Journal Reading

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Title

Prospective correlation of arterial vs venous blood gas measurements in trauma patients☆,☆☆

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Introduction

- **ABG** provides important information for critically ill patients
- **BE**(base excess) is a useful predictor of serious injury in trauma patients
- Base deficit improves as a patient is successfully resuscitated
- American College of Surgeons (ACS)

Introduction

- ABG can cause patient morbidity by arterial injury and is more painful. **Interchangeable?**
- Prior study: VBG can substitute for an ABG in DKA or acutely ill medical patients (r=0.97), pH lower 0.03 and 0.056
- (1) VBG similar to ABG in pH and BE in acutely injured patient?
- (2)Linear regression equation accurately predict ABG from VBG?

Materials and Methods

- ACS-verified level 1 trauma center, from Jan.~Sep. 2006
- Paired ABG and VBG (pH and BE)
- Age>18 years

Systolic blood pressure less than 90 mm Hg in the emergency department (ED)
Requiring transfusion of blood products
Requiring endotracheal intubation
Positive Focused Assessment of Sonography in Trauma
Ongoing hemorrhage (declining bedside hemoglobin level)
Pelvic fractures with disrupted ring
Hypoxia (SpO_2 <93% on room air).
Judgment of trauma captain

All patients older than 60 years with any of the following:

Motor vehicle crash (MVC) greater than 30 mph
MVC with passenger space intrusion greater than 12 in
Passenger ejection from the vehicle
MVC rollover
MVC with fatality in same vehicle
Automobile vs pedestrian injury, at any speed
Fall from greater than standing height
Systolic blood pressure less than 100 mm Hg on ED arrival
Pulse less than 60 or greater than 100 beats per minute

Study Procedures

- Included if an ABG was clinically indicated
- Femoral and radial arteries
- 10 mins of sample acquisition
- BE calculated from pH and pCO2 results
- 15 attending physicians
- Consensus single threshold→
- **pH<0.05 units**
- **BE<2**

Statistical Analysis

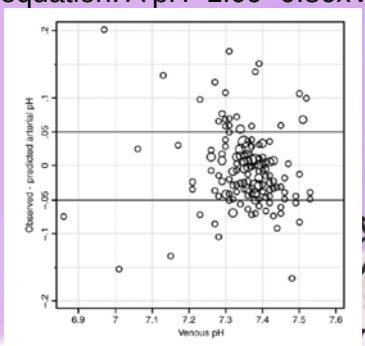
- 384 patients enrolled, split equally into derivation and validation groups
- Linear regression to predict ABG pH and BE from the corresponding VBG results
- Excel and Stata
- 95% confidence intervals (95% CI)
- 95% limits of agreement (LOAs)

Results

- 385 collected, excluded 29 (7.5%) with incomplete data, 10 (2.5%) greater than 1 hour between samples, 1 times were not recorded
- **346** (89.9%) for analysis
- No statistically significant differences in these parameters between study patients and overall population of trauma patients

pH Result

- Predictive equation: A pH=1.09+0.86xV, r^2=0.70
- Accuracy



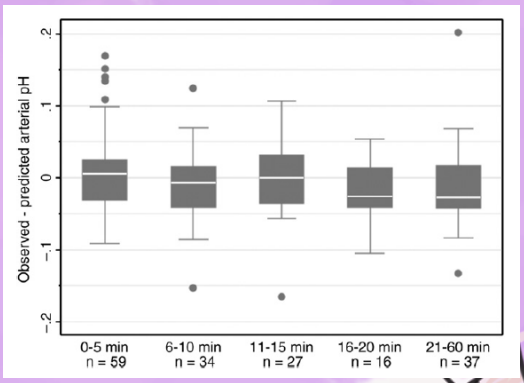
pH Result

Table 1 Similarity of observed ABG values to those predicted by linear regression from VBG values

		n	95% LOA	Percentage of paired samples within consensus clinically equivalent range ± ≤0.05 (95% CI)	Percentage of paired samples within double the clinically equivalent range ± ≤0.10 (95% CI)
pH	Validation sample	173	−0.11 to 0.10	72% (65-79%)	93% (88-96%)
	Low BE	31	−0.17 to 0.12	58% (39-75%)	81% (63-93%)
	Normal or high BE	142	−0.09 to 0.09	75% (67-82%)	96% (91-98%)

