

Reducing AKI Rates in Hip Fractures: Fluid Resuscitation Protocol Utilizing Noninvasive Plethysmography Variability Index

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INTRODUCTION:

Hip fractures in the elderly are linked to increased morbidity and mortality, which includes 12.7% to 24.0% of patients developing acute kidney injury (AKI) post-surgery. Geriatric patients face higher risks of non-recovery from AKI and progression to chronic kidney disease (CKD), which predicts worse short- and long-term outcomes. Intravascular hypovolemia and excessive fluid administration contribute to AKI, emphasizing the need for tailored fluid management strategies. The Perfusion Index (PI) and Plethysmography Variability Index (PVi) provide noninvasive tools for assessing perfusion and volume status. PVi has shown potential in guiding fluid therapy in critically ill patients. This study evaluates PVi's utility in fluid management for hip fracture patients to reduce AKI rates.

METHODS:

Design: Prospective cohort study.

Setting: Academic Level 1 trauma center.

Patient Selection Criteria: One-hundred consecutive adult patients with an isolated hip fracture treated operatively between February 2023 and June 2024. Patients with an ejection fraction < 35%, decompensated CHF, COPD exacerbation, vasopressor requirements, pregnant, or ESRD were excluded.

Outcomes Measures and Comparisons: Incidence of postoperative AKI, intensive care unit (ICU) admission, hospital length of stay, 30-day readmissions, and mortality at 90 days, 6 months, and 1 year between patients treated with preoperative maintenance fluids while nil per os (NPO) or an individualized fluid resuscitation protocol guided by continuous PVi and SpHb monitoring.

RESULTS:

The PVi group had significantly lower AKI rates (6% vs. 20%; $P = 0.04$), fewer ICU transfers (0% vs. 14%; $P = 0.006$), and shorter hospital stays (5.1 days vs. 6.5 days; $P = 0.008$). There were no statistically significant differences in 30-day readmissions or mortality at any time point.

DISCUSSION AND CONCLUSION:

We identified lower rates of AKI, transfers to the ICU, and LOS for PVi guided fluid resuscitation in adult hip fracture patients. Surgeons should consider this noninvasive technology to for fluid optimization preoperatively.

Hip Fracture Arrives at the ED

- Administer 1L LR bolus.

Patient Arrival on the Floor

- Use the order set labeled "Orthopaedic hip fracture fluid resuscitation protocol using pleth variability index (PVi)"
- Check PVi and SpHb q4h**
 - If **SpHb < 8 g/dL and PVi > 15**: Administer one unit of PRBC.
 - If **SpHb < 8 g/dL and PVi < 15**: Administer one unit of PRBC.
 - If **SpHb > 8 and PVi > 15**: Start LR infusion at 4mL/kg/hr based on IBW.
 - If **SpHb > 8 and PVi < 15**: Do not administer any additional fluids
 - Recheck PVi and SpHb in 4 hours, and repeat steps 1-5.

End Protocol

- If the patient has shortness of breath, SpO₂ < 92%, or any signs/symptoms of fluid overload.
- If maximum fluid volume of 20 mL/kg of ideal body weight
- Once the patient reaches the operating room.

(IBW: Ideal Body Weight, PRBC: Packed Red Blood Cells, LR: Lactated Ringer's, SpO₂: oxygen saturation)

