patients with erythromycin. In the crossover study of erythromycin and metoclopramide, 11 of 13 patients reported improvement on erythromycin and 7 of 13 patients on metoclopramide ($P=.36$).

Jonathan Lee, MD
Scott Keller, MD
In His Image FMR
Tulsa, OK


**Are orthostatic vital signs useful in detecting dehydration and hypovolemia in adults?**

**Evidence-Based Answer**

Heart rate is the only orthostatic vital sign (OVS) that correlates with dehydration (change in total free water) for adult patients in the emergency department (ED) (SOR: B, prospective observational study). OVSs vary widely in euvoicmic patients, making “normal” values of uncertain utility (SOR: C, observational study). OVSs do not reliably predict modest volume (intravascular) losses (SOR: C, expert opinion).

A 1992 prospective observational study of 166 adults (mean age 38.5 years) with complaints suggestive of dehydration (mostly vomiting and/or diarrhea) presenting to an ED had OVSs measured and compared with a control group of 21 healthy control participants who were members of the medical staff. Exclusion criteria included resting tachycardia of more than 120 beats per minute, inability to stand, and concurrent use of beta-blockers, digoxin, or calcium channel blockers. The orthostatic protocol had patients remain supine for at least 2 minutes, followed by recording blood pressure, then heart rate. Next, the patient would stand for 60 seconds and the blood pressure and heart rate were again recorded. A total body water deficit (TBWD) was calculated to estimate the degree of dehydration using the formula: TBWD = 0.6 x weight (kg) – (0.6 x weight [kg] x measured serum osmolality [mOsm])/300 mOsm.

Using linear regression, increased heart rate was the only OVS demonstrating a significant correlation with degree of dehydration (see TABLE). Large variations were noted in OVSs in healthy individuals with substantial overlap between the dehydrated and healthy groups (see TABLE).

A 1991 prospective observational study measured OVSs in 132 presumed euvoicmic adult patients (mean age 34.1±13.6 years) presenting to an ED. Euvolemia was presumed in the absence of vomiting, diarrhea, or menorrhagia; and the presence of fluid intake in the preceding 24 hours, thereby supposing neither intravascular nor total free water loss. Patients were excluded in the setting of intravenous fluid therapy, resuscitation for medical reasons, chest or abdominal trauma, baseline systolic blood pressure less than 90 mmHg, cervical spine immobilization, altered mental status, or combative patient behavior. The orthostatic protocol had patients remain supine for at least 3 minutes, followed by recording blood pressure and heart rate. Next, the patient would stand for 2 minutes and the blood pressure and heart rate were repeated.

Average heart rate increased by 17.2 beats per minute (range -5 to +39.4 beats per minute). Average systolic blood pressure increased by 2.8 mmHg (range -20 to +25.7 mmHg). Average diastolic blood pressure increased 9.2 mmHg (range -6.4 to +24.9 mmHg). Of the presumed euvoicmic patients, 43% had “positive” OVSs per the definition in the study protocol (heart rate increase of 20 beats per minute, systolic or diastolic blood pressure decrease by >10 mmHg). The authors concluded that OVSs may overdiagnose hypovolemia.

In 2012, the Emergency Nurses Association published evidence-based recommendations regarding

### TABLE

<table>
<thead>
<tr>
<th></th>
<th>Heart rate change (beats per minute)</th>
<th>Systolic blood pressure change (mmHg)</th>
<th>Diastolic blood pressure change (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dehydrated patient</td>
<td>13.6±10.3a</td>
<td>-7.8±12.6</td>
<td>0.78±7.9</td>
</tr>
<tr>
<td>Healthy control</td>
<td>6.8±7.8</td>
<td>-2.5±8.0</td>
<td>5.3±9.9</td>
</tr>
</tbody>
</table>

*aSignificant correlation with total body water deficit percentage (coefficient of determination $r^2=0.5$; $P=.005$).
the utility of OVSs in assessing patients’ fluid volume/intravascular alterations. They noted that in adult patients “[OVS] alone lack the sensitivity to reliably detect volume losses less than 1,000 mL.”

Timothy Mott, MD
Rebecca Allen, MD
Naval Hospital Pensacola FMR
Pensacola, FL

The opinions and assertions contained herein are those of the authors and are not to be construed as official or as reflecting the views of the US Navy Medical Department, the Navy at large, or the Department of Defense.


What is the best treatment for vertebral body compression fractures in osteoporotic women?

Evidence-Based Answer

The best treatment for osteoporotic vertebral compression fractures (VCFs) remains unclear. When vertebroplasty (VP) is compared with sham treatment, no differences are noted in pain or function. Balloon kyphoplasty (BK) is better than usual care for pain relief, but has not been tested against sham intervention. Evidence-based guidelines recommend against VP and still mention BK as an option for VCFs (SOR: B, based on meta-analysis of RCTs and evidence-based guidelines).

A 2015 meta-analysis of 11 RCTs (N=1,401) compared VP (8 studies) or BK (3 studies) with sham treatment (blinded) or conservative treatment (nonblinded) for VCFs. Conservative treatment included bed rest; analgesics; use of a corset, brace, or cast; and rehabilitation. Patients were 63 to 80 years old with VCFs ranging from 3 days to more than 1 year old that occurred in the setting of osteoporosis.

VP/BK combined reduced pain, as measured on a 0 to 10 numeric pain rating scale (0= no pain and 10=worst pain), to a greater degree relative to baseline at all time points compared with conservative treatment. Analyzed separately, VP and BK both showed significant pain reductions compared with conservative treatment at all time points. BK demonstrated a greater effect at less than 3 months relative to VP (−3.6 vs −1.3), but this difference was not sustained at 6 months and more than 12 months. In blinded trials, however, no differences were noted between VP and sham treatment at less than 3 months (mean difference [MD] −0.52; 95% CI, −1.47 to 0.44) and 6 months (MD −0.51; 95% CI, −1.52 to 0.50). BK has not been directly compared with sham therapy.1

Compared with conservative treatment, VP/BK combined also demonstrated reduced disability at less than 3 months using the 0 to 24 point Roland-Morris Disability score (3 studies, N=372; MD −4.97; 95% CI, −8.71 to −1.23), but no differences were found at 24 months. Additionally, VP/BK combined improved quality of life at less than 3 months relative to conservative treatment based on the 0 to 100 point Short Form 36 scale (3 studies, n=398; MD 5.53; 95% CI, 1.45 to 9.61) with subgroup analysis also favoring BK (2 studies, n=346; MD 6.38; 95% CI, 1.94 to 10.82), but not VP. Pooled analysis (7 trials, n=855) did not demonstrate significant differences in adverse events between VP/BK combined compared with conservative treatment (139/433 vs 124/422; relative risk [RR] 1.10; 95% CI, 0.85–1.43). Similarly, no differences were noted between VP and sham treatment (20/106 vs 16/103; RR 1.32; 95% CI, 0.80 to 2.18).1

The American Academy of Orthopedic Surgeons 2010 guidelines recommend against VP for osteoporotic VCFs in neurologically intact patients (strong evidence; based on the 2 high-quality RCTs examining sham vs operative treatment in the 2015 meta-analysis).2 BK is recommended as an option (limited evidence). For conservative management, the guidelines recommended a 4-week course of calcitonin (moderate evidence) and use of bisphosphonates (limited evidence). The guidelines site inconclusive evidence to recommend for or against bed rest, complementary and alternative medicine, opioids/analgesics, bracing, exercise, and electrical stimulation.

Annette Beyea, DO, MPH
Daphne Lang, MD
Maine Dartmouth FMR
Augusta, ME