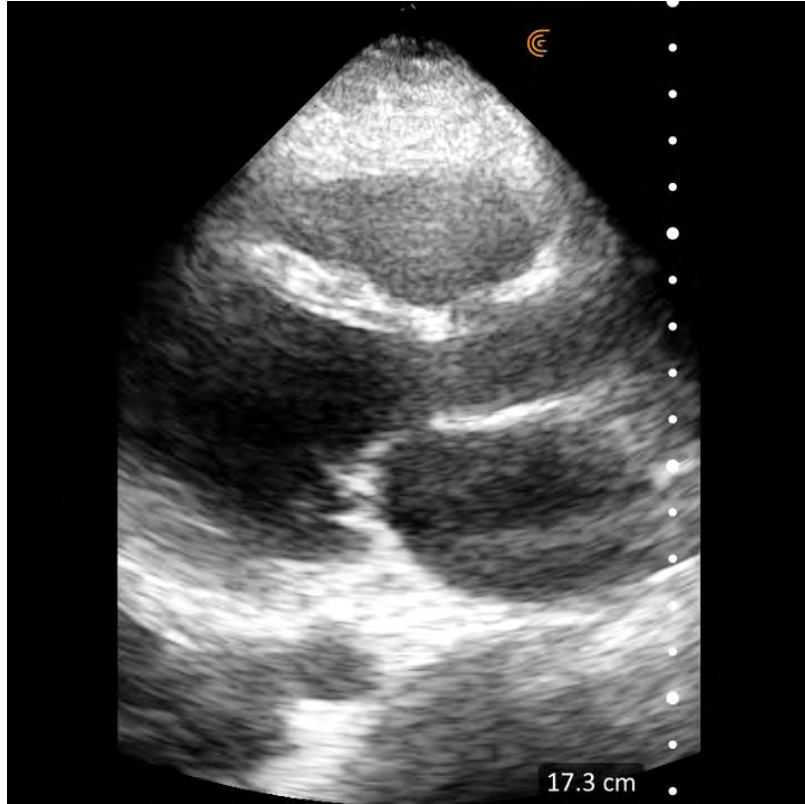
- Blood pressure: 172/137
- Heart rate: 114
- Respiratory rate: 18
- O2 saturation: 99% on room air

Brief physical exam

- General: Uncomfortable-appearing
- HENT: Nares patent without drainage, no tenderness overlying sinuses, **+JVP**
- CV: Regular rhythm, **tachycardic rate**
- Pulm: **Conversational dyspnea, faint crackles, decreased lung sounds in bases**
- MSK: **2+ pitting edema bilateral LEs**



Impression: Fluid Overload



POC Ultrasound

Plan: Direct Admission

	Latest Ref Rng & Units	1/2/2024
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Sodium	135 - 145 mmol/L	135
Potassium	3.5 - 5.0 mmol/L	3.7
Chloride	98 - 109 mmol/L	102
CO2	24 - 29 mmol/L	19 ▼
BUN	6 - 20 mg/dL	15
Glucose	65 - 105 mg/dL	115 ▲
Creatinine	0.52 - 1.04 mg/dL	1.02
Calcium	8.4 - 10.2 mg/dL	9.2
Anion Gap	3 - 11	14 ▲
Osmolality Calc	280 - 297 mosm/kg	282
BUN/Creatinine Ratio	ratio	14.7
Total Bilirubin	0.1 - 1.2 mg/dL	0.8
Aspartate Aminotransferase (AST)	14 - 36 U/L	47 ▲
Alanine Aminotransferase (ALT)	0 - 34 U/L	59 ▲
Total Protein	6.3 - 8.2 g/dL	7.5
Albumin Level	3.5 - 5.0 g/dL	4.4
Alkaline Phosphatase	40 - 180 U/L	87
EGFR	mL/min/1.73m ²	68 📄

