Guidelines for the Management of Acute Cervical Spine and Spinal Cord Injuries: 2013 Update

Beverly C. Walters, MD, MSc, FRCSC, Mark N. Hadley, MD, R. John Hurlbert, MD, PhD, FRCSC, Bizhan Aarabi, MD, FRCSC, Sanjay S. Dhall, MD, Daniel E. Gelb, MD, Mark R. Harrigan, MD, Curtis J. Rozelle, MD, Timothy C. Ryken, MD, MS, and Nicholas Theodore, MD

In 2002, an author group selected and sponsored by the Joint Section on Spine and Peripheral Nerves of the American Association of Neurological Surgeons and Congress of Neurological Surgeons published the first evidence-based guidelines for the management of patients with acute cervical spinal cord injuries (SCIs).[1-23] In the spirit of keeping up with changes in information available in the medical literature that might provide more contemporary and more robust medical evidence, another author group was recruited to revise and update the guidelines. The review process has been completed and is published and can be once again found as a supplement to *Neurosurgery*. The purpose of this article is to provide an overview of the changes in the recommendations as a result of new evidence or broadened scope.

CHANGES IN METHODOLOGY

In accordance with the established practice of guideline development within organized neurosurgery, a thorough review of the medical literature was undertaken for each subject chosen for evaluation. Although literature outside the English language was excluded, a sample of non-English abstracts that could be found in the database of the National Library of Medicine failed to reveal any data significantly different from what we found in the English literature. Each chapter of recommendations contained in the new guidelines uses standard search techniques fully described in each chapter.

After articles appropriate to each review question were identified, a rigorous critical evaluation was undertaken to establish the strength (quality) of the evidence and the level (certainty) of the recommendations. As in previous guidelines, published evidence was divided into Class I (well-designed and -executed randomized controlled trials), Class II (comparative studies, including randomized controlled trials with significant flaws, nonrandomized cohort studies, or case-control studies), and Class III (case series and expert opinion). Different from previous recommendations, the levels that used to be called standards, guidelines, and options are now referred to as Level I, Level II, and Level III, bringing them more in line with other neurosurgical and medical specialty paradigms and allowing the use of the term guidelines to denote the broader scope of the overall recommendations.[24] Our author group universally felt that further stratification of guidelines into additional subsets (1a, 1b, 1c, 2a, 2b, 2c, etc)[25] would not denote improved certainty or strength but instead would undermine consensus building and promote confusion among the readership.

NOTABLE EXCLUSIONS FROM THE GUIDELINES

Topical areas not included in the current guidelines pertain to the timing of surgery and use of hypothermia. The published evidence for these clinical strategies is so sparse that recommendations cannot be made with any degree of confidence pending further study. A single prospective study on surgical timing has subsequently been published since completion of our SCI guidelines review. Although designed as a prospective, nonrandomized comparative study (Class II), methodological flaws downgrade it to Class III evidence, rendering it unhelpful for establishing quality and certainty in the case of acute surgical intervention in SCI.[26] Systemic hypothermia has been studied in animal models of SCI but only anecdotally in humans by way of a single Class II study also published after the current guidelines went to press. Again, in this instance, the evidence is early and cannot support a practice recommendation.[27]

The use of intraoperative somatosensory evoked potentials in the setting of trauma as a warning of SCI has not been addressed in the current guidelines. Those studies that our author group was able to find were carried out in nonacute (elective) spinal surgical situations. Although we felt that inferences might be made to acute SCI surgery, our supervising Joint Guidelines Committee of the American Association of Neurological Surgeons and Congress of Neurological Surgeons preferred to minimize such extrapolations. Hence, recommendations with respect to intraoperative electrophysiological monitoring will be made under a different (nontraumatic) guidelines initiative.

