Imaging Guidelines in Trauma: Help or Hindrance?

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Auckland City Hospital

What Are They?

ACCF/AHA Guideline

2010 ACCF/AHA/AATS/ACR/ASA/SCA/SCAI/SIR/STS/SVM Guidelines for the Diagnosis and Management of Patients With Thoracic Aortic Disease

A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, American Association for Thoracic Surgery, American College of Radiology, American Stroke Association, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society of Interventional Radiology, Society of Thoracic Surgeons, and Society for Vascular Medicine

Endorsed by the North American Society for Cardiovascular Imaging

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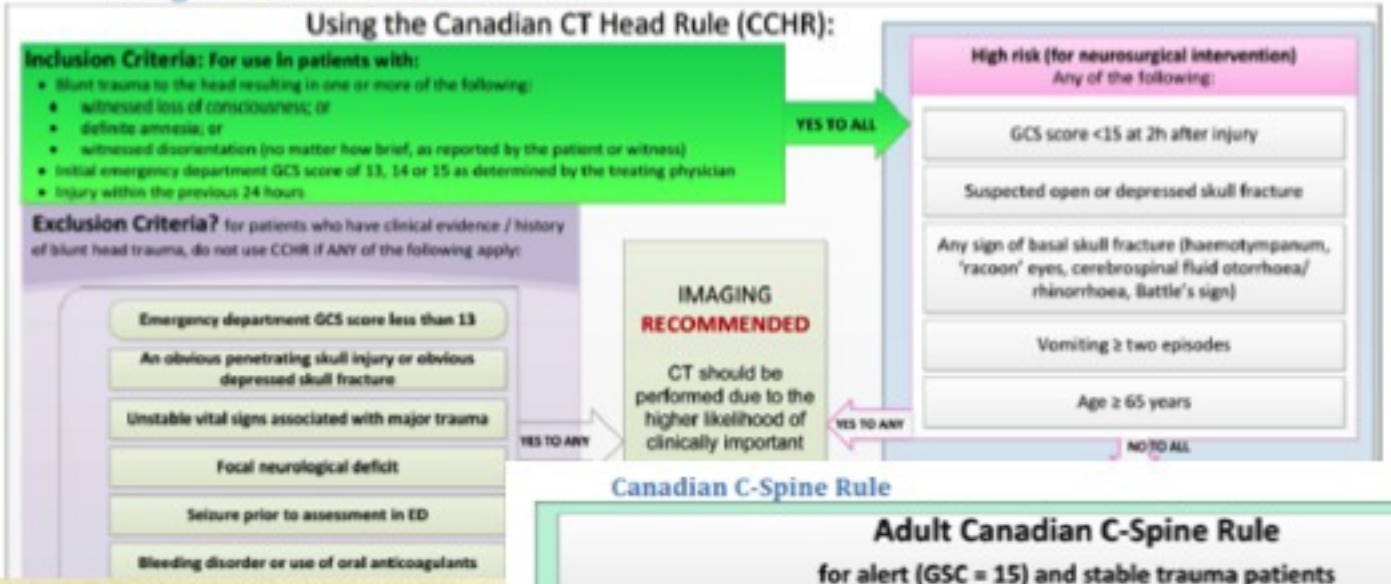
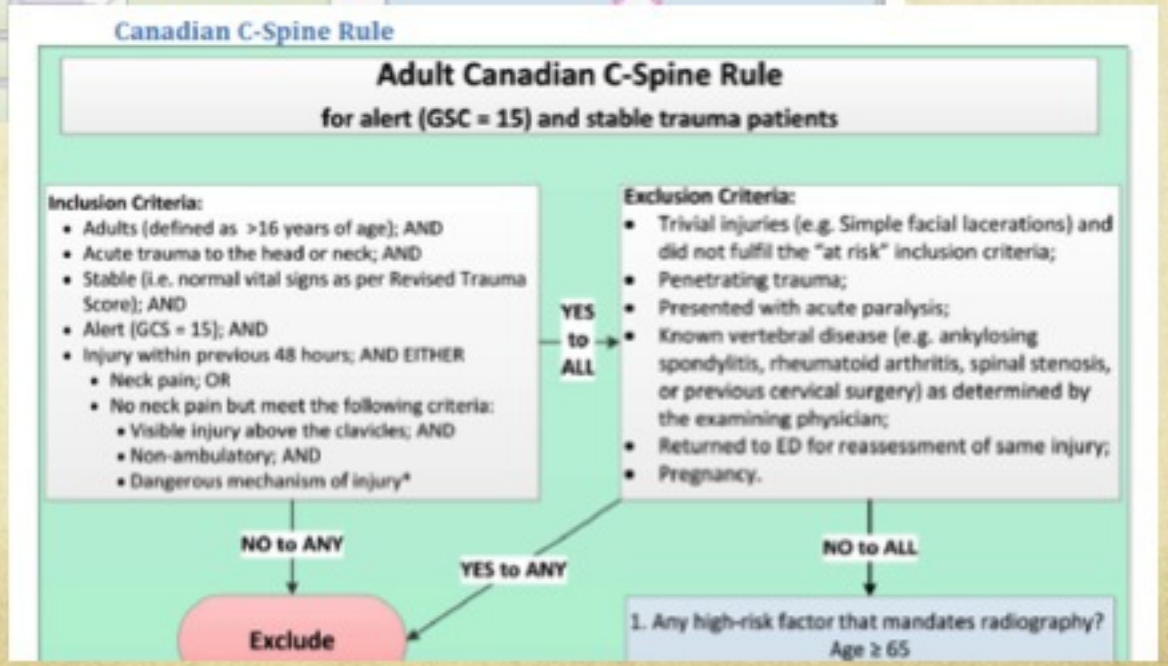
Adult Head Trauma

Using the Canadian CT Head Rule



Canadian C-Spine Rule




CONSENSUS!

