DIAGNOSTIC IMAGING PATHWAYS
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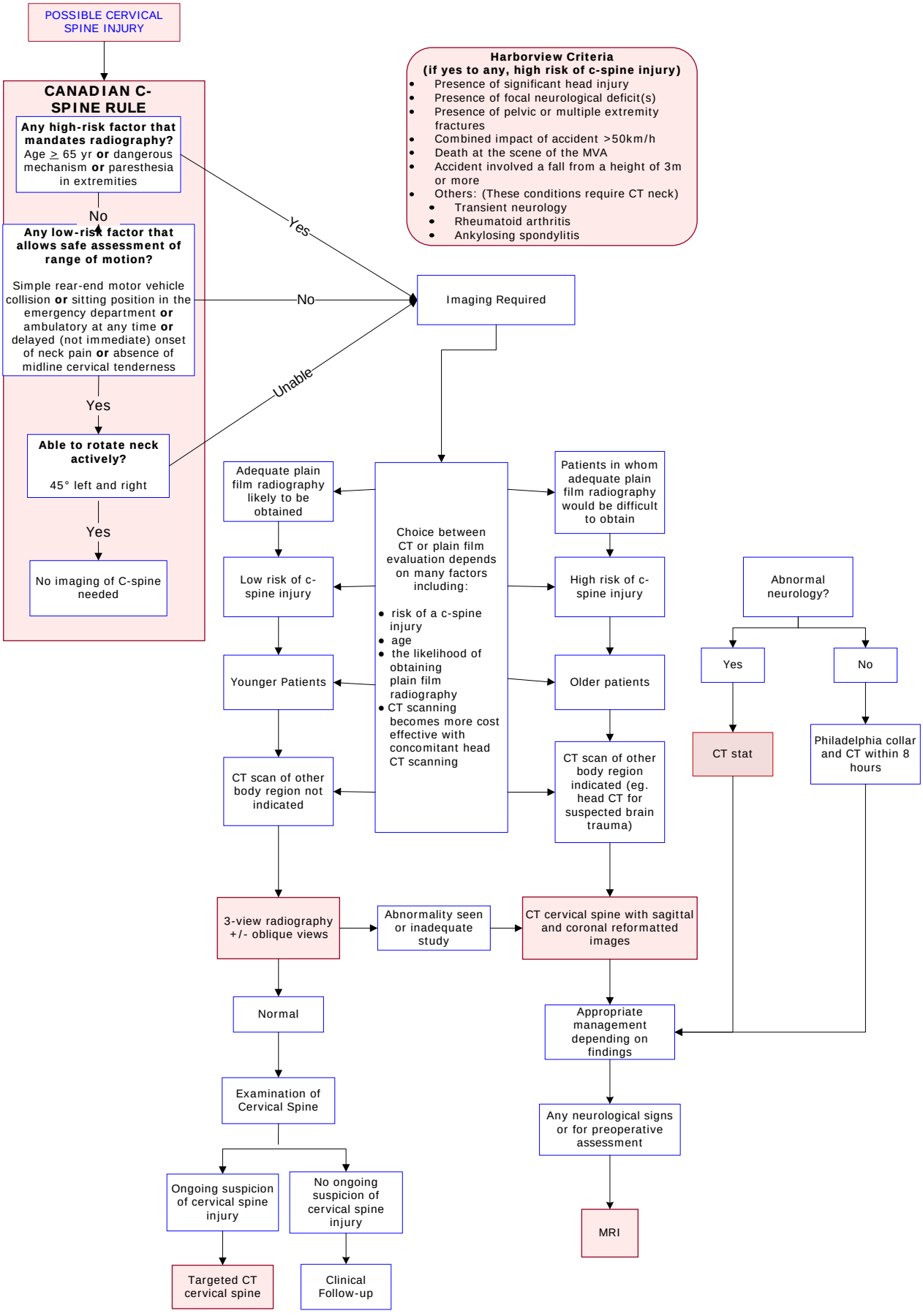
Pathway last updated August 2010. Pathways will be reviewed periodically and updated

