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PEARLS OF LABORATORY MEDICINE

Intraosseous Blood Analysis

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CCTC Clinical Chemistry Trainee Council

A Real World Example

Image from Patel KK and Scott MG. A fatty blood sample. Clin. Chem. 2015; 61: 672-3.

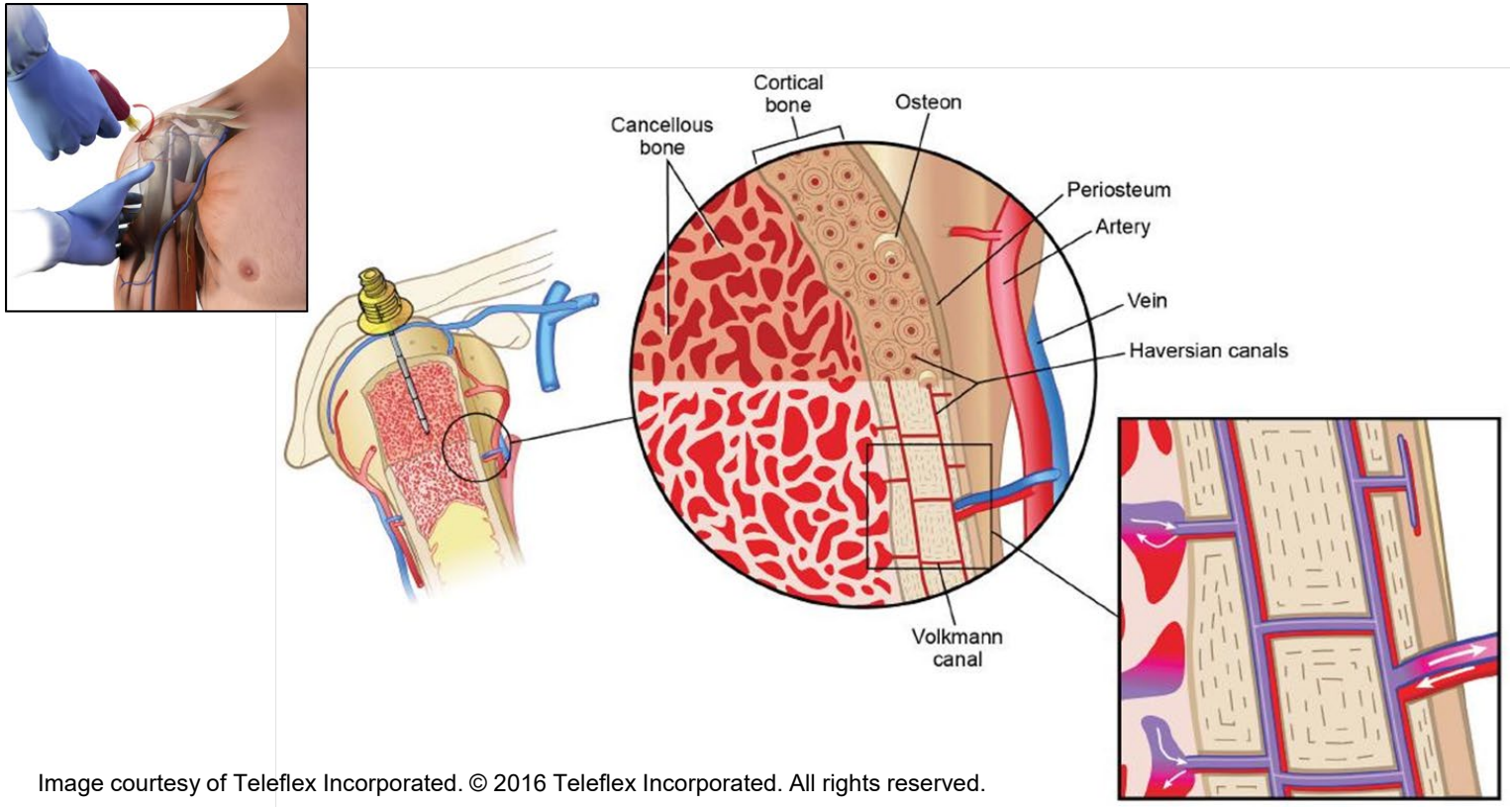
- 85-yo female in hypovolemic shock
- Intraosseous (IO) blood sample
- Comprehensive metabolic panel (CMP), phosphate, magnesium, lactate dehydrogenase (LD), creatine kinase (CK), troponin, B-type natriuretic peptide

What would you do with this sample?

