Rationale

This CPG emphasizes initial assessment and early care phase of suspected spinal injury. External recommendations regarding long-term management were omitted as out of scope of this CPG. Emphasis was placed on blunt injury, as gunshot or other penetrating injuries are rarer in Canada than in the United States.

Modifications to external recommendations and the development of new recommendations were based on the following considerations:

- Relevance and applicability to the BC trauma system, including the Patient Transfer Network (PTN) and the importance of consult with VGH Spine Services prior to transfer
- Alignment with recommendations in the BC Diagnostic Imaging Guidelines for Polytrauma

Additional literature support is provided below.

i. What constitutes distracting injuries?

There is conflicting evidence (small retrospective studies) with regard to lower extremity injuries distracting patients from a cervical spine injury.

Several studies conclude that lower-body injuries (i.e., bony fractures in the pelvis, lower extremity) should not be distracting to clear the cervical spine.[1, 2, 3]

One study concluded femur fractures should not be considered distracting amongst lower extremity injuries.[4]

[1] Heffernan DS, Schermer CR, Lu SW. What defines a distracting injury in cervical spine assessment? J Trauma. 2005 Dec;59(6):1396–9.

[2] Ong AW, Rodriguez A, Kelly R, Cortes I, Protetch J, Daffner RH. Detection of Cervical Spine Injuries in Alert, Asymptomatic Geriatric Blunt Trauma Patients: Who Benefits From Radiologic Imaging? The American Surgeon. 2006 Sep 1;72(9):773–7.

[3] Kulvatunyou N, Lees JS, Bender JB, Bright B, Albrecht R. Decreased use of cervical spine clearance in blunt trauma: The implication of the injury mechanism and distracting injury. Accident Analysis & Prevention. 2010 Jul 1;42(4):1151–5.

[4] Dahlquist RT, Fischer PE, Desai H, Rogers A, Christmas AB, Gibbs MA, et al. Femur fractures should not be considered distracting injuries for cervical spine assessment. The American Journal of Emergency Medicine. 2015 Dec 1;33(12):1750–4.

ii. What are the effectiveness and benefits of the Canadian C-Spine Rule in clearing cervical spine injuries?

The sensitivity rate of the Canadian C-Spine Rule ranges from 98–100 %. [5, 6, 7, 8, 9]

Implementing the Canadian C-Spine Rule resulted in a 12.5–56 % reduction in imaging without missing clinically important cervical spine injury. [5, 9, 10]

Implementing the Canadian C-Spine Rule resulted in cost savings of US $226,500 and prevention of 105.7 mSv in radiation exposure, with no missed injuries, over a 3-month period at a level 1 trauma centre. [11]

iii. What is the optimal Mean Arterial Blood Pressure (MAP) after acute spinal cord injury?

Threshold for optimal MAP is >85 mmHg, based a systematic review. [12]

Duration and time below the threshold 85 mmHg may have greater influence on neurological outcomes than average MAP. [13]

5 Stiell IG, Clement CM, McKnight RD, Brison R, Schull MJ, Rowe BH, et al. The Canadian C-Spine Rule versus the NEXUS Low-Risk Criteria in Patients with Trauma. New England Journal of Medicine. 2003 Dec 25;349(26):2510–8.

6 Hoffman JR, Mower WR, Wolfson AB, Todd KH, Zucker MI. Validity of a Set of Clinical Criteria to Rule Out Injury to the Cervical Spine in Patients with Blunt Trauma. New England Journal of Medicine. 2000 Jul 13;343(2):94–9.

7 Bandiera G, Stiell IG, Wells GA, Clement C, De Maio V, Vandemheen KL, et al. The Canadian C-Spine rule performs better than unstructured physician judgment. Annals of Emergency Medicine. 2003 Sep 1;42(3):395–402.

8 Anderson PA, Muchow RD, Munoz A, Tontz WL, Resnick DK. Clearance of the Asymptomatic Cervical Spine: A Meta-analysis. Journal of Orthopaedic Trauma. 2010 Feb;24(2):100–106.

9 Michaleff ZA, Maher CG, Verhagen AP, Rebbeck T, Lin C-WC. Accuracy of the Canadian C-spine rule and NEXUS to screen for clinically important cervical spine injury in patients following blunt trauma: a systematic review. CMAJ. 2012 Oct 9;cmaj.120675.