Cervical Spine Injury


POSSIBLE CERVICAL SPINE INJURY
CANADIAN C-SPINE RULE
Any high-risk factor that mandates radiography?
Age ≥ 65 yr or dangerous mechanism or paresthesia in extremities
No
Any low-risk factor that allows safe assessment of range of motion?
Simple rear-end motor vehicle collision or sitting position in the emergency department or ambulatory at any time or delayed (not immediate) onset of neck pain or absence of midline cervical tenderness
Yes
Able to rotate neck actively?
45° left and right
Yes
No imaging of C-spine needed
Yes
No
Unable
Harborview Criteria
(if yes to any, high risk of c-spine injury)
Presence of significant head injury
Presence of focal neurological deficit(s)
Presence of pelvic or multiple extremity fractures
Combined impact of accident >50km/h
Death at the scene of the MVA
Accident involved a fall from a height of 3m or more
Others: (These conditions require CT neck)
Transient neurology
Rheumatoid arthritis
Ankylosing spondylitis
Imaging Required
Choice between CT or plain film evaluation depends on many factors including:
risk of a c-spine injury
age
the likelihood of obtaining plain film radiography
CT scanning becomes more cost effective with concomitant head CT scanning
Adequate plain film radiography likely to be obtained
Low risk of c-spine injury
Younger Patients
CT scan of other body region not indicated
Patients in whom adequate plain film radiography would be difficult to obtain
High risk of c-spine injury
Older patients
CT scan of other body region indicated (eg. head CT for suspected brain trauma)
3-view radiography +/- oblique views
Abnormality seen or inadequate study
CT cervical spine with sagittal and coronal reformatted images
Normal
Examination of Cervical Spine
Ongoing suspicion of cervical spine injury
No ongoing suspicion of cervical spine injury
Targeted CT cervical spine
Clinical Follow-up
Abnormal neurology?
Yes
No
CT stat
Philadelphia collar and CT within 8 hours
Appropriate management depending on findings
Any neurological signs or for preoperative assessment
MRI

CANADIAN C-SPINE RULES AND THE NATIONAL EMERGENCY X-RADIOGRAPHY UTILIZATION STUDY (NEXUS) PREDICTION RULE

- The Canadian C-spine rules were developed from a sample of almost 9,000 patients from 10 Canadian hospitals.[1] Prospective evaluation of the CCSR compared to the NEXUS rules in over 8,000 patients by the authors of the CCSR reported a sensitivity of 99.4% and specificity of 45.1% for the CCSR to detect clinically important c-spine injury. The sensitivity and specificity of the NEXUS rules were only 90.7% and 36.8% in this study.[2] Previous prospective evaluation of the NEXUS criteria reported a sensitivity of 99%.[24]
- Use of either clinical decision rule is intended to identify patients whom can be safely managed without radiological examination of the c-spine.
- A retrospective case-control study designed to stratify patients 65 years and older into risk groups found that the significant predictors of cervical spine fracture in older patients were: [22]
    - Presence of new focal neurological deficits
    - Severe head injury (intracranial haemorrhage, GCS < 15/15 at time of clinical assessment)
    - High energy mechanism of injury (MVA combined speed of >56km/h, fall from a height of 3m or greater, car striking pedestrian, airplane accidents)
- In patients 65 years and over, there is a greater risk of cervical spine fractures with low-moderate energy trauma compared to the general population, and a higher incidence of fractures without associated clinical factors that are predictive of cervical spine injury. [22]

HARBOURVIEW CLINICAL DECISION RULE

- A large retrospective study of 4285 patient designed to validate a recommended clinical decision rule for cervical spine screening using helical CT. This was based on 6 injury-mechanism and clinical parameters, and assumed that a head CT scan was indicated in all patients. [5]
- The six criteria that predicted a high risk of cervical spine fracture are:
    - Presence of significant head injury
    - Presence of focal neurology
    - Presence of pelvic or multiple extremity fractures
    - Combined impact of accident >56km/h
    - Death at the scene of the MVA
    - Fall from a height of 3m or more