	Latest Ref Rng & Units	1/2/2024
		<input type="text"/>
NT-proBNP	pg/mL	12,400.0

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Chest X-ray

- Left Ventricle: Size is normal. Normal wall thickness. Severe global hypokinesia present. Severely reduced systolic function with an approximate EF of 10 -15%.
- Right Ventricle: Size is normal. Reduced systolic function.
- Right Atrium: Mildly dilated.
- Aortic Valve: Normal valve structure. Trileaflet.
- Mitral Valve: Mild regurgitation.
- Tricuspid Valve: There is no pulmonary hypertension. RVSP is 31.0 mmHg. Mild to moderate regurgitation with a centrally directed jet.
- Extracardiac: Large pleural effusion present.
- A complete 2D, color flow doppler and spectral doppler echocardiogram was performed.

Echocardiogram

- Diuresis
- Initiate GDMT immediately
- Iron Transfusion
- Heart catheterization
- Dietician consult
- Education



Discharge with close
TCM follow up

NT-proBNP Monitoring

UPDATE

** As of 5/5/23, original author James L. Januzzi, Jr., MD, FACC provided this update to include recent information and research related to the content.*

Over recent years, greater clarity has been gained regarding the understanding of how to best interpret concentrations of B-type natriuretic peptide (BNP) or N-terminal (NT)-proBNP in ambulatory individuals with or without prior heart failure (HF). Among those without prevalent HF, data now suggest that the wall stress—leading to rise in these biomarkers—may be present even prior to the onset of symptomatic HF. Accordingly, the Universal Definition of HF^a and the 2022 American College of Cardiology (ACC)/American Heart Association (AHA)/Heart Failure Society of American (HFSA) Heart Failure guidelines^b both recognize elevation of BNP/NT-proBNP (as well as high sensitivity cardiac troponin) as independent indicators of "Stage B/PreHF" and risk factors for progression to symptomatic disease. In those with established HF, concentrations of BNP and NT-proBNP are important indicators of wall stress, and although they are influenced by the degree of congestion in such patients, other variables strongly affect values of both markers. Notably, cardiac remodeling—presence of dilation and loss of left ventricular (LV) function as well as development of increased LV mass—is an important driver of BNP/NT-proBNP concentrations in ambulatory HF. Clinicians should be aware that rising values for either marker in this context may not necessarily indicate congestion but might well identify presence of progressive dysfunction of the LV.

- a. Bozkurt B, Coats AJ, Tsutsui H, et al. Universal Definition and Classification of Heart Failure: a report of the Heart Failure Society of America, Heart Failure Association of the European Society of Cardiology, Japanese Heart Failure Society and writing committee of the universal definition of heart failure. *J Card Fail* 2021;Mar 1:[Epub ahead of print].
- b. Heidenreich PA, Bozkurt B, Aguilar D, et al. 2022 AHA/ACC/HFSA guideline for the management of heart failure: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *J Am Coll Cardiol* 2022;79:1757-80.

American College of Cardiology:

Update on Cardiac Biomarkers and Heart Failure

2024 ACC Expert Consensus Decision Pathway for Treatment of HFrEF

- BNP or NT-proBNP can be used for assessing disease severity or establishing prognosis
- Trends can indicate presence of or severity of congestion and potential for cardiac remodeling, particularly of the left ventricle
- "A measurement of BNP or NT-proBNP at each clinical evaluation may inform clinical decisions"
- More frequent measurement may be appropriate at times such as when GDMT is being rapidly titrated
- If BNP or NT-proBNP levels do not fall with GDMT, indicates worse prognosis

"Measurement of BNP or NT-proBNP is useful to **monitor risk**, assist in decision making regarding the ordering of imaging studies to evaluate LV remodeling, and to provide helpful objective data regarding decision-making for referral to an advanced HF specialist."