Consensus

"To me, *consensus* seems to be the process of abandoning all beliefs, principles, values and policies. So it is something in which no one believes and to which no one objects."

Margaret Thatcher

Physician Autonomy

"To many, physician autonomy means physicians should have complete freedom to provide treatments for patients according to their best judgment."

Physician Autonomy and Health Care Reform
Ezekiel J. Emanuel, MD, PhD; Steven D. Pearson, MD, MSc
JAMA. 2012;307(4):367-368.

To Err Is Human

Building a Safer Health Care System

- 1999 Report on Patient Safety from the Institute of Medicine, USA
- Patient Deaths due to Preventable Medical Errors
  - Estimated 44,000 – 98,000 per year
    - Motor vehicle accidents (43,000)
    - Breast cancer (42,000)

To Err Is Human

- Direct and Indirect Costs - US
  - $17-29 billion for preventable adverse events
  - 2% of total national health care expenditure
  - Medication error alone:
    - $5000/admission on average
    - $2.1 million/year for a 700 bed hospital
- New Zealand:
  - 13% of all hospital admissions associated with an adverse event
    - 15% of these result in permanent disability or death
    - Substantial cost: average of 9 extra hospital days/event

Adverse events in New Zealand public hospitals I: occurrence and impact.
Davis P et al 2002. NZ Med J; 115 (1167): U271.

What are we doing wrong?

Unexplainable **variation in practice**

Over Use

Under Use

Misuse

Of tests, procedures, and medication

We do not consistently apply the science we know

“Miracle on the Hudson”

- January 15, 2009, 3 minutes after take off from LaGuardia Airport in New York City, a US Air Airbus A320 struck a flock of geese and lost power to both engines
- Judging that he didn’t have time to safely return to LaGuardia or land at another nearby airport, Captain Sullenberger decided to crash land the plane in the Hudson River
- First time a major aircraft had crash landed in the water in 45 years
- All passengers and crew survived – 155 people
- One serious casualty: one woman broke both legs

Chesley B. "Sully" Sullenberger, III

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EXECUTIVE SAFETY/RELIABILITY MANAGEMENT PROFESSIONAL

Bottom-line driven manager supported by progressively responsible experience across 40+ years in the aviation industry. Possess in-depth understanding of aviation operations acquired through real-world flight experience, professional training and leadership roles with one of world's leading airlines. History of achievement in safety, innovation, crew training, operational improvement, cost savings, productivity improvement and customer service; proven ability to maximize crew performance and flight safety. Combine strong industry knowledge and business leadership skills to consistently manage complex scheduling, lead high-performance, motivated teams and implement efficient processes that ensure smooth operations and quality customer service. Strong communicator, effective negotiator and motivational team builder; able to effectively communicate needs and merge disparate teams in the support of market objectives. Respected for wide range of industry knowledge, solid sense of integrity and demonstrated passion for industry as a whole as evidenced by lifelong career of flying.

Risk comparison

Serious injury after crash landing in an airplane on the Hudson River:

- 1/155 = 0.6%

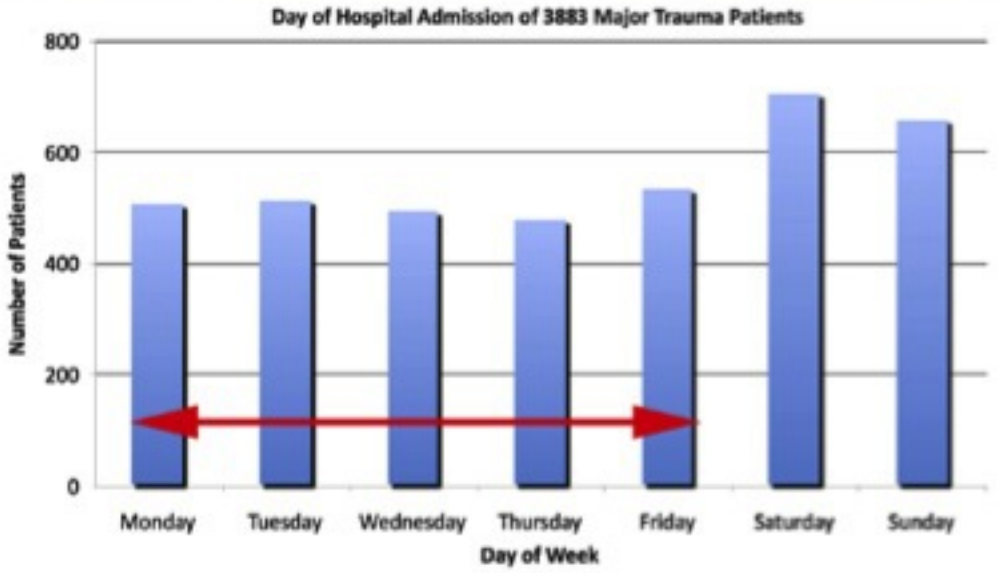
Permanent disability or death due to avoidable medical error:

