



# Does Blood Volume and BNP Correlate?

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## Introduction

B-type natriuretic peptide (BNP) is a cardiac neurohormone predominantly released from the ventricles in response to stretch of ventricular myocytes or increase in wall tension. Values of BNP have guided physicians in fluid and diuretic therapy in patients with cardiac dysfunction but BNP levels reflect distension of cardiac chamber and may not represent intravascular blood volume (BV) status.

## Rationale and Objective

To determine if there is any correlation between BNP levels and Blood volume measurements in critically ill patients.

## METHODS

A retrospective review was done comparing blood volume measurements with BNP levels in Surgical Intensive Care Unit patients.

## Methods

- Plasma volume (PV) was measured using radioisotope iodine-131 labeled albumin injected over 1 minute with serial blood draws over 12, 18, 24, 30 and 36 minutes extrapolated to time zero (BVA-100, Daxor, N.Y). Simultaneous Hematocrit measurement (Red cell volume/plasma volume) allowed calculation of Blood Volume (BV = PV + Red cell volume)
- BV Values are expressed in mL as well as % deviation from ideal volumes. The predicted normal BV was determined from patient's height, weight and deviation from ideal body weight as described by Feldshuh and Enson. The range of normal values and degrees of deviation are presented below.

	Whole Blood Volume	Red Cell Volume	Plasma Volume
Normal	± 8%	± 10%	± 8%
Mild Deviation	9-16%	11-20%	9-16%
Moderate Deviation	17-24%	21-30%	17-24%
Severe Deviation	25-32%	31-40%	25-32%
Extreme Deviation	>32%	>41%	>32%

## Results

- Thirty SICU patients contributed 58 data points of Blood volume and BNP obtained simultaneously. Average age was 63 ±13 years, with 12 females and 18 males.
- Diagnosis (number of patients):
  - Septic Shock (14)
  - Trauma (11)
  - Hemorrhagic shock (5)
- Co-Morbidities (number of patients)
  - Cardiac (19)
  - Pulmonary (11)
  - Renal failure (8)
  - Liver failure (1)

There was no correlation between BNP levels and the %deviation from ideal blood volume (r=0.12, p=0.39). The volume states of patients were grouped according to BNP levels (see below):



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	BNP <100 pg/mL (n=5)	BNP 101-500 pg/mL (n=29)	BNP >500 pg/mL (n=24)
Hyper-volemia (n=31)	N=2	N=15	N=14
Hypo-volemia (n=14)	N=1	N=9	N=4
Euvolemia (n=13)	N=2	N=5	N=6

In Hypervolemic states, 29 of 31 (94%) instances demonstrated elevated BNP >100 pg/mL.

In Hypovolemic states, 13 of 14 (93%) instances demonstrated elevated BNP >100 pg/mL

In Euvolemic states, 11 of 13 (85%) had elevated BNP.

## Discussion

1. BNP may correlate with myocardial distension but may not represent intravascular volume status.

2. ACC/AHA Practice Guidelines: Recommendations for use of cardiac biomarkers in Heart failure. Level of evidence CLASS II b.

3. BV measurements may guide in optimizing fluid management when there is uncertainty about intravascular volume status of complex patients.

## CONCLUSION

There was no correlation between BNP levels and blood volume in critically ill surgical patients. Further studies need to clarify the role of BNP and BV in guiding fluid management specially in situations where the 2 values are incongruent.