Functional magnetic resonance imaging may potentially contribute to SCI research, but to date, there are no clinical studies that establish its usefulness in human SCI. Thus, it has been excluded from the current guidelines.[28] Similarly, there are no recommendations on the use of drugs,[29] biologicals,[30] or

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TABLE. Comparison of Cervical Spine and Spinal Cord Injury Guidelines Recommendations Between 2 Iterations Where Differences in Recommendations Have Occurred (All Other Recommendations Remain as Previously Stated) [a] [32]

Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
Immobilization	Option	All trauma patients with a cervical spinal column injury or with a mechanism of injury having the potential to cause cervical spine injury should be immobilized at the scene and during transport by using 1 of several available methods. A combination of a rigid cervical collar and supportive blocks on a backboard with straps is effective in limiting motion of the cervical spine and is recommended.	Level II	Spinal immobilization of all trauma patients with a cervical spine or SCI or with a mechanism of injury having the potential to cause cervical spinal injury is recommended. Triage of patients with potential spinal injury at the scene by trained and experienced EMS personnel to determine the need for immobilization during transport is recommended. Immobilization of trauma patients who are awake, alert, and not intoxicated; who are without neck pain or tenderness; who do not have an abnormal motor or sensory examination; and who do not have any significant associated injury that might detract from their general evaluation is not recommended.
	None	Not addressed	Level III	Spinal immobilization in patients with penetrating trauma is not recommended because of the increased mortality from delayed resuscitation.
Transportation	None	Not addressed	Level III	Whenever possible, the transport of patients with acute cervical spine injuries or SCIs to specialized acute SCI treatment centers is recommended.
Clinical assessment: neurological status	Option	The ASIA international standards are recommended as the preferred neurological examination tool.	Level II	New Class II medical evidence.
Clinical assessment: functional status	Guideline	The Functional Independence Measure is recommended as the functional outcome assessment tool for clinicians involved in the assessment and care of patients with acute SCIs.	Level I	The Spinal Cord Independence Measure is recommended as the preferred functional outcome assessment tool for clinicians involved in the assessment, care, and follow-up of patients with SCIs.
	Option	The modified Barthel Index is recommended as a functional outcome assessment tool for clinicians involved in the assessment and care of patients with acute SCIs.	NA (not included in the current iteration)	NA (not included in the current iteration)
Clinical assessment: pain	None	Not addressed	Level I	The International Spinal Cord Injury Basic Pain Data Set is recommended as the preferred means to assess pain, including pain severity, physical functioning, and emotional functioning, among SCI patients.
Radiographic assessment: asymptomatic patient	Standard	Radiographic assessment of the cervical spine is not recommended in trauma patients who are awake, alert, and not intoxicated; who are without neck pain or tenderness; and who do not have significant associated injuries that detract from their general evaluation.	Level I	In the awake, asymptomatic patient who is without neck pain or tenderness, who has a normal neurological examination, who is without an injury detracting from an accurate evaluation, and who is able to complete a functional range of motion examination, radiographic evaluation of the cervical spine is not recommended. Discontinuance of cervical immobilization for these patients is recommended without cervical spinal imaging.