- 13% x 15% = 2.0%

Trauma Statistics

- Commonest cause of death under age 45
- 36 life years lost per trauma death
- For every trauma death, 2 will have serious permanent disability
- **Increased morbidity and mortality after hours – weekend effect**
  - **Not seen in established trauma centers**
- Better outcomes if high volume (>400/year)
  - Auckland City Hospital: about 300/year

Trauma: Who Cares? A report of the National Confidential Enquiry into Patient Outcome and Death (2007)


Day of Hospital Admission of 3883 Major Trauma Patients
Number of Patients
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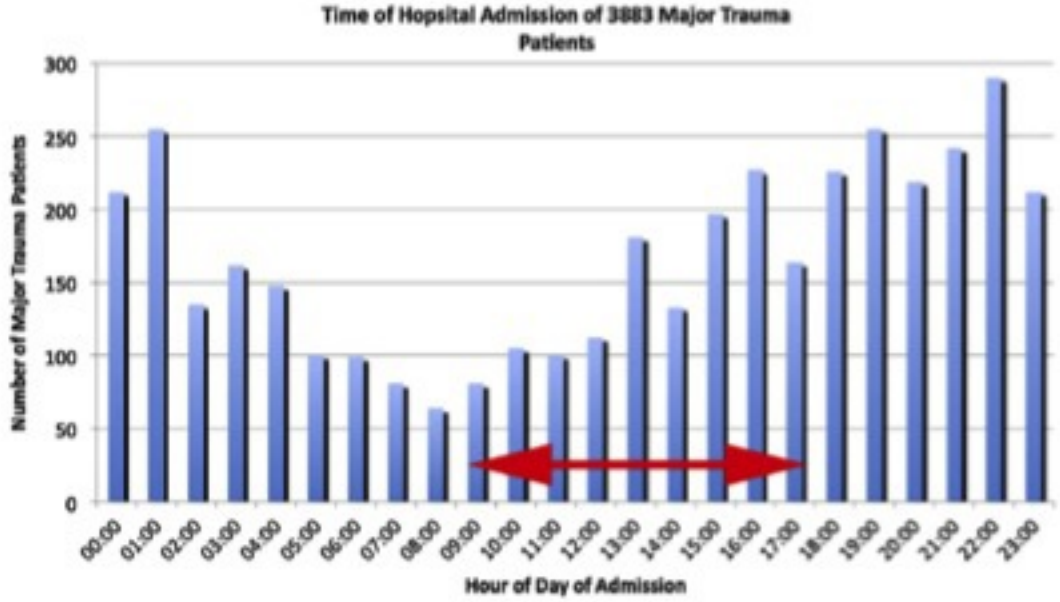
Sunday
Day of Week

(a)


Time of Hopsital Admission of 3883 Major Trauma Patients
Number of Major Trauma Patients
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18:00
19:00
20:00
21:00
22:00
23:00
Hour of Day of Admission

(b)

Attributes of a Trauma Center

Surgery

- 24/7 Consultant led trauma team

Radiology

- 24/7 staffing (resident radiologist, MRT)
- CT scanner in ED

Interventional Radiology

- 24/7, within 30-60 minutes
- 47% increase in mortality for each hour of delay in hemodynamically unstable patients

Standardized protocols

Focus on audit and education, continuous improvement

Does Organizing Trauma Care Make a Difference?

- Trauma: Who Cares? A report of the National Confidential Enquiry into Patient Outcome and Death (2007)
  - Deficiencies, unexplainable variation in trauma care
  - In hospital mortality 20% higher than in US
  - 3 times more likely to die if major trauma compared to Australia
- 30% decrease in mortality in first 48 hours if patient transferred to trauma center vs non trauma center first
- NHS Restructured Trauma Care in 2012
  - 37 additional survivors over expected in first 6 months after London Trauma Network established

How do we organize trauma imaging in Auckland?

Who should get CT?

Mechanism is not specific for presence of injury

Table 2
Examples of pre-hospital high-risk mechanisms of injury.[59]

Extrication time from wreckage >20 min	High yield
Death of occupant in same vehicle	High yield
Passenger ejection from vehicle	Intermediate yield
Pedestrian/motorcyclist struck by motor vehicle	Intermediate yield
Fall >20 feet	Low yield
Vehicle roll-over	Low yield
"Gut feeling" of clinician of serious injury	Low yield