10 Stiell IG, Clement CM, Grimshaw J, Brison RJ, Rowe BH, Schull MJ, et al. Implementation of the Canadian C-Spine Rule: prospective 12 centre cluster randomised trial. BMJ. 2009 Oct 29;339:b4146.

11 Paydar S, Ahmadi A, Dalfardi B, Shakibafard A, Abbasi H, Bolandparvaz S. Clinical and economic effects of selective radiological evaluation of high-energy trauma patients: a prospective experience of a level 1 busy trauma centre. Emerg Med J. 2015 Jul 1;32(7):535–8.

12 Casha S, Christie S. A Systematic Review of Intensive Cardiopulmonary Management after Spinal Cord Injury. Journal of Neurotrauma. 2009 Dec 23;28(8):1479–95.

13 Hawryluk G, Whetstone W, Saigal R, Ferguson A, Talbott J, Bresnahan J, et al. Mean Arterial Blood Pressure Correlates with Neurological Recovery after Human Spinal Cord Injury: Analysis of High Frequency Physiologic Data. Journal of Neurotrauma. 2015 Feb 10;32(24):1958–67.

iv. What is the effectiveness of CT vs. plain radiography in detecting cervical spine injuries?

According to a meta-analysis, plain radiography has a sensitivity rate of 52 % while CT has a sensitivity rate of 98 % in detecting cervical spine injuries. [14]

v. What is the effectiveness of CT vs. plain radiography in detecting thoraco-lumbar spinal injuries?

According to a systematic review, plain radiography has a sensitivity rate of 22–75 % while CT has a sensitivity rate of 95–100 % in detecting thoraco-lumbar spinal injuries. [15]

vi. What is the effectiveness of clinical examination and using age and mechanism of injury in ruling out thoraco-lumbar spinal injuries?

A prospective observational study found clinical examination has a sensitivity of 78.4 % and specificity of 72.9 %. [16]

The same study found the addition of age ≥60 years and high-risk mechanism (fall, crush, motor vehicle crash with ejection/rollover, unenclosed vehicle crash, auto vs. pedestrian) as factors resulted in:

- Sensitivity of 98.9 % and specificity of 29.0 % for clinically significant injuries, and
- Sensitivity of 100 % and specificity of 27.3 % for injuries requiring surgery.

[14] Holmes JF, Akkinepalli R. Computed tomography versus plain radiography to screen for cervical spine injury: a meta-analysis. J Trauma. 2005 May;58(5):902–5.

[15] Sixta S, Moore FO, Ditillo MF, Fox AD, Garcia AJ, Holena D, et al. Screening for thoracolumbar spinal injuries in blunt trauma: An Eastern Association for the Surgery of Trauma practice management guideline. Journal of Trauma and Acute Care Surgery. 2012 Nov;73(5):S326.

[16] Inaba K, Nosanov L, Menaker J, Bosarge P, Williams L, Turay D, et al. Prospective derivation of a clinical decision rule for thoracolumbar spine evaluation after blunt trauma: An American Association for the Surgery of Trauma Multi-Institutional Trials Group Study. Journal of Trauma and Acute Care Surgery. 2015 Mar;78(3):459–467.

vii. What is the optimal timing of surgical decompression in acute spinal cord injury?

The STASCIS study is the largest prospective non-randomized study on the timing of decompression for acute c-spine cord injury to date (313 patients enrolled between 2002–2009 from 6 centres across Canada). The study investigators reported at least 2 grade AIS improvement at 6-month follow-up with decompression conducted within 24 hours of SCI, with no significant complications.[17]

Two small prospective (quasi-)randomized studies on the topic showed mixed results of early decompression:

- One study found no significant differences in neurologic outcome, LOS in hospital, LOS in ICU or rehabilitation facility between early (≤72 hours) and late (>72 hours) groups (n=34).[18]
- Another study observed better neurologic outcomes, shorter hospital stays, shorter ICU stays and lower complication rates in early surgery group (≤8 hours) than late group (3–15 days) (n=27).[19]

Overall, systematic reviews and meta-analyses report benefits of early surgery, which can range from 4–72 hours.[20, 21]

Significantly higher hospitalization cost and increase in length of stay in hospital is associated with surgery after 24 hours in spinal cord injuries.[22] Savings to the Canadian health-care system has been estimated at over US$58 million for one quality adjusted life years (QALY) gained for patients with complete SCI, and over US$536K for one QALY gained in patients with incomplete SCI.[23]

17 Fehlings MG, Vaccaro A, Wilson JR, Singh A, Cadotte DW, Harrop JS, et al. Early versus Delayed Decompression for Traumatic Cervical Spinal Cord Injury: Results of the Surgical Timing in Acute Spinal Cord Injury Study (STASCIS). PLOS ONE. 2012 Feb 23;7(2):e32037.