- It was estimated that cervical spine CT can be more cost effective compared to conventional radiography if head CT was also performed and if the probability of cervical spine fracture in the population screened with helical CT exceeded 5%. [5]
- Cost effectiveness is based on preventing delayed cases of paralysis by improved detection of unstable fractures. [5]
- Application of the criteria to stratify patients yielded a positive scan rate for cervical spine fractures in 8.7% of those screened with helical CT. [5]
- As a retrospective analysis, this study was limited to data in the medical records, and the presence and absence of individual criteria was not routinely documented. [5]

PLAIN RADIOGRAPHY

- Three view radiography includes:
    - anteroposterior (AP)
    - true lateral (including all seven cervical vertebrae and C7-T1 junction)
    - open-mouth odontoid views
- In some centres oblique views are also performed although one study has suggested that oblique views do not improve detection of abnormalities over three view radiography. [10]
- When CT is used as the reference standard, radiography misses up to 56% of cervical spine fractures. [8]
- However, when considering only clinically significant fractures radiography has a sensitivity of approximately 94%. [3]
- Radiography is preferred to CT when patients have a low risk of injury (more cost-effective) and are younger (more sensitive to radiation).
- Limitations of plain radiography:
    - High rate of diagnostic error (poor quality images and misinterpretation of the findings). [11,12]
    - Difficulty obtaining technically adequate films in severely injured multiple trauma patients. [13]
    - Misses a significant percentage of fractures, particularly upper cervical spine fractures. [8,9,11,14]

COMPUTED TOMOGRAPHY

- More sensitive and specific than three view cervical spine radiography. Combined sensitivity of CT is 98% and 54% for plain film radiography. 8,23
- The American College of Radiology has recommended that all patients who require radiological evaluation of the c-spine for suspected traumatic fracture undergo CT examination in preference to plain film radiography.3 Recommendations to use plain film in patients at low risk have been proposed by other authors to decrease cost and radiation. 6,7
- CT is advantageous in patients who have a high likelihood of injury (increased yield), 4 who are older (less susceptible to radiation) and in whom a head CT is also being performed (more cost-effective).18
- A clinical prediction rule has been developed to identify subjects at high risk of cervical spine fracture and the Harbourview criteria has been prospectively validated. 4,5
- In patients who have a fracture demonstrated on X-ray or in whom the plain films are negative but there is a high suspicion of cervical injury, CT should be used for more definitive evaluation of the cervical spine. 11,15
- Cost effective analysis of c-spine imaging options have not included the costs associated with the increased radiation caused by CT. 9
- CT is associated with an estimated skin dose of 27.6mGy compared with 2.8mGy for plain film radiography. The estimated thyroid dose is 26mGy for CT and 1.8mGy for plain film. 17
- CT is not as good as MRI in demonstrating soft tissue or spinal cord injury. 15
- In general CT is useful in the following situations: 12,16
    - To facilitate complete cervical spine evaluation in the face of inadequate plain films.
    - To clarify uncertain radiological findings on plain radiography.
    - To detect occult spinal fractures.
    - To determine the presence and degree of displacement of bony fragments into the neural canal.
    - To assess the spinal stability and to assist in operative planning.
- Advantages:
    - Improved accuracy.

    - Faster diagnosis.

- Limitations:
    - May miss fractures in the axial plane including base of odontoid and some subluxations.
    - Limited ability to show ligamentous injuries.
    - Increased radiation exposure.
    - Higher cost than plain radiography

MAGNETIC RESONANCE IMAGING

- Not particularly effective at detecting cervical spine fractures. 15,19,20
- However, is the procedure of choice for evaluating soft tissue, ligamentous and spinal cord injury. 15,19-21
- Indications: 16
    - Clinical evidence of spinal cord injury, especially incomplete injury.
    - Neurological deficits not explained by plain film or CT findings.
    - Patients with injuries requiring posterior stabilisation to exclude concomitant disc herniations that might alter the surgical approach.
- Limitations:
    - Expensive.
    - Long imaging time.
    - Inability to fully characterise vertebral fractures.
    - Technical difficulties in clinically unstable patients.
    - Limited availability.

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