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Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
	Option	It is recommended that cervical spine immobilization in awake patients with neck pain or tenderness and normal cervical spine x-rays (including supplemental CT as necessary) be discontinued after either normal and adequate dynamic flexion/extension radiographs or a normal MRI study is obtained within 48 h of injury.	Level III	In the awake patient with neck pain or tenderness and normal high-quality CT imaging or normal 3-view cervical spine series (with supplemental CT if indicated), the following recommendations should be considered: (1) Continue cervical immobilization until asymptomatic; (2) Discontinue cervical immobilization after normal and adequate dynamic flexion/extension radiographs; (3) Discontinue cervical immobilization after a normal MRI obtained within 48 h of injury (limited and conflicting Class II and Class III medical evidence); or (4) Discontinue cervical immobilization at the discretion of the treating physician.
		Cervical spine immobilization in obtunded patients with normal cervical spine x-rays (including supplemental CT as necessary) may be discontinued after dynamic flexion/extension studies are performed under fluoroscopic guidance, after a normal MRI study is obtained within 48 h of injury, or at the discretion of the treating physician.		
Radiographic assessment: symptomatic patient	Standard	A 3-view cervical spine series (anteroposterior, lateral, and odontoid views) is recommended for radiographic evaluation of the cervical spine in patients who are symptomatic after traumatic injury. This should be supplemented with CT to further define areas that are suspicious or not well visualized on the plain cervical x-rays.	Level I	In the awake, symptomatic patient, high-quality CT imaging of the cervical spine is recommended. If high-quality CT imaging is available, routine 3-view cervical spine radiographs are not recommended. If high-quality CT imaging is not available, a 3-view cervical spine series (anteroposterior, lateral, and odontoid views) is recommended. This should be supplemented with CT (when it becomes available) if necessary to further define areas that are suspicious or not well visualized on the plain cervical x-rays.
	Option	It is recommended that cervical spine immobilization in awake patients with neck pain or tenderness and normal cervical spine x-rays (including supplemental CT as necessary) be discontinued either after normal and adequate dynamic flexion/extension radiographs or after a normal MRI study is obtained within 48 h of injury.	Level III	In the awake patient with neck pain or tenderness and normal high-quality CT imaging or normal 3-view cervical spine series (with supplemental CT if indicated), the following recommendations should be considered: (1) Continue cervical immobilization until asymptomatic; (2) Discontinue cervical immobilization after normal and adequate dynamic flexion/extension radiographs; (3) Discontinue cervical immobilization after a normal MRI obtained within 48 h of injury (limited and conflicting Class II and Class III medical evidence); or

TABLE. (Continued)

Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
				(4) Discontinue cervical immobilization at the discretion of the treating physician.
Radiographic evaluation in obtunded (or unevaluable) patients	Option	Cervical spine immobilization in obtunded patients with normal cervical spine x-rays (including supplemental CT as necessary) may be discontinued after dynamic flexion/extension studies performed under fluoroscopic guidance, after a normal MRI study is obtained within 48 h of injury, or at the discretion of the treating physician.	Level I	In the obtunded or unevaluable patient, high-quality CT imaging is recommended as the initial imaging modality of choice. If CT imaging is available, routine 3-view cervical spine radiographs are not recommended. If high-quality CT imaging is not available, a 3-view cervical spine series (anteroposterior, lateral, and odontoid views) is recommended. This should be supplemented with CT (when it becomes available) if necessary to further define areas that are suspicious or not well visualized on the plain cervical x-rays.
Closed reduction	Option	Early closed reduction is recommended.	Level III	No changes in recommendations
Cardiopulmonary management	Option	Management of patients with acute SCI in a monitored setting is recommended. Maintaining a mean arterial blood pressure of 85-90 mm Hg after SCI is recommended.	Level III	No changes in recommendations
Pharmacology management: corticosteroids	Option	Treatment with methylprednisolone for either 24 or 48 h is recommended as an option in the treatment of patients with acute SCIs. It should be undertaken only with the knowledge that the evidence suggesting harmful side effects is more consistent than any suggestion of clinical benefit.	Level I	Administration of methylprednisolone for the treatment of acute SCI is not recommended. Clinicians considering methylprednisolone therapy should bear in mind that the drug is not approved by the Food and Drug Administration for this application. There is no Class I or Class II medical evidence supporting the clinical benefit of methylprednisolone in the treatment of acute SCI. Scattered reports of Class III evidence claim inconsistent effects likely related to random chance or selection bias. However, Class I, II, and III evidence exists that high-dose steroids are associated with harmful side effects, including death.
Pharmacology management: GM-1 ganglioside	Option	Treatment of patients with acute SCIs with GM-1 ganglioside is recommended as an option without demonstrated clinical benefit.	Level I	Administration of GM-1 ganglioside (Sygen) for the treatment of acute SCI is not recommended.
Occipital condylar fractures: diagnostic	Guidelines (CT)	CT is recommended to diagnose occipital condylar fractures	Level II (CT)	No changes in recommendations
	Option (MRI)		Level III (MRI)	
Occipital condylar fractures: treatment	Option	Treatment with external cervical immobilization is recommended.	Level III	External cervical immobilization is recommended for all types of occipital condyle fractures. More rigid external immobilization in a halo vest device should be considered for bilateral occipital condylar fractures. Halo vest immobilization or occipitocervical stabilization and fusion is recommended for injuries with associated atlanto-occipital ligamentous injury or evidence of instability.