JACC Heart Failure

Prognostic Impact of Repeated NT-proBNP Measurements in Patients with Heart Failure with Reduced Ejection Fraction

- Study arm had GDMT titrated to achieve goal NT-proBNP of <1000 pg/mL
- Looked at primary endpoints of time to first heart failure hospitalization or cardiovascular mortality
- Showed that repeated NT-proBNP measurements strongly predicted outcomes in HFrEF and that increases could predict an event as early as three weeks out
- Greater prognostic information was had from repeated measurements than from baseline measurement by itself

"Secular trends in NT-proBNP are predictive of future events well before such outcomes occur."

Clinical Case

Part Two

Titrate down diuretic dosing

Pending NT-proBNP result each
visit

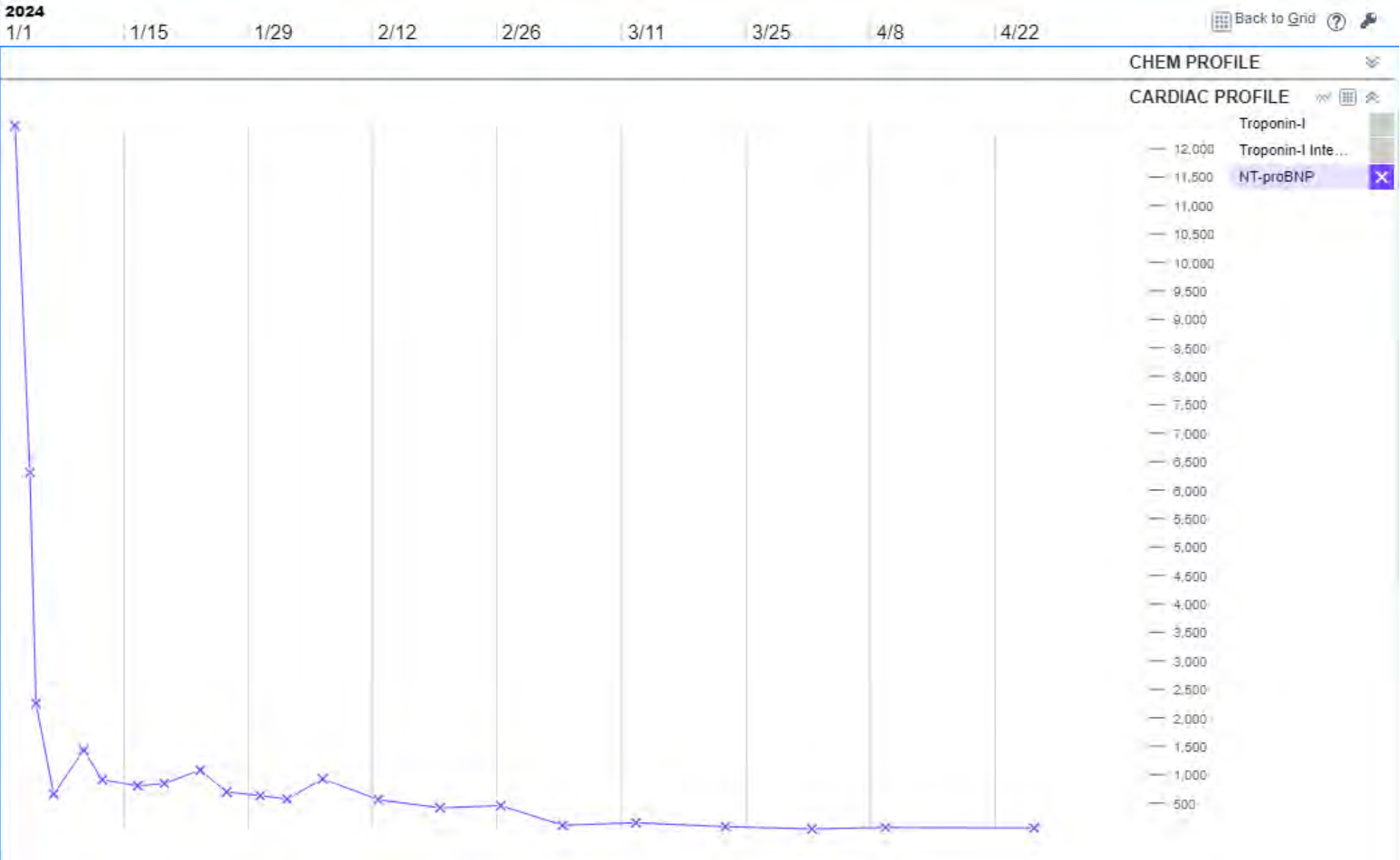
Titrate up GDMT dosing

Pending vital sign log each visit

General Approach to Further Outpatient Monitoring

- At every visit:
 - ROS, activity tolerance
 - Vital sign log review
 - Medication review
 - Close physical exam
 - Lab work: BNP, BMP, Magnesium
- Three-month visit:
 - Iron saturation level
 - Repeat echocardiogram

NT-proBNP Monitoring: My Patient



Date	NT-proBNP
1/02/24	12,400
1/04/24	6,310
1/05/24	2,250
1/07/24	660*
1/10/24	1,430
1/12/24	911
1/16/24	805
1/19/24	845
1/23/24	1,080
1/26/24	697

Direct admission

*Discharged

Begin furosemide 40 mg daily

Halve furosemide to 20 mg daily

Alternate furosemide 40 mg daily with furosemide 20 mg daily

Decreased furosemide back to 20 mg daily

Red: Diuresis

Green: GDMT titration

Date	NT-proBNP
1/30/24	634
2/02/24	571
2/06/24	926
2/12/24	560
2/26/24	455
3/04/24	112
3/12/24	155
3/22/24	86
04/01/24	46

Increase furosemide to 40 mg daily

Decreased furosemide back to 20 mg daily

Decreased furosemide to 20 mg every other day. Increase spironolactone to 25 mg daily

Stopped furosemide. Increase carvedilol to 6.125 mg BID