IO Vascular Access

- Introduced in 1922 by Drinker and Doan
- Indicated any time vascular access is difficult to obtain in emergent, urgent, or medically necessary (non-emergent) cases
- Mainly used to deliver fluids and medications

IO Vascular Access



The Science & Fundamentals of Intraosseous Vascular Access. Second Edition. 2013. Vidacare® Corporation. (Reproduced with permission from Teleflex)

IO Blood Sample Quantity & Quality

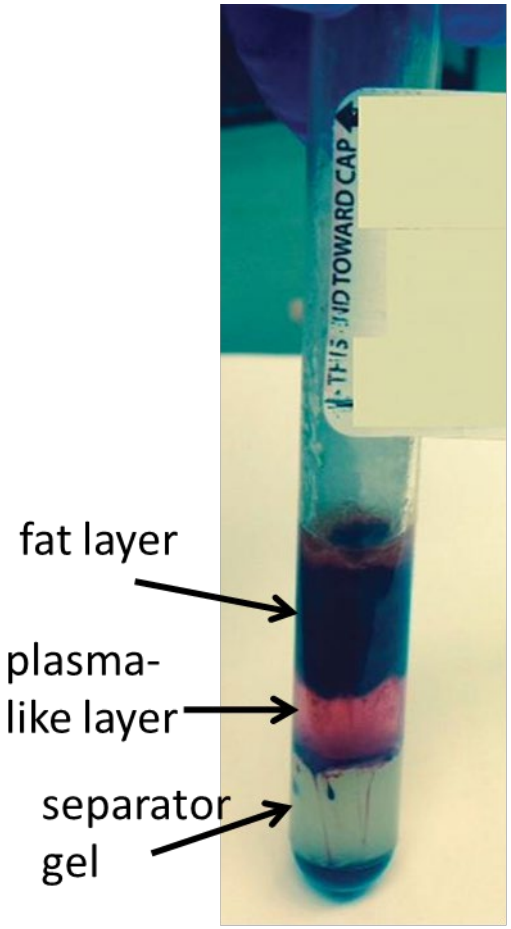


Image from Patel KK and Scott MG. A fatty blood sample. Clin. Chem. 2015; 61: 672-3.

- Limited sample volume
- Sample clotting and hemolysis are both common
- Highly lipemic samples also occur albeit at lower frequency
- Contamination with bone spicules

Assay Validation

- Non-standard body fluid
- Validation studies required by good lab practice and regulatory bodies
- CLSI C49-A section on “Clinically unique samples” may be helpful
- How to obtain sufficient sample volume for study?

Human Studies – Methods

- 7 studies (published 1991 to 2014)
- Up to 30 hemodynamically stable patients
- CMP, complete blood count (CBC), blood gases, lactate, and/or typing and screeing
- Central lab or point-of-care analyzers

Human Studies – Findings

	CORRELATION OF IO AND VENOUS BLOOD RESULTS		
ANALYTE	**STRONG**	**MODERATE**	**EVIDENCE**
Hemoglobin	✓		3/3 studies
Hematocrit		✓	3/4 studies
Urea	✓		3/3 studies
Creatinine	✓		3/3 studies
Glucose	✓		3/5 studies
pH	✓		1/3 studies
		✓	1/3 studies
Base excess	✓		1/2 studies
		✓	1/2 studies

Human Studies – Limitations

- Small study populations
- Location of IO access site may (not) be important
- Volume of marrow discarded prior to collection for lab analysis influences final results
- Outcomes may differ in hemodynamically unstable patients, patients with abnormal acid-base status, and/or patients with other serious acute pathological conditions

Animal Studies – Methods

- Over 11 studies (published 1986 to present)
- Up to 32 animals (pigs most common)
- Healthy state and critical illness
- CMP, LD, uric acid, blood gases, lactate, morphine, CBC
- Central lab or point-of-care analyzers

Animal Studies – Findings

- Average pH and pCO_2 generally correlate well between IO blood and other blood types
- Individual pH and pCO_2 show substantial variability
- Discordant results on blood chemistries
- Applicability of findings to humans?

Summary

- IO samples are often low in volume and have poor quality
- Human studies are limited in number & use small study populations consisting of hemodynamically stable patients
- Limited correlation exists with venous blood results

A Real World Example

Image from Patel KK and Scott MG. A fatty blood sample. Clin. Chem. 2015; 61: 672-3.

- ER able to establish central venous line
- Cancelled IO blood sample

	IO	Venous	Venous Ref Range
Potassium (mEq/L)	10.0	5.2	3.3-4.8
Creatinine (mg/dL)	2.0	1.9	0.6-1.3
Urea (mg/dL)	118	112	7-22
Glucose, random (mg/dL)	108	126	59-198

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Disclosures/Potential Conflicts of Interest

Upon Pearl submission, the presenter completed the Clinical Chemistry disclosure form. Disclosures and/or potential conflicts of interest:

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