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Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
AOD: diagnostic	None	Not addressed	Level I	CT imaging to determine the condyle-C1 interval in pediatric patients with potential AOD is recommended.
	Option	If there is clinical suspicion of AOD and plain x-rays are nondiagnostic, CT or MRI is recommended, particularly for the diagnosis of non–type II dislocations.	Level III	If there is clinical or radiographic suspicion of AOD and plain radiographs are nondiagnostic, CT of the craniocervical junction is recommended. The condyle-C1 interval determined on CT has the highest diagnostic sensitivity and specificity for AOD among all radiodiagnostic indicators.
AOD: treatment	Option	Traction may be used in the management of patients with AOD, but it is associated with a 10% risk of neurological deterioration.	Level III	Traction is not recommended in the management of patients with AOD and is associated with a 10% risk of neurological deterioration.
Atlas fractures	Option	Treatment is based on specific fracture type and the integrity of the transverse ligament.	Level III	No changes in recommendations
Odontoid fracture	Guideline	Treatment of type II odontoid fractures based on 50 y of age.	Level II	No changes in recommendations
Axis fractures: odontoid	None	Not addressed	Level III	If surgical stabilization is elected, either anterior or posterior techniques are recommended.
Axis fractures: hangman fracture	Option	External immobilization is recommended.	Level III	No changes in recommendations
		Surgery is recommended for angulation and instability.		
Axis fractures: miscellaneous body	Option	External immobilization is recommended for the treatment of isolated fractures of the axis body.	Level III	External immobilization for the treatment of isolated fractures of the axis body is recommended. Consideration of surgical stabilization and fusion in unusual situations of severe ligamentous disruption and/or an inability to achieve or maintain fracture alignment with external immobilization is recommended.
				In the presence of comminuted fracture of the axis body, evaluation for VAI is recommended.
Atlas/axis combination fractures	Option	Treatment is based on characteristics of axis fracture.	Level III	No changes in recommendations
Os odontoideum: diagnostic	Option	Plain radiographs with flexion/extension with or without CT or MRI are recommended.	Level III	No changes in recommendations
Os odontoideum: management	Option	Occipital-cervical fusion with or without C1 laminectomy may be considered in patients with os odontoideum who have irreducible dorsal cervicomedullary compression and/or evidence of associated occipital-atlantal instability.	Level III	Occipital-cervical internal fixation and fusion with or without C1 laminectomy is recommended in patients with os odontoideum who have irreducible dorsal cervicomedullary compression and/or evidence of associated occipital-atlantal instability.
		Transoral decompression may be considered in patients with os odontoideum who have irreducible ventral cervicomedullary compression.		Ventral decompression should be considered in patients with os odontoideum who have irreducible ventral cervicomedullary compression.
Classification of subaxial injuries	None	Not addressed	Level I	SLIC and CSISS
			Level III	Harris and Allen

TABLE. (Continued)

Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
Subaxial cervical spinal injuries	None	Not addressed	Level III	The routine use of CT and MRI of trauma victims with ankylosing spondylitis is recommended, even after minor trauma. For patients with ankylosing spondylitis who require surgical stabilization, posterior long-segment instrumentation and fusion, or a combined dorsal and anterior procedure is recommended. Anterior standalone instrumentation and fusion procedures are associated with a failure rate of up to 50% in these patients.
Central cord syndrome	Option	Aggressive multimodality management of patients with acute traumatic canal cord syndrome is recommended.	Level III	No changes in recommendations
Pediatric injuries: diagnostic	None	Not addressed	Level I	CT imaging to determine the condyle-C1 interval for pediatric patients with potential AOD is recommended.
	Guideline	In children who have experienced trauma; who are alert and conversant; who have no neurological deficit, no midline cervical tenderness, and no painful distracting injury; and who are not intoxicated, cervical spine x-rays are not necessary to exclude cervical spine injury and are not recommended.	Level II	Cervical spine imaging is not recommended in children who are >3 y of age and who have experienced trauma and who: (1) Are alert, (2) Have no neurological deficit, (3) Have no midline cervical tenderness, (4) Have no painful distracting injury, (5) Do not have unexplained hypotension, (6) And are not intoxicated.
		In children who have experienced trauma; who are not alert and nonconversant; who have neurological deficit, midline cervical tenderness, or painful distracting injury; or who are intoxicated, it is recommended that anteroposterior and lateral cervical spine x-rays be obtained.		Cervical spine imaging is not recommended in children who are <3 y of age who have experienced trauma and who: (1) Have a Glasgow Coma Scale score >13, (2) Have no neurological deficit, (3) Have no midline cervical tenderness, (4) Have no painful distracting injury, (5) Are not intoxicated, (6) Do not have unexplained hypotension, (7) Do not have motor vehicle collision, (8) Do not have a fall from a height $>$ 10 ft, or (9) Do not have nonaccidental trauma as a known or suspected mechanism of injury. Cervical spine radiographs or high-resolution CT is recommended for children who have experienced trauma and who do not meet either set of the above criteria.

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Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
				A 3-position CT with C1-C2 motion analysis to confirm and classify the diagnosis is recommended for children suspected of having AARF.
	Options	In children younger < 9 y of age who have experienced trauma; who are nonconversant or have an altered mental status, a neurological deficit, neck pain, or painful distracting injury; who are intoxicated; or who or have unexplained hypotension, it is recommended that anteroposterior and lateral cervical spine x-rays be obtained.	Level III	Anteroposterior and lateral cervical spine radiography or high-resolution CT is recommended to assess the cervical spine in children < 9 y of age.
		In children ≥ 9 y of age who have experienced trauma; who are nonconversant or have an altered mental status, a neurological deficit, neck pain, or painful distracting injury; who are intoxicated; or who have unexplained hypotension, it is recommended that anteroposterior, lateral, and open-mouth cervical spine x-rays be obtained.		Anteroposterior, lateral, and open-mouth cervical spine radiography or high-resolution CT is recommended to assess the cervical spine in children ≥ 9 y of age.
		CT scanning with attention to the suspected level of neurological injury to exclude occult fractures or to evaluate regions not seen adequately on plain x-rays is recommended.		High-resolution CT scan with attention to the suspected level of neurological injury is recommended to exclude occult fractures or to evaluate regions not adequately visualized on plain radiographs.
		Flexion/extension cervical x-rays or fluoroscopy may be considered to exclude gross ligamentous instability when there remains a suspicion of cervical spine instability after static x-rays are obtained.		Flexion and extension cervical radiographs or fluoroscopy is recommended to exclude gross ligamentous instability when there remains a suspicion of cervical spinal instability after static radiographs or CT scan.
		MRI of the cervical spine may be considered to exclude cord or nerve root compression, to evaluate ligamentous integrity, or to provide information regarding neurological prognosis.		MRI of the cervical spine is recommended to exclude spinal cord or nerve root compression, to evaluate ligamentous integrity, or to provide information regarding neurological prognosis.
Pediatric injuries: treatment	None	Not addressed	Level III	Reduction with manipulation or halter traction is recommended for patients with acute AARF (< 4-wk duration) that does not reduce spontaneously. Reduction with halter or tong/halo traction is recommended for patients with chronic AARF (> 4-wk duration).
				Internal fixation and fusion are recommended in patients with recurrent and/or irreducible AARF.
				Operative therapy is recommended for cervical spine injuries that fail nonoperative management.
SCIWORA: diagnostic	Option	Plain spinal x-rays of the region of injury and CT scanning with attention to the suspected level of neurological injury to exclude occult fractures are recommended.	Level III	MRI of the region of suspected neurological injury is recommended in a patient with SCIWORA.
		MRI of the region of suspected neurological injury may provide useful diagnostic information		Radiographic screening of the entire spinal column is recommended.
		Plain x-rays of the entire spinal column may be considered.		Assessment of spinal stability in a SCIWORA patient is recommended using flexion/extension radiographs in the acute setting and at late follow-up, even in the presence of an MRI negative for extraneural injury.