Increase carvedilol to 6.125 x1.5 BID

Increase carvedilol to 12.5 mg BID

Red: Diuresis

Green: GDMT titration

- Left Ventricle: Size is normal. Findings consistent with mild left ventricular concentric hypertrophy. Mild global hypokinesis with regional variations present. Mildly reduced LV systolic function with an approximate EF of 40 - 45%.
- Right Ventricle: Size is normal. Normal systolic function.
- Aortic Valve: Trileaflet. There was mild aortic valve sclerosis without stenosis.
- Mitral Valve: Mildly thickened leaflets. Mild mitral annular calcification.
- A limited 2D echocardiogram was performed.
- Doppler/regurgitation not assessed in limited 2D study.

Three Month Echocardiogram

Limitations and Opportunities

- May not fit every patient population
- Compliance and motivation are essential
- Need intensive education if patient does not have an inherent health literacy
- Potential for structured BNP monitoring and office visits in known heart failure patients
- Devoted heart failure vs high risk family medicine clinic time
- Heart failure education group classes

Questions

References

- Fuery, M, Leifer, E, Samsky, M. et al. Prognostic Impact of Repeated NT-proBNP Measurements in Patients With Heart Failure With Reduced Ejection Fraction. *J Am Coll Cardiol HF*. 2024 Mar, 12 (3) 479–487.
- Maddox, T, Januzzi, J, Allen, L. et al. 2024 ACC Expert Consensus Decision Pathway for Treatment of Heart Failure With Reduced Ejection Fraction: A Report of the American College of Cardiology Solution Set Oversight Committee. *J Am Coll Cardiol*. 2024 Apr, 83 (15) 1444–1488.
- “Update | Cardiac Biomarkers and Heart Failure - American College of Cardiology.” *American College of Cardiology*, 9 Feb. 2015, www.acc.org/Latest-in-Cardiology/Articles/2015/02/09/13/00/Cardiac-Biomarkers-and-Heart-Failure#:~:text=Accordingly,%20the%20Universal%20Definition%20of,as%20independent%20indicators%20of%20%22Stage.