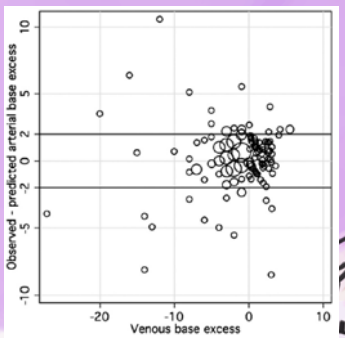
- Only 72% fit within +/-0.05 pH units
- 95% LOA -0.11 to 0.10 pH units (too wide)
- Consensus derived clinically equivalent range too narrow
- Fit better for normal or high BE (p=0.03)

Observed ABG arterial pH value	Calculated arterial pH derived from observed VBG venous pH value	Difference
7.60	7.63	0.03
7.50	7.54	0.04
7.40	7.45	0.05
7.30	7.37	0.07
7.20	7.28	0.08
7.10	7.20	0.10
7.00	7.11	0.11
6.90	7.02	0.12
6.80	6.94	0.14
6.70	6.85	0.15
6.60	6.77	0.17
6.50	6.68	0.18



Base Excess Results

- Predictive equation: A BE=-0.87+0.78xV, r^2=0.75
- Accuracy

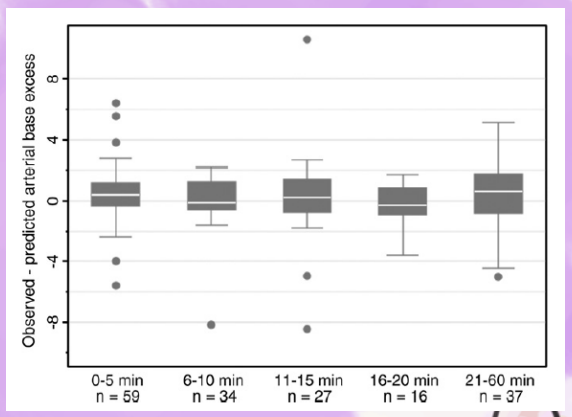


Base Excess Results

Table 1 Similarity of observed ABG values to those predicted by linear regression from VBG values

		n	95% LOA	Percentage of paired samples within consensus clinically equivalent range ±≤2	Percentage of paired samples within double the clinically equivalent range ±≤4
BE	Validation sample	173	−3.9 to 4.4	80% (74%-86%)	93% (88%-96%)
	Low BE	31	−7.6 to 4.6	61% (42%-78%)	74% (55%-88%)
	Normal or high BE	142	−2.5 to 3.8	85% (77%-90%)	97% (93%-99%)

- Only 80% fit within +/-2 BE units
- 95% LOA -3.9 to 4.4 BE units (too wide)
- Consensus derived clinically equivalent range too narrow
- Fit better for normal or high BE (p<0.0001)



Limitations

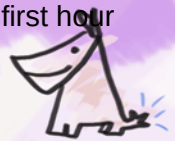
- Clinically equivalent thresholds for pH and BE were **arbitrarily determined** (by experts)
- Convenience sample **omitting midnight to 8 AM**
- Excluded samples drawn **more than 1 hour apart** or missing data
- Only **25.6%** of all trauma patients were enrolled
- Small sample size
- Didn't constrain the location of blood draws
- Didn't follow up patients

Discussion

- Largest study in acute-phase trauma patients
- VBG and ABG results correlate well in trauma patients (r^2=0.70 and 0.75)
- But **LOAs broader** and predicted values outside ranges too frequently (28% and 20%)
- Not clear which values best reflect shock physiology

Discussion

- Other studies: lack data, eg: LOAs, proportion fell outside
- Gennis et al: 95% within +0.11 pH units, **heterogenous group**
- Clinical and hemodynamic state in trauma would change more rapidly
- Assessed patients essentially in first hour after injury