TABLE. (Continued)

Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
SCIWORA: treatment	Option	External immobilization is recommended until spinal stability is confirmed by flexion/extension x-rays.	Level III	External immobilization of the spinal segment of injury is recommended for up to 12 wk.
		External immobilization of the spinal segment of injury for up to 12 wk may be considered.		Early discontinuation of external immobilization is recommended for patients who become asymptomatic and in whom spinal stability is confirmed with flexion and extension radiographs.
		Avoidance of "high-risk" activities for up to 6 mo after SCI without radiographic abnormality may be considered.		Avoidance of "high-risk" activities for up to 6 mo after SCIWORA is recommended.
SCIWORA: prognosis	Option	MRI of the region of neurological injury may provide useful prognostic information about neurological outcome after SCI without radiographic abnormality.	None	Not addressed (see diagnostic)
VAI: diagnostic	Option	Conventional angiography or magnetic resonance angiography is recommended for the diagnosis of VAI after nonpenetrating cervical trauma in patients who have complete cervical SCIs, fracture through the foramen transversarium, facet dislocation, and/or vertebral subluxation.	Level I	CT angiography is recommended as a screening tool in selected patients after blunt cervical trauma who meet the modified Denver Screening Criteria for suspected VAI.
			Level III	Conventional catheter angiography is recommended for the diagnosis of VAI in selected patients after blunt cervical trauma, particularly if concurrent endovascular therapy is a potential consideration, and can be undertaken in circumstances in which CT angiography is not available.
				MRI is recommended for the diagnosis of VAI after blunt cervical trauma in patients with a complete SCI or vertebral subluxation injuries.
VAI: treatment	Option	Anticoagulation with intravenous heparin is recommended for patients with VAI who have evidence of posterior circulation stroke.	Level III	It is recommended that the choice of therapy for patients with VAI, anticoagulation therapy vs antiplatelet therapy vs no treatment, be individualized on the basis of the patients' VAIs, their associated injuries, and their risk of bleeding.
		Either observation or treatment with anticoagulation in patients with VAIs and evidence of posterior circulation ischemia is recommended		The role of endovascular therapy in VAI has yet to be defined; therefore, no recommendation regarding its use in the treatment of VAI can be offered.
		Observation in patients with VAIs and no evidence of posterior circulation ischemia is recommended.		
Venous thromboembolism: prophylaxis	None	Not addressed	Level II	Early administration of venous thromboembolism prophylaxis (within 72 h) is recommended
	Option	Vena cava filters are recommended for patients who do not respond to anticoagulation or who are not candidates for anticoagulation therapy and/or mechanical devices.	Level III	Vena cava filters are not recommended as a routine prophylactic measure but are recommended for select patients who fail anticoagulation or who are not candidates for anticoagulation and/or mechanical devices.
Nutritional support	Option	Nutritional support of patients with SCIs is recommended. Energy expenditure is best determined by indirect calorimetry in these patients because equation estimates of energy expenditure and subsequent caloric need tend to be inaccurate.	Level II	Indirect calorimetry as the best means to determine the caloric needs of SCI patients is recommended.

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TABLE. (Continued)

Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
			Level III	Nutritional support of SCI patients is recommended as soon as feasible. It appears that early enteral nutrition (initiated within 72 h) is safe but has not been shown to affect neurological outcome, length of stay, or incidence of complications in patients with acute SCI.