Anatomic/physiologic parameters alone not sensitive

>1 million US trauma patients

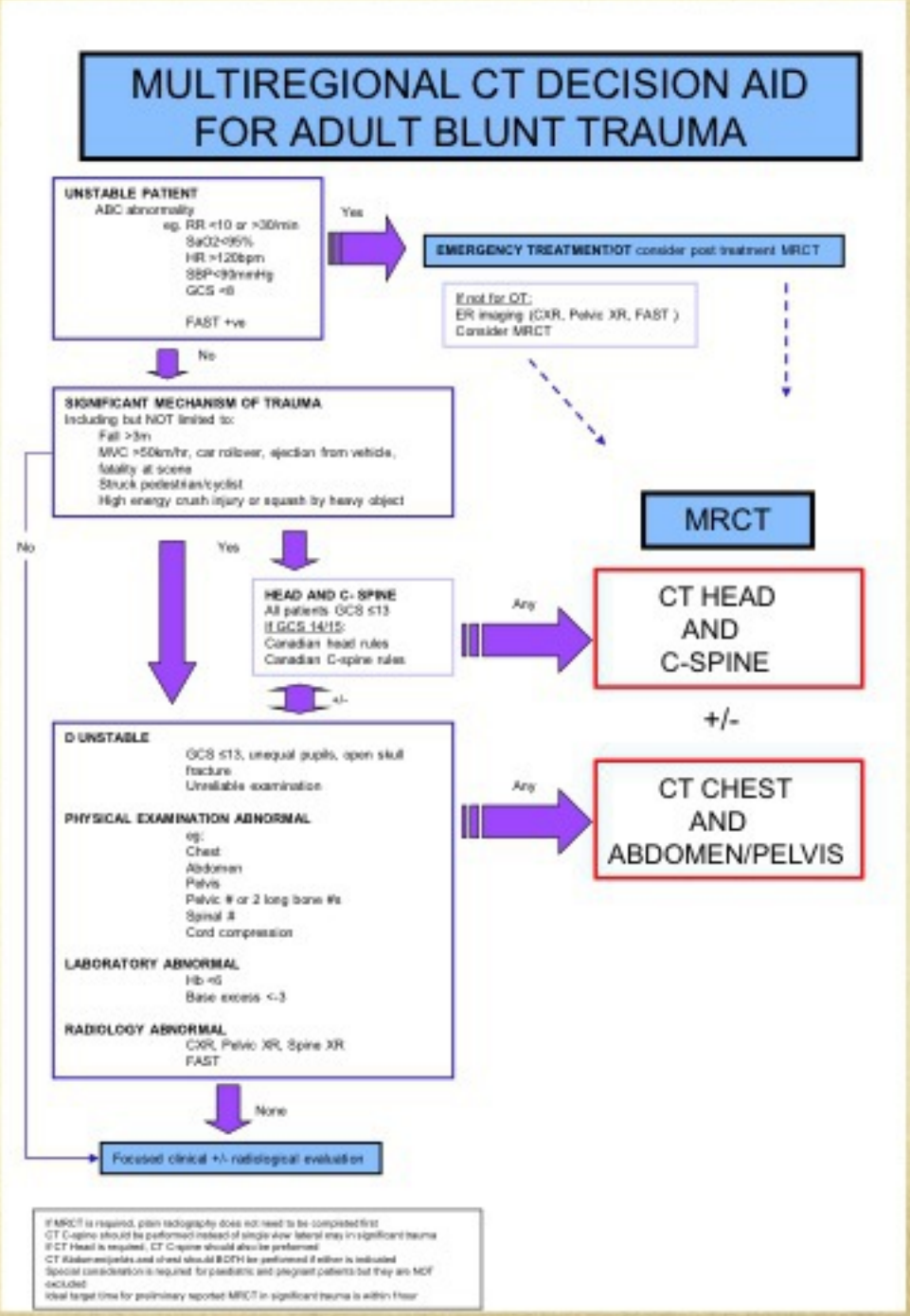
- anatomic and physiological parameters only have a sensitivity of 56% for detecting patients with an ISS >15

The right scan, for the right patient, at the right time: The reorganization of major trauma service provision in England and its implications for radiologists. J.J. Harvey, A.T.H. West. Clinical Radiology 68 (2013) 871-886.

Combination of criteria: physiological, anatomical, and mechanism of injury to identify severely injured patients with occult or compensated injuries.

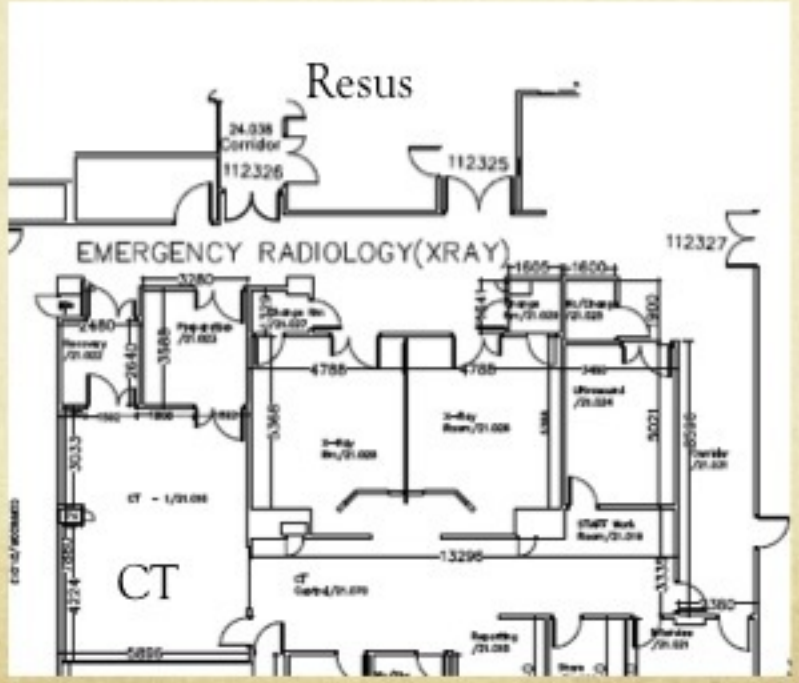
Multiregional CT Decision Aid For Adult Blunt Trauma

Middlemore Hospital
Auckland
Courtesy E. Perry



Trauma CT at ADHB

- Decision for CT – team ED/trauma/radiology
- Trauma patients prioritised to come to CT as soon as team is ready



Multiregional Whole Body Scan

- CT head/C spine, no IV contrast
  - Radiologist review, +/- CTA neck
  - Vascular injury underdiagnosed, cause of preventable stroke
  - Protocol

    CTAC CTA Carotids Trauma 50mls Omni 350 + 50mls Saline

    Arterial High Energy Transfer Mechanism trauma from Resus with:

    Clinical: Acute infarction brain, CHI consistent with DAI and GCS <6

    Radiology: Skull Base fracture, LeFortII, III or mandible #, C1-3 fracture, Vertebral body fracture, Facet subluxation/dislocation

    Review of CT Head and C Spine first.