Discussion

- Venous: peripheral Artery: central, unknown effect on acid-base values
- Schmelzer et al: central venous BE associated with survival, global perfusion, outcome
- VBG sufficient guide resuscitation? Need follow up
- **Enroll a consecutive sample, shortening the time between blood draws, follow up clinical outcome**
- ABG on all trauma patients is unethical
- Central VBG more difficult to study

Summary

- Only 72% to 80% correlate with ABG
- 95% LOAs unacceptably wide
- ABG samples **should be obtained** for management of acutely ill trauma patients if accurate acid-base status is required
- Reliance on VBG samples to predict arterial pH and BE **cannot be justified**

Title

ED crowding and the use of nontraditional beds ☆

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Introduction

- Traditional ED beds
- Hallway gurneys
- Conference rooms
- Lower priority, supplies difficult available, difficult obtaining sensitive information
- **Primary aim**: bed type and ED evaluation time
- **Secondary aim**: bed type and ED evaluation time stratified by C.C. category

Research Design and Methods

- Integrated ED information system in urban, adult ED
- Electrical order and medical record
- Aug.1.2009 to Aug.1.2010

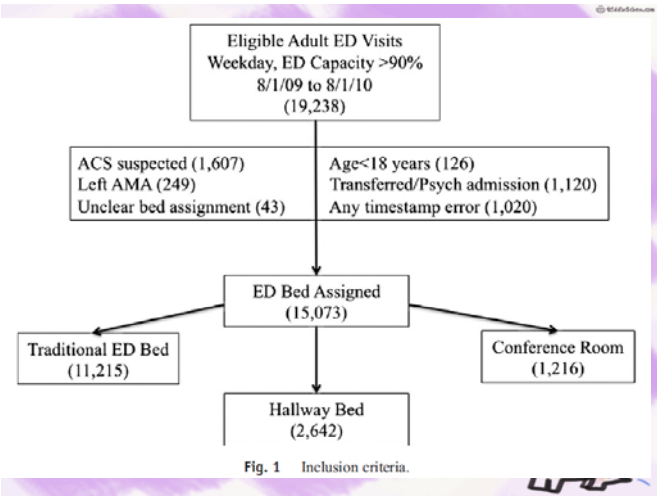

Fig. 1 Inclusion criteria.

Research Design and Methods

- **No explicit protocol** to guide bed assignment
- Patients assigned to a traditional bed were not moved into a nontraditional bed
- 46 traditional beds, 7 hallway beds, 5 conference room beds

Research Design and Methods

- Primary outcome: ED evaluation time, the time between ED bed assignment and ED disposition (admission or discharged)
- Secondary analyses: bed assignment and ED evaluation time stratified by 5 most frequent C.C.
  - Abd/GU
  - Joint/Muscle
  - Fever, malaise
  - Head and neck
  - Other

Analysis

- Simple and multivariate linear regression
- Natural log transformation of ED evaluation time
- Adjusted for multiple ER-level and patient-level characteristics
- Marginal prediction used to calculate mean ED evaluation time for each bed type

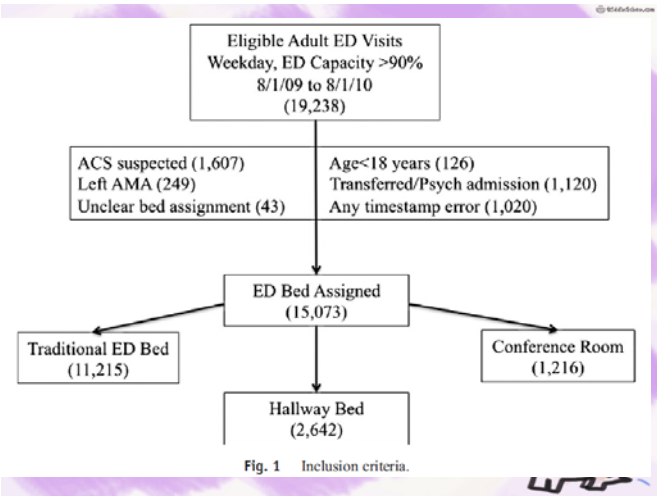

Fig. 1 Inclusion criteria.