[a]AARF, atlanto-axial rotatory fixation; AOD, atlanto-occipital dislocation; ASIA, American Spinal Injury Association; CSISS, Cervical Spine Injury Severity Score; CT, computed tomography; EMS, emergency medical services; MRI, magnetic resonance imaging; SCI, spinal cord injury; SLIC, SubaxiaL Injury Classification; SCIWORA, spinal cord injury without radiographic abnormalities; VAI, vertebral artery injury.

devices[31] aimed at neural regeneration of the spinal cord because of the absence of clinical evidence. It is our hope that such evidence will be forthcoming in time for the next SCI guidelines review.

SCOPE OF THE REVISED GUIDELINES

In this 2013 iteration of the cervical SCIs guidelines, the scope has been broadened, as have the recommendations. In 2002, the guidelines featured 76 recommendations in contrast to 112 recommendations in the present version. Among the new guidelines are 19 Level I recommendations supported by Class I medical evidence. These include assessment of functional outcomes (1); assessment of pain after SCI (1); radiographic assessment (1); pharmacology (2); diagnosis of atlanto-occipital dislocation (1); cervical subaxial injury classification schemes (2); pediatric spinal injuries (1); vertebral artery injuries (1); and venous thromboembolism (1). In addition, there are 11 Level II recommendations, based on Class II evidence, with the remaining 77 recommendations qualifying as Level III recommendations from a variety of Class III medical evidence. The Table highlights these differences between the 2 SCI guidelines processes (used with permission from the published guidelines).[32]

The most contentious of the present recommendations likely pertains to the use of methylprednisolone in acute SCI and therefore deserves special comment. Methylprednisolone has been used for decades as a standard of care to improve neurological and functional outcome in SCI; however, careful examination, particularly of randomized clinical trials expected to produce Class I data,[33-35] reveals many methodological flaws in study design and data analysis that refute the conclusions of the authors.[36-38] As these limitations have come to light, there has also been a change in the perception of frontline surgeons treating SCI with respect to the necessity of steroids at all.[39-43] In the case of the present guidelines, our author group downgraded them from Class I to Class III because the primary (a priori) outcome measures were all negative. Any positive results reported from either National Acute Spinal Cord Injury Study (NASCIS) II or NASCIS III came from post hoc analysis rather than being preplanned.

In a randomized clinical trial, comparison of data defined by protocol (ie, before data are accrued) is considered Class I evidence, including both primary and secondary outcomes. All other queries within the data set are Class III, whether they are published at the time of initial analysis or 10 years later. Class II is reserved for a priori comparisons within a prospective study in which the study population is nonrandomized but still comparative (eg, cohort studies, case-control studies, or before-and-after studies). This is fundamentally important and explains why retrospective mining of a prospective database still yields Class III evidence (unless in the format of a case-control study). Class of evidence pertains to how the research question was asked (study design). It does not pertain to how the data were accrued.

The underlying tenet is that retrospective examination of prospective data is still a "fishing expedition" or essentially a retrospective exercise unless clearly stated as part of the prospective research question(s). Outside of a priori analyses, any

number of post hoc comparisons can be made within a data set (retrospective or prospective) until an interesting result is found. In a perfect world, authors should report how many post hoc comparisons they make and apply a correction to their statistical testing (eg, Bonferroni) before reporting claims of positive results. However, in reality, we know that this rarely happens, including in the case of the NASCIS studies.

SUMMARY

The 2013 update on the "Guidelines for the Management of Acute Cervical Spine and Spinal Cord Injuries" is meant to help the practicing neurosurgeon in his or her efforts to provide up-to-date, evidence-based care to patients with acute SCIs. They are based on a formal critical evaluation of the evidence, with a well-developed relationship between the strength of the evidence and the level of recommendations. This time-consuming and extensive process produces the best estimate of scientific foundation for current SCI care.

For related video content, please access the Supplemental Digital Content: http://www.youtube.com/watch?v=KB1NBEDkw9c

Disclosures

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