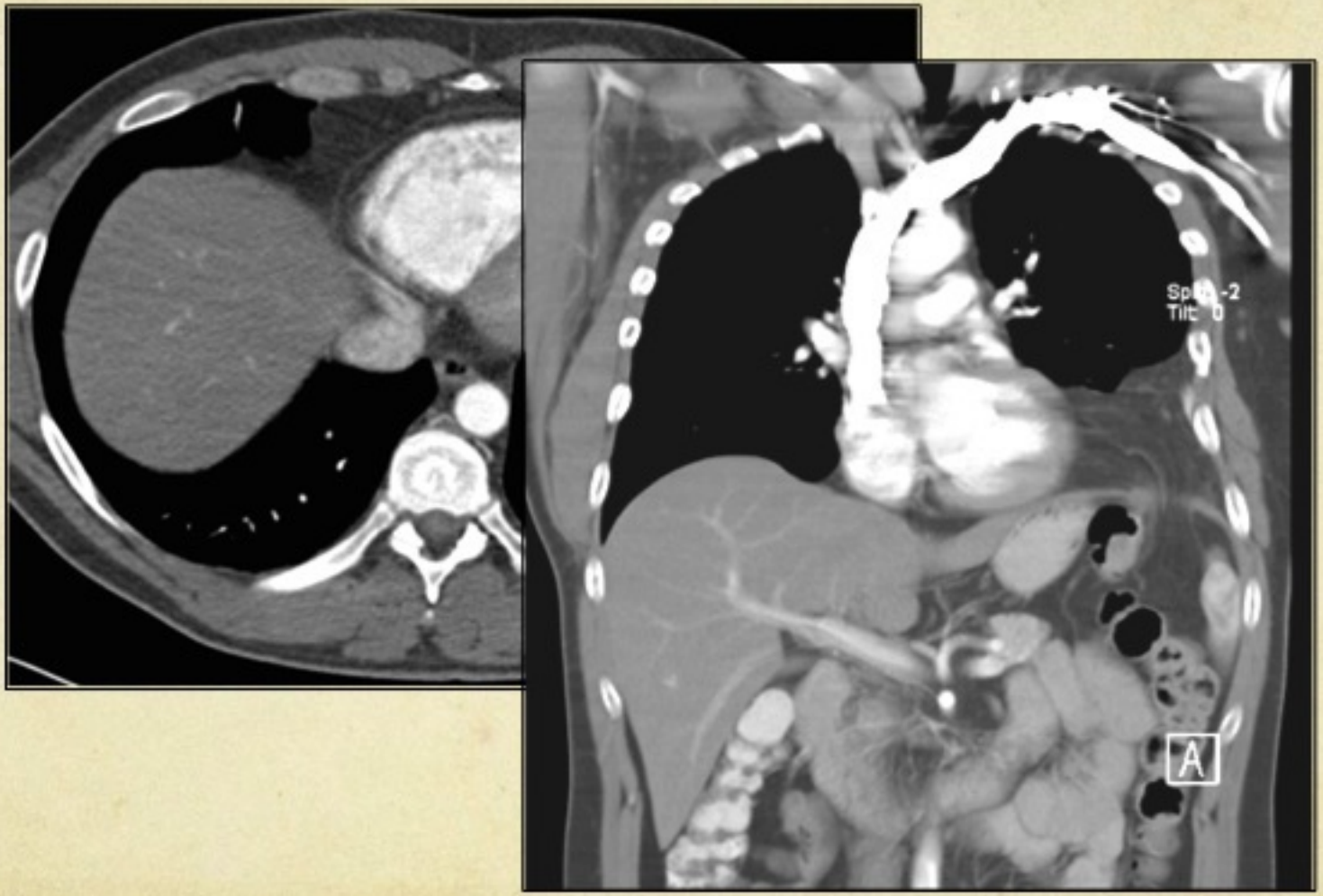
CT Protocols at ADHB

- CT Chest, Abdomen, Pelvis
  - Arterial Chest Abdomen, PV Abdo Pelvis
    - Arterial phase to detect active extravasation or pseudoaneurysm in solid organs
    - Add Arterial pelvis if unstable pelvic fracture

Reformats for Trauma

- Head – axial soft tissue and bone
- C-spine – axial, coronal, sag bone, axial soft tissue
- Chest abdomen pelvis – axial, coronal, sagittal soft tissue and bone, axial lung

A missed injury leading to delayed diagnosis and postoperative infection of an unstable thoracic spine fracture - case report of a potentially preventable complication. Hiroyuki Yoshihara, Todd F VanderHeiden* and Philip F Stahel. *Patient Safety in Surgery* 2011, 5:25


