

Table 2. Reversal of Dabigatran, Rivaroxaban, and Apixaban

NOAC	Reversal
Dabigatran [Siegal DM, Cuker A. <i>J Thromb Thrombolysis</i> . 2013; Lillo-Le-Louet A et al. <i>Thromb Haemost</i> . 2012]	rVIIa: Inconsistent results, likely not useful Dosing: 50-100 U/kg 4-factor PCC: Inconsistent results aPCC (Feiba) Reversed markers and in animals Complete reversal in volunteer ex vivo studies Best option at this time
Rivaroxaban and apixaban	rVIIa did not work in animal studies 4-factor PCC was effective in animal studies and is the best current option aPCC FEIBA reversed markers in animals

aPCC, activated prothrombin complex concentrate; NOAC, new oral anticoagulant; PCC, prothrombin complex concentrate; rVIIa, recombinant factor VIIa.

animal and in vitro studies. Clinical trials are currently underway studying the recombinant factor Xa derivative, and adexanet alfa, as a specific reversal agent for rivaroxaban [NCT02220725] and apixaban [NCT02207725]. This agent is a factor Xa decoy that targets and sequesters direct and indirect factor Xa inhibitors in the blood. Once bound, the factor Xa inhibitors cannot bind and inhibit native factor Xa, allowing restoration of normal hemostasis.

Platelet inhibitors, including salicylates, clopidogrel, and factor IIb/IIIa inhibitors may be somewhat reversed by transfusion of platelets [Vilahun G et al. *J Thromb Haemost*. 2007] and desmopressin [Leithouser B et al. *Clin Hemorrhol*. 2008], but there is no definitive proof. If reversal is attempted using platelets, 2 to 3 pools of platelets should be used. ϵ -Aminocaproic acid is an antifibrinolytic agent used for hemophiliacs that might reverse fibrinolytics, but there are no data supporting this use [Stief T. *Clin Appl Thromb Hemost*. 2008].

Dr Kaide concluded that anticoagulant reversal should be attempted in situations where “maximal harm is already in progress” and the risk of bleeding outweighs the risk of reversal of anticoagulation. New antidotes for the NOACs are under development and will be available in the near future.

Bedside Ultrasonography Useful for Trauma Patients

Written by Phil Vinal

In the decades since the Focused Assessment with Sonography in Trauma examination was first proposed, the use of point-of-care ultrasonography has expanded further into the trauma world. Matt Dawson, MD, University of Kentucky, Lexington, Kentucky, USA,

discussed the modern use of bedside ultrasonography in the initial evaluation of trauma patients.

Bedside ultrasonography has been shown to be equal to or more sensitive than other modalities for detecting traumatic injuries. In a randomized controlled clinical trial, patients presenting to the emergency department with suspected torso damage assessed with ultrasonography had considerably decreased time to operative care, improved resource use, and lower medical costs [Melniker LA et al. *Ann Emerg Med*. 2006]. A more recent study reported that bedside ultrasonography had higher sensitivity and similar specificity compared with chest radiography for the diagnosis of pneumothorax [Ding W et al. *Chest*. 2011].

Point-of-care ultrasonography has long been used for the assessment of hemoperitoneum and hemopericardium in emergency departments and operating rooms [Rippey JC, Royse AG. *Best Pract Res Clin Anaesthesiol*. 2009]. Ultrasonography can also be used to assess vascular injuries, musculoskeletal injuries, genitourinary injuries, and fetal viability in pregnant trauma patients. In addition, ultrasonography can be used to guide nerve blocks and vascular access in real time.

Another application that may be useful in the setting of trauma is the tracheal rapid ultrasound examination [Chou HC et al. *Resuscitation*. 2011]. Correct positioning of an endotracheal tube can be confirmed by a sonographer within 3 seconds of placement, with 100% sensitivity and specificity [Muslu B et al. *J Ultrasound Med*. 2011].

Another useful application of ultrasonography is as a noninvasive test for elevated intracranial pressure (ICP). Optic nerve sheath diameter > 5 mm as detected by ocular ultrasonography identifies patients with ICP > 20 cm H₂O and has been highly correlated with ventriculostomy measurements [Kimberly HH et al. *Acad Emerg Med*. 2008]. Third-ventricle midline shift as evaluated by transcranial color-coded sonography is more sensitive and specific than the pulsatility index in detecting large intracerebral hemorrhage and it is also a significant predictor of short-term functional outcome (OR, 2.09; 95% CI, 1.06 to 4.13) [Tang SC et al. *J Ultrasound Med*. 2006].

Point-of-care ultrasonography is particularly useful in settings in which traditional radiography is unavailable or undesired. Clavicle fracture, a common orthopedic injury in children, can be diagnosed with bedside ultrasonography with 95% sensitivity, 96% specificity, and 96% overall accuracy [Cross KP et al. *Acad Emerg Med*. 2010]. Even in the hands of physicians with minimal training, portable ultrasonography is useful for detecting fractures in a remote setting [Marshburn TH et al. *J Trauma*. 2004].