Table 1 Patient and ED characteristics

	Traditional bed (11 215)	Hallway bed (2642)	Conference room bed (1216)
Age (y)[a]	44 (29, 60)	39 (28, 52)	41 (28, 55)
Sex, female (%)	55	57	62
Insurance (%)			
Private	34	38	38
State/Federal	48	43	43
Self-pay	15	16	17
Mode of arrival (%)			
Ambulance	25	13	7
Car	70	85	93
Helicopter	4	2	0
ESI[a]	2 (2, 3)	3 (2, 3)	3 (2, 3)
Disposition (%)			
Discharged	58	76	77
Admitted	42	24	23
Waiting room time (min)[a]	44 (20, 74)	39 (17, 90)	32 (17, 55)
ED evaluation time (min)[a]	227 (146, 329)	234 (159, 333)	236 (162, 344)
Boarding time (min)[a]	239 (95, 780)	422 (162, 1126)	283 (151, 928)

ESI indicates emergency severity index; min indicates minutes.
[a] Median (interquartile range).

Table 2 Mean ED evaluation time, in minutes

	Mean time (min) (95% Confidence Interval) [a]
Unadjusted linear regression	
Traditional bed	209 (207-212)
Hallway bed	225 (219-231)
Conference room bed	226 (218-235)
Adjusted linear regression [b]	
Traditional bed	227 (226-228)
Hallway bed	240 (240-241)
Conference room bed	238 (237-239)

[a] Mean (95% CI); all $P < .001$.
[b] Adjusted for ED and patient level characteristics listed in Appendix 2.

Table 3 Adjusted mean ED evaluation time, by chief complaint

Chief complaints	Traditional (95% CI) [a]	Hallway (95% CI) [a]	Conference room (95% CI) [a]
Abdominal	249 (247-250)	265 (263-266)	258 (256-259)
Joint	196 (194-197)	208 (207-211)	210 (208-212)
Fever, general	230 (228-232)	233 (232-235)	237 (235-239)
Head, neck	211 (209-214)	239 (236-241)	222 (219-224)

[a] Adjusted mean time in minutes (95% CI); all $P < .001$; adjusted for the variables listed in Appendix 2.

Table 4 Differences in adjusted mean ED evaluation time [a]

Chief complaints	Hallway (95% CI) [b]	Conference room (95% CI) [b]
All complaints	13.3 (13.2-13.3)	10.9 (10.8-10.9)
Abdominal	16.0 (15.9-16.1)	9.0 (9.0-9.1)
Joint	13.2 (13.1-13.3)	14.5 (14.3-14.6)
Fever, general	3.5 (3.4-3.5)	7.5 (7.4-7.6)
Head, neck	27.4 (27.1-27.7)	10.2 (10.0-10.3)

[a] Traditional bed referent.
[b] Difference in adjusted mean time in minutes (95% CI).

Discussion

- Exclusively focusing on expanding ED physical space is unlikely to be sole solution
- Mean ED: 11 and 13 mins longer
- Small increase in evaluation time suggest: using nontraditional beds may be preferable to keeping patients in the waiting room until a traditional bed is available

Discussion

- Factors contribute to longer evaluation time: presume less sick, medical supplies not readily available, private discussion and sensitive exam difficult to do
- Other factors: co morbidities such as dementia, psychosis, higher risk to fall
- Who are less likely to require private exam or invasive procedures, nontraditional beds may be efficient strategy, **but other C.C. may wait longer for traditionals**

Limitations

- Observational study, lack of randomization
- May not be generalizable to all other hospitals
  - no return to nontraditional beds
  - Prevalence and practice of nontraditional bed use have not been reported in detail
  - Nursing and physician staffing patterns
  - Ability to conduct private interviews and exam

Conclusion

- Hallway and conference room beds experienced modestly longer ED evaluation times, 11 and 13 mins respectively
- **Fever patients** in nontraditional beds had **smallest increases** in ED evaluation time
- Selective use of nontraditional beds for patients with specific complaints may be an efficient strategy

- Thank you for your attention!