A

Reporting

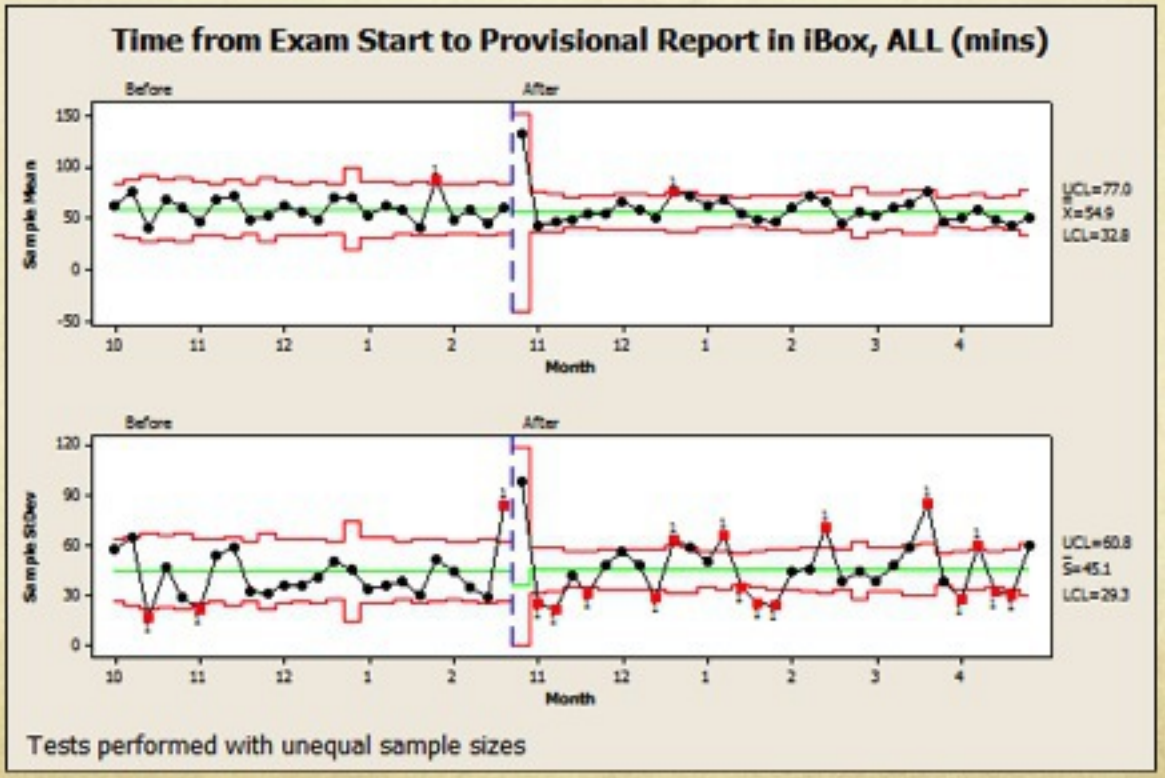
- Verbal report of major findings at time of scan
  - Registrars given a 'list' of critical findings to assess

HEAD		
Bleed	Yes	No
Midline Shift	Yes	No
SPINE		
Major fracture	Yes	No
Canal Compromise	Yes	No
SPINE		
Major fracture	Yes	No
Canal Compromise	Yes	No

CHEST				
Pneumothorax	Yes	No	Right	Left
Haemothorax	Yes	No	Right	Left
Aortic Injury	Yes	No		
Extravasation	Yes	No	Right	Left
ABDOMEN/PELVIS				
Pneumoperitoneum	Yes		No	
Haemoperitoneum	Yes		No	
Extravasation	Yes		No	
Obvious Organ Injury (see comment box below)	Yes		No	
Major Pelvic Fracture	Yes		No	

Reporting

Written report within 60 minutes with phone call if significant change from verbal report



When Things Go Wrong

A Near Miss

19 year old fell off his bike,
left flank pain, amnesia

CT: Head
Abdomen and Pelvis

Protocol:
APT
Abd/pel Trauma
100 ml Omni 300
No Oral
PV, +/- arterial
Trauma
Trauma Follow up/ Liver Laceration FU


Age:019Y
Sex:M
SE:3 IM:45
-163.5
HEAD FIRST ABDO PV/TRAUMA
15:10:39
Acces #15873248
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198
kV:100
mas97
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TILT:0
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C:CONTRAST
W 350 : L 50
P350
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HELIX
AXIAL 3x2 ST


Age:019Y
Sex:M
SE:3 IM:51
-175.5
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Acces #15873248
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L 198
kV:100
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mA115
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W 350 : L 50
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HELIX
AXIAL 3x2 ST


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Age:019Y
Sex:M
SE:3 IM:61
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W 350 : L 50
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AXIAL 3x2 ST

Non Operative Management

6 hours later:
Emergent Splenectomy

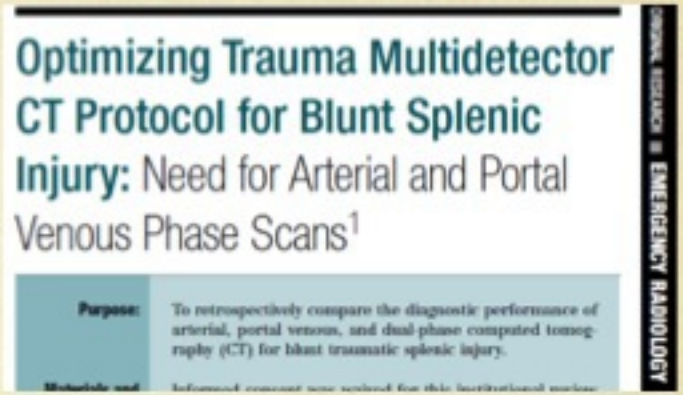
What went wrong?