Ultrasonography has long been the standard for hemodynamically unstable patients with concerning mechanism of injury. However, ultrasonography is also



being use to assess and to follow-up on stable patients with blunt abdominal trauma concern for solid organ (liver, spleen, kidneys) damage, particularly in low-energy injuries [Afang A et al. *Eur J Emerg Med.* 2012].

Spinal Boards for Spinal Immobilization Prove Harmful

Written by Mary Beth Nierengarten

One million spine injuries occur annually, and 2% to 3% are spinal cord injuries [Hauswald M. *Emerg Med J.* 2013]. For patients with suspected spinal injury, the use of spinal boards for spine immobilization confers no benefit [Oteir AO et al. *Prehosp Disaster Med.* 2014] and may cause harm [Goldberg W et al. *Ann Emerg Med.* 2001]. Christopher B. Colwell, MD, Denver Health Medical Center, Denver, Colorado, USA, reviewed the current evidence on the use of spinal boards for spinal immobilization.

Dr Colwell noted that the traditional use of spinal boards for spinal injuries is based on a set of beliefs that additional movement in people with suspected spinal injuries may exacerbate or cause injury and that immobilization can prevent further injury.

However, data used to support this dogma are not based on solid evidence. Dr Colwell highlighted the lack of evidence from randomized clinical controlled trials to support the recommendation to use backboards and cervical-collars (c-collars) for trauma patients with signs and symptoms of spinal injury made in the 1971 guidelines by the American Academy of Orthopedic Surgeons.

For patients with a penetrating trauma, such as a gunshot wound, Dr Colwell emphasized that the evidence clearly shows that spinal immobilization is harmful and doubles the mortality rate [Haut ER et al. *J Trauma.* 2010]. Because of the increased mortality rate due to delayed resuscitation, the American Academy of Neurological Surgeons recommended against spinal immobilization in patients with penetrating trauma [Theodore N et al. *Neurosurgery.* 2013]. Dr Colwell provided further evidence that spinal boards have harmful consequences, such as respiratory compromise and increased pain (Table 1).

Harm is also associated with c-collars [Ben-Galim P et al. *J Trauma.* 2010], and there is evidence to suggest that routine use of c-collars can be safely avoided [Sundström T et al. *J Neurotrauma.* 2014].

For those looking for a way to safely transfer a patient from the pram to the hospital bed, research has shown that scoop stretchers can restrict motion as well as long boards [Del Rossi G et al. *AmJ Emerg Med.* 2010]. Evidence has demonstrated that controlled self-extrication

Table 1. Evidence for Harm With Spinal Boards

Harm	Evidence
Respiratory compromise	Walsh M et al. <i>Ann Emerg Med.</i> 1990; Bauer D et al. <i>Ann Emerg Med.</i> 1988
Pressure sores and tissue hypoxia	Ham HW et al. <i>J Trauma.</i> 2014; Hemmes B et al. <i>Injury.</i> 2014; Oomens CW et al. <i>Clin Biomech (Bristol, Avon).</i> 2013; Berg G et al. <i>Prehosp Emerg Care.</i> 2010
Increased pain	Lerner EB et al. <i>Prehosp Emerg Care.</i> 1998; Chan D et al. <i>Ann Emerg Med.</i> 1994
Increased radiation	March JA et al. <i>Prehosp Emerg Care.</i> 2002
Increased pain, increased radiation, increased admission in pediatric patients	Leonard JC et al. <i>Prehosp Emerg Care.</i> 2012

had up to 4 times less spine movement [Dixon M et al. *Emerg Med J.* 2013].

Given the evidence, Dr Colwell concluded that change is needed regarding the traditional use of spinal boards for spinal immobilization and emphasized that if a medication had the same risk/benefit ratio as spinal boards, it would no longer be used.

Diagnosis and Treatment of NSTEMI in 2014

Written by Emma Hitt Nichols, PhD

Acute coronary syndromes (ACSs) affect > 780 000 individuals in the United States each year, 70% of which cases will be NSTEMI [Amsterdam EA et al. *Circulation.* 2014]. Tarlan Hedayati, MD, Cook County Health and Hospitals System, Chicago, Illinois, USA, discussed updates in the treatment of NSTEMI-ACS based on the 2014 American Heart Association / American College of Cardiology guideline for the management of patients with NSTEMI-ACS [Amsterdam EA et al. *Circulation.* 2014].

NSTEMI-ACS includes NSTEMI and unstable angina (UA). The difference between the 2 is the myocardial necrosis that occurs in NSTEMI, which can be identified by an increase in biomarkers caused by myocyte death. However, troponin levels are elevated not only in patients with myocardial infarction (MI) but also in those with other conditions, such as tachycardia, trauma, heart failure, pulmonary embolism, burns, drug toxicity, respiratory failure, and neurologic diseases. Therefore, a history and clinical exam are important in the diagnosis of NSTEMI. Elevated troponin levels may be present for up to 2 weeks after the index event, but a