18 Vaccaro AR, Daugherty RJ, Sheehan TP, Dante SJ, Cotler JM, Balderston RA, et al. Neurologic Outcome of Early Versus Late Surgery for Cervical Spinal Cord Injury. Spine. 1997 Nov 15;22(22):2609–2613.

19 Cengiz ŞL, Kalkan E, Bayir A, Ilik K, Basefer A. Timing of thoracolomber spine stabilization in trauma patients; impact on neurological outcome and clinical course. A real prospective (rct) randomized controlled study. Arch Orthop Trauma Surg. 2008 Sep 1;128(9):959–66.

20 van Middendorp JJ, Hosman AJF, Doi SAR. The Effects of the Timing of Spinal Surgery after Traumatic Spinal Cord Injury: A Systematic Review and Meta-Analysis. Journal of Neurotrauma. 2013 Jul 1;30(21):1781–94.

21 Liu J-M, Long X-H, Zhou Y, Peng H-W, Liu Z-L, Huang S-H. Is Urgent Decompression Superior to Delayed Surgery for Traumatic Spinal Cord Injury? A Meta-Analysis. World Neurosurgery. 2016 Mar 1;87(Supplement C):124–31.

22 Mac-Thiong J-M, Feldman DE, Thompson C, Bourassa-Moreau É, Parent S. Does Timing of Surgery Affect Hospitalization Costs and Length of Stay for Acute Care following a Traumatic Spinal Cord Injury? Journal of Neurotrauma. 2012 Aug 24;29(18):2816–22.

23 Furlan JC, Craven BC, Massicotte EM, Fehlings MG. Early Versus Delayed Surgical Decompression of Spinal Cord after Traumatic Cervical Spinal Cord Injury: A Cost-Utility Analysis. World Neurosurgery. 2016 Apr 1;88(Supplement C):166–74.

viii. What is the rate of pressure ulcers development associated with cervical spine immobilization?

The incidence rate for the development of pressure ulcers ranges from 6.8–38 %, according to a systematic review.[24]

The risk of pressure ulcer development increases by 66 % for every day on the collar.[25]

ix. What are the potential complications in hemodynamic management of acute spinal cord injury?

A retrospective study found significant complications associated with vasopressor use, especially tachycardia and bradycardia. Dopamine had the highest rates of complication among the vasopressors studied (69.2%), particularly when used in injuries below T6.[26]

A multi-centre randomized trial showed that dopamine is associated with significantly more arrhythmic events than norepinephrine in patients with septic shock but no significant difference in mortality rate at 28 days between the two drug groups.[27]

According to a meta-analysis, dopamine was associated with greater mortality and a higher incidence of arrhythmic events compared to norepinephrine in patients with septic shock.[28]

[24] Ham W, Schoonhoven L, Schuurmans MJ, Leenen LPH. Pressure ulcers from spinal immobilization in trauma patients: A systematic review. Journal of Trauma and Acute Care Surgery. 2014 Apr;76(4):1131–1141.

[25] Ackland HM, Cooper JD, Malham GM, Kossmann T. Factors Predicting Cervical Collar-Related Decubitus Ulceration in Major Trauma Patients. Spine. 2007 Feb 15;32(4):423–428.

[26] Inoue T, Manley GT, Patel N, Whetstone WD. Medical and Surgical Management after Spinal Cord Injury: Vasopressor Usage, Early Surgerys, and Complications. Journal of Neurotrauma. 2013 Sep 10;31(3):284–91.

[27] De Backer D, Biston P, Devriendt J, Madl C, Chochrad D, Aldecoa C, et al. Comparison of Dopamine and Norepinephrine in the Treatment of Shock. New England Journal of Medicine. 2010 Mar 4;362(9):779–89.

[28] De Backer D, Aldecoa C, Njimi H, Vincent J-L. Dopamine versus norepinephrine in the treatment of septic shock: A meta-analysis*. Critical Care Medicine. 2012 Mar;40(3):725.