Review of events

- Report: splenic injury with active bleeding and blood in pelvis; verbal report to ED at time of scan, emergent surgical opinion advised.
- Surgical team discussed with Interventional Radiology; intervention not undertaken at that time
- Patient observed for 6 hours in high dependency unit, became hemodynamically unstable and referred to IR, diverted to theatre due to instability for open splenectomy

To Err Is Human

- Diagnostic
  - Error or delay in diagnosis
    - No
  - Failure to employ indicated tests
    - Yes
  - Use of outmoded tests or therapy
    - Yes
  - Failure to act on results of monitoring or testing
    - Yes



Optimizing Trauma Multidetector CT Protocol for Blunt Splenic Injury: Need for Arterial and Portal Venous Phase Scans[1]

Purpose: To retrospectively compare the diagnostic performance of arterial, portal venous, and dual-phase computed tomography (CT) for blunt traumatic splenic injury.

EMERGENCY RADIOLOGY

Prospective Trial of Angiography and Embolization for All Grade III to V Blunt Splenic Injuries: Nonoperative Management Success Rate Is Significantly Improved

Preston R Miller, MD, FACS, Michael C Chang, MD, FACS, J Jason Hoth, MD, FACS, Nathan T Mowery, MD, FACS, Amy N Hildreth, MD, FACS, R Shayn Martin, MD, FACS, James H Holmes, MD, FACS, J Wayne Meredith, MD, FACS, Jay A Requarth, MD, FACS

Do We Need to Develop A Guideline?

Name, Blame, Shame doesn't work they say....

What Did We Do?

- Multidisciplinary Group to Discuss Case
  - Senior Trauma Surgeon, Trauma Fellow
  - Two Interventional Radiologists
  - Diagnostic Radiologist
- Reviewed the Literature
- Hashed out a pathway/guideline for splenic trauma
- Communicated with team members, educated team members, disseminated information
- Audit

Blunt Splenic Trauma Guidelines

- Imaging will be performed as detailed below* on blunt trauma patients who do not have immediate indications for theatre i.e. peritonitis, hypotension.
- Evidence of splenic trauma with **contrast extravasation, false aneurysm, and/or arteriovenous fistula** will proceed directly to angiography from emergency department. This will be organised by phone call from the most senior surgical registrar available to the interventional consultant.
- Any grade 3+ splenic injury without the above findings will prompt a phone call from the surgical consultant to the interventional consultant. If the surgical consultant is not available within 20 minutes to make this call, the most senior surgical fellow/registrar will initiate the communication
- Factors that may prompt angiography in the absence of contrast extravasation, false aneurysm, and/or arteriovenous fistula include but are not limited to:
    - Significant hemoperitoneum
    - Clinical findings concerning for impending instability
        - Hemoglobin drop
        - Tachycardia
        - Hypotension
        - Fluid requirement >1L or blood product requirement
    - Patients who are higher risk for complications from hypotension and/or laparotomy
        - TBI
        - Elderly/comorbid
- If it is decided that the patient not require immediate angiography, a plan will be put in place to allow for prompt reconsideration should the patient's condition change. Ideally the patient will be admitted to a monitored setting i.e. HDU.

***Imaging** (pertains only to those patients who do not require a chest CT; these patients will continue as before)

- Dual phase abdominal CT (arterial upper abdomen, portal venous abdomen and pelvis):
    - Resus patients coming through as a trauma call
    - Non resus patients with positive FAST
- Dual phase abdominal CT including pelvis (arterial abdomen and pelvis, portal venous abdomen and pelvis):
    - Patients with unstable pelvic fractures.
- Single phase abdominal CT (portal venous phase abdomen and pelvis):
    - All other trauma patients.

