Appendix A: Knowledge Synthesis

i. Routine Standardized Whole Body CT in Hemodynamically Stable Patients

The Royal College of Radiologists (UK) recommends whole body contrast-enhanced MDCT (WBCT) in all severely injured patients as a standard.[1] There is much debate in the literature whether the benefits of routine WBCT in major trauma patients outweigh risks associated with radiation exposure.[2,3] Most research on the topic has been observational, with a few prospective studies, that show WBCT is associated with reduced morality rate and shorter stay in the ED in major trauma patients when compared with selective imaging.[4,5]

The REACT-2 study is the first randomized controlled trial of immediate WBCT in major trauma patients. Initial findings from REACT-2 show that, while routine WBCT does not affect mortality rates among major trauma patients, it does detect more clinically relevant incidental findings when compared to selective CT imaging.[6,7]

ii. Intravenous Contrasts

The New Hampshire Trauma Medical Review Committee (US) recommends intravenous (IV) contrast for all routine CT scan of the abdomen and the pelvis. Waiting for serum BUN/Cr should not delay CT imaging with IV contrast.[8]

A major concern in IV contrast is the risk for contrast-induced nephropathy (CIN), an acute kidney injury associated with iodinated contrast medium where serum creatinine increases by ≥25% or >0.5 mg/dL within three days of IV contrast administration.[9] Reported incidence rate of CIN is low, ranging from 1.9% to 6.6%.[8,10,11,12,13] Risk factors for CIN include renal insufficiency, diabetes, presence of malignancy, old age and use of non-steroidal anti-inflammatory drugs (NSAIDs).[1]

Patients with pre-existing renal insufficiency, diabetes mellitus, or taking furosemide (Lasix) or nephrotoxic drugs may warrant caution in administering IV contrast for CT imaging.[8]

iii. Oral Contrasts

The Royal College of Radiologists (UK) recommends against routine use of oral contrasts, except in penetrating abdominal or pelvic injuries where injury to the bowel is suspected.[14] No difference in accuracy has been observed between CT administered with oral contrast and those without, and omitting oral contrast saves time and costs and decreases the risk of aspiration.[15] A protocol of omitting oral contrast in abdominal and pelvic CT has been associated with lower radiology turnaround time and length of stay in hospital, without significant negative impact on patient safety.[16]

iv. Arch to COW CT Angiography

There is some early evidence of the benefits of including arch to COW CT angiography in routine WBCT. Langner and colleagues prospectively evaluated a CTA protocol of the head as part of a whole body CT work-up (n=368) and argue that craniocervical CTA can be easily integrated into a WBCT protocol. However, existing guidelines are more conservative in their approach.[17] The Society of NeuroInterventional Surgery recommends CT angiography to be performed on all patients who meet an institutional threshold for clinical stroke severity.[18] The Canadian Stroke Best Practice Recommendations indicate immediate arch to vertex CTA (or magnetic resonance angiography) in patients who present with suspected ischemic stroke.[19] See **Appendix B** for a list of clinical indicators for requesting arch to COW CT angiography.

v. Whole Body CT in Hemodynamically Unstable Patients

Although traditionally whole body CT (WBCT) had been contraindicated in hemodynamically unstable trauma patients, recent evidence suggests WBCT can be beneficial in unstable patients with minimal risk.[20,21,22] Most notably, in their large retrospective multicentre study of over 16,000 blunt trauma patients, Huber-Wagner and colleagues found WBCT to significantly increase survival in both hemodynamically stable and unstable patients.[23] Another study led by Huber-Wagner showed that proximity of the CT suite to the trauma room results in improved probability of survival of severely injured patients.[24]

Drawing on recent evidence, the Royal College of Radiologists (UK) recommends CT protocols for hemodynamically unstable patients and that EDs should be planned and designed to increase the numbers of trauma patients who are hemodynamically stable enough for WBCT (Standard 10).[14]

vi. Associated Injuries in Chest and Abdominal/Pelvic Trauma

The association between traumatic injuries to the abdomen and the pelvis has been shown.[25,26] There is some evidence that support the association between chest and abdominal/pelvic injuries to suggest the value of imaging all three areas simultaneously. Parreira and colleagues found 25% of patients admitted for pelvic trauma had associated thoracic injuries.[27] Similarly, Shannon and colleagues found 62% percent of injuries in the abdominal/pelvic region were associated with concurrent thoracic region injuries and 37% of thoracic injuries were associated with concurrent abdominal/pelvic injuries.[28] Furthermore, concurrent rib and pelvic fractures have been shown to indicate solid abdominal organ injury (42%) more often than rib or pelvic fractures alone (26% and 15%, respectively).[29]

vii. CT Cystography

The American Urological Association (AUA) and Societé Internationale d'Urologie (SIU) recommend retrograde cystography (plain film or CT) in stable patients with gross hematuria and pelvic fracture.[30,31] Similarly, the European Urological Association (EUA) recommends cystography in suspected bladder injury.[32] Studies comparing plain film and CT cystography show comparable rates of sensitivity, particularly for retrograde CT cystography (sensitivity 95-100%).[33,34] CT cystography has the added benefit of minimizing patient exposure to radiation by being administered concurrently with abdominal/pelvic CT[34] and diagnosing other injuries or causes of abdominal pain.[31]

viii. Occult Spinal Injuries

There is controversy around whether CT can detect critical non-skeletal injuries (i.e. ligamentous or vertebral disk), particularly in obtunded or unevaluable patients, and to what extent MRI scans should be used. The Eastern Association for the Surgery of Trauma (EAST) conditionally recommends clearing the C-spine in obtunded adult patients based on CT scan alone, based on the ability of high quality CT imaging to rule out critical injuries (average negative predictive value of 88.5%), high costs of MRI, and the risks associated with removing a patient from a monitored environment for additional imaging.[35] Systematic reviews have shown that 15-16% of abnormalities are detected in MRI scan after a negative CT result, with 0.3-0.7% of cases that lead to unstable C-spine injury.[36,37] A recent prospective study showed ligamentous injuries detected via MRI scan in 16.6% of unevaluable patients and/or patients with cervicalgia with initially negative CT scan results.[38]

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