CT: Who and How

Angio: All patients with contrast extravasation, pseudoaneurysm, or a/v fistula

Consultant Discussion: Any grade 3+ injury without extrav/psa/fistula

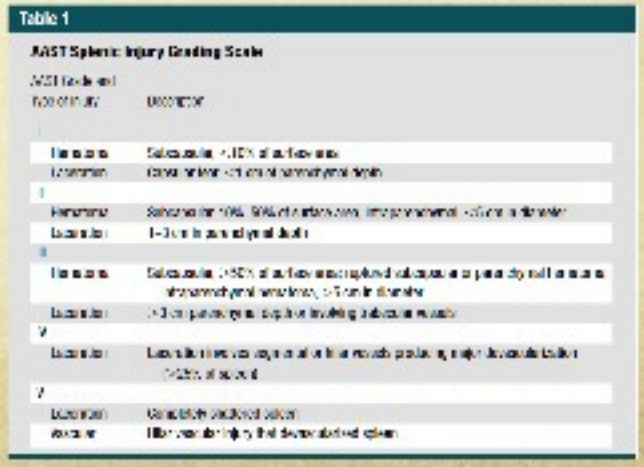
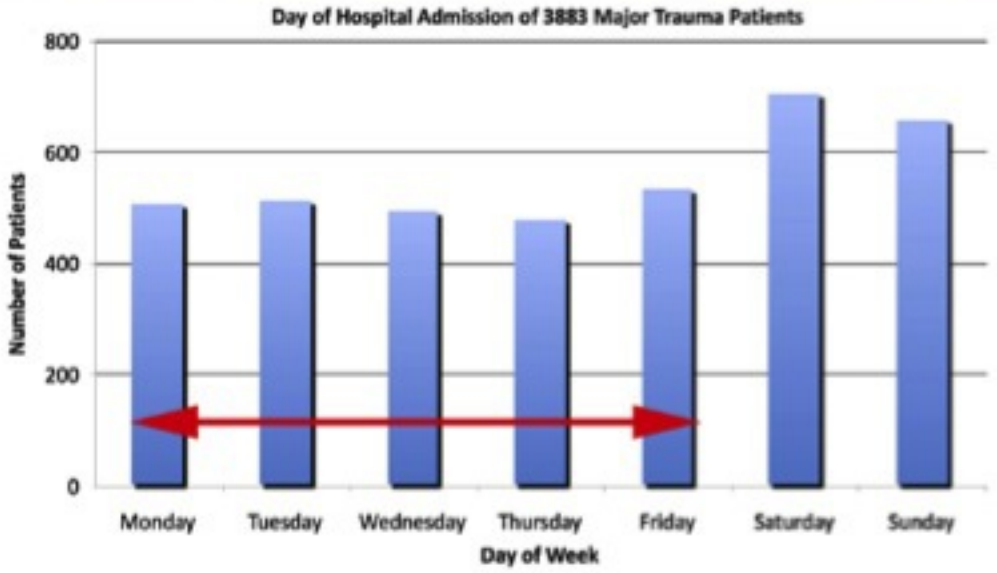


Table 1

AAST Splenic Injury Grading Scale

Guidelines?

Isn’t this just part of our job?


Day of Hospital Admission of 3883 Major Trauma Patients
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Monday
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Friday
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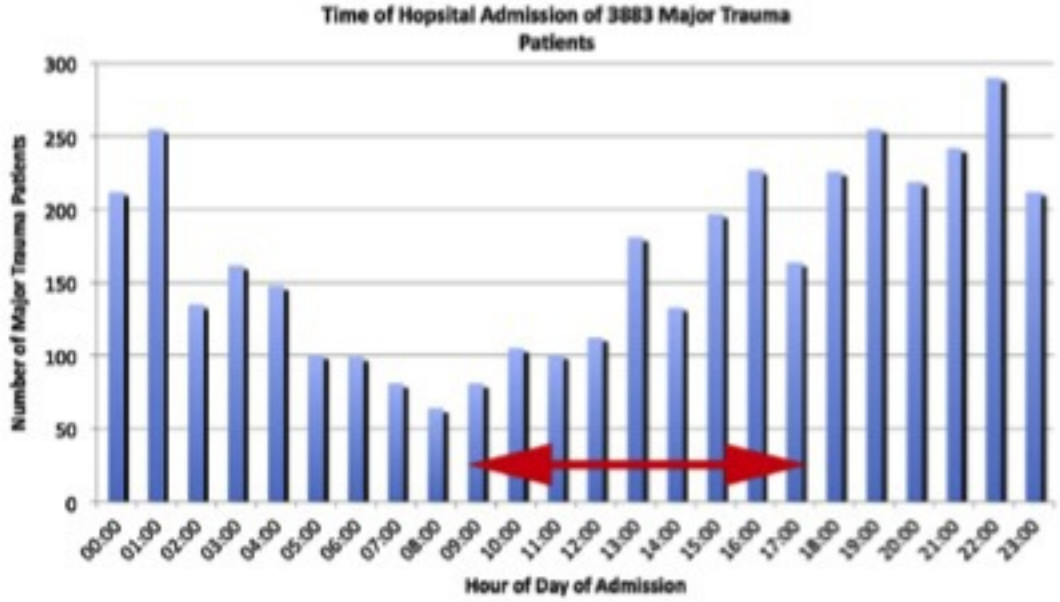
Sunday
Day of Week

(a)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23:00
Hour of Day of Admission

(b)

"The minutes and first hours after an accident are not the time to be working out care from first principles. We miss the obvious under pressure; we cannot hope to make consistently inspired diagnoses. It is not the time to be negotiating a hierarchy, debating priorities and searching shelves and drawers for equipment. We need a well worked out process based on getting most things right and very few things wrong."

Trauma: Who Cares? A report of the National Confidential Enquiry into Patient Outcome and Death (2007). Prof Treasure.

Guidelines

Hinderance

Supported by evidence

Do not reflect current multidisciplinary teams

Team structures can be hard to change

Cumbersome and interfere with delivery of care

Reviewed and changed as needed to continuously improve care

Autonomy

Systems-based practice

Thank you very much!

References

To Err Is Human: Building a Safer Health System. Kohn L, Corrigan J, Donaldson M, eds. Washington, DC: Committee on Quality of Health Care in America, Institute of Medicine. National Academies Press; 1999.

Error in medical practice. Lillis S 2013. Chapter 21 in St George IM (ed.). Cole's medical practice in New Zealand, 12th edition. Medical Council of New Zealand, Wellington.

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