www.surgicalneurologyint.com

ScientificScholar®
Knowledge is power
Publisher of Scientific Journals

Surgical Neurology International

Editor-in-Chief: Nancy E. Epstein, MD, Clinical Professor of Neurological Surgery, School of Medicine, State U. of NY at Stony Brook.

SNI: General Neurosurgery

Editor
Eric Nussbaum, MD
National Brain Aneurysm and Tumor Center, Twin Cities, MN, USA

SNI
Open Access

Review Article

A summary of common grading systems used in neurosurgical practice

Sarvesh Kutty

Department of Neurosurgery, Leeds General Infirmary, Leeds, United Kingdom.

E-mail: *Sarvesh Kutty - kuttysarvesh@gmail.com

***Corresponding author:**
Sarvesh Kutty,
Department of Neurosurgery,
Leeds General Infirmary, Leeds,
United Kingdom.

kuttysarvesh@gmail.com

Received : 13 August 2022
Accepted : 12 October 2022
Published : 28 October 2022

DOI
10.25259/SNI_731_2022

Quick Response Code:

ABSTRACT

Background: Grading and scoring systems are routinely used across various specialties in medicine and surgery. They help us assess the severity of disease and often guide management as well. In addition, grading systems allow us to prognosticate and gauge outcomes. Neurosurgeons also utilize an array of scores and grading systems. This article aims to collate some of the common grading systems used in neurosurgical practice to be utilized as an easy reference especially for junior doctors and other health-care providers working in this field.

Methods: An initial literature search was carried out to look at the grading systems in use. These were then distilled down to the ones that are frequently used in clinical neurosurgical practice based on my own experience as a doctor working in a tertiary neurosurgical unit. Neuro-oncology scoring systems were excluded from the study.

Results: Grading systems are grouped based on the area of neurosurgical practice they fall into such as cranial, vascular, spinal, and miscellaneous. A brief description of each grading system is provided and the conditions when they can be used in a tabular format. Discussion on the advantages and disadvantages of each grading system is not included in the study.

Conclusion: The list of grading systems in this article is not exhaustive. To the best of my knowledge, there seems to be no recent article, which summarizes them concisely. I hope that this summary will benefit the neurosurgical community and wider audience.

Keywords: Grading systems, Neurosurgery, Scores

INTRODUCTION

There are numerous grading systems used in neurosurgery. This article aims to give a brief summary of some of the commonly encountered grading systems in practice. For ease of use, tables are provided for each of them. Although there are various articles on the individual grading systems listed below, I believe that this concise tabular format will benefit clinicians working in neurosurgery. The grading systems have been classified into the subspecialty of neurosurgical practice they fall into. Neuro-oncology scoring systems were excluded from this study due to the complexity of the current guidelines.

CRANIAL NEUROSURGERY

Glasgow coma scale (GCS)

Professor Teasdale and Jennett first published the GCS in 1974 in the Lancet.[41] It is used worldwide not only in neurosurgery but also in many other fields of medicine to assess a patient's conscious level and coma. Moreover, it serves as a practical tool for doctors and nurses to document neurological status regularly. The GCS has three components to assess; eye opening – which can be graded from 1 point to 4 points, verbal response from 1 point to 5 points, and motor responsiveness from 1 point to 6 points. The sum of each component is used to calculate an overall score. A minimum score is 3 and a maximum score is 15 [Table 1]. In neurosurgical practice, the most important component is the motor score. When documenting GCS, it is helpful to document the individual breakdown for each component as well as the overall score, that is, E4, V5, M6, and GCS 15. If the patient is unable to verbalize, for example, due to endotracheal intubation or tracheostomy, then this should be specified when documenting the GCS. This is often abbreviated in the verbal score as V-T (for endotracheal tube or tracheostomy). Similarly, if the patient is dysphasic, then this is written as V-D.

Pediatric GCS

The pediatric GCS [Table 2] is slightly different to the adult version but assesses the same three components as above. This scale is used in children below the age of 2 years. Standard GCS scale can be used for those above the age of 2.[8,25]

Table 1: Glasgow Coma Scale.

Eye opening	Verbal response	Motor response
Spontaneously (4)	Oriented (5)	Obeys commands (6)
To voice (3)	Confused (4)	Localizes to pain (5)
To pain (2)	Inappropriate words (3)	Withdrawal from pain (4)
no eye opening (1)	Incomprehensible sounds (2)	Flexion to pain (decortication) (3)
	No verbal response (1)	Extension (decerebration) (2)
		No motor response (1)

The numbers in brackets correspond to the points assigned for each area of the scale.

Endoscopic third ventriculostomy (ETV) success score

An ETV is a procedure done mainly for obstructive hydrocephalus (noncommunicating). However, its use is not limited to this condition. The procedure involves making a hole in the floor of the third ventricle to allow cerebrospinal fluid to flow.[13] ETV success score was proposed by Kulkarni *et al.*[28] and was aimed to estimate the likelihood of ETV success at 6-month postoperatively. The score takes into account three components, namely, age of the patient; etiology; and history of a previous shunt and assigns percentage points based on this. The points are then added. A score >80% suggests a high likelihood of success, 50–70% suggests moderate likelihood of success, and <40% suggests a low likelihood of success[28] [Table 3].

House-Brackmann classification for facial nerve palsy

This is a scoring system proposed by Dr. House and Brackmann in 1985. The purpose of this is to assess the severity of facial nerve palsy.[23] It consists of six grades, as shown in Table 4. In neurosurgical procedures involving major vestibular schwannomas, avoidance of facial nerve injury is crucial. This grading system can be utilized to assess and track the patient's facial nerve recovery.[40]

Frisen scale for papilledema

The Frisen and modified Frisen scale describes the grade of optic disk swelling in conditions with raised intracranial pressure.[17] These include conditions such as hydrocephalus and idiopathic intracranial hypertension.[15] It is particularly useful in both acute and chronic settings and is one of the indicators of severity of the above named conditions. It is also helpful in monitoring disease progression and treatment outcome[12] [Table 5].

Grading for diffuse axonal injury (DAI)

Adams *et al.* described in 1989 a grading system for DAI based on histology of anatomic distribution of cerebral

Table 2: Pediatric Glasgow Coma Scale.

Eye opening	Verbal response	Motor response
Spontaneously (4)	Smiles, oriented to sounds, follows objects, and interacts (5)	Moves spontaneously and purposefully (6)
To verbal stimuli (3)	Cries, but consolable, inappropriate interactions (4)	Withdraws to touch (5)
To pain (2)	Inconsistently inconsolable and moaning (3)	Withdraws to pain (4)
No eye opening (1)	Inconsolable and agitated (2)	Abnormal flexion to pain (3)
	No verbal response (1)	Extension to pain (2)
		No motor response (1)

The numbers in brackets correspond to the points assigned for each area of the scale.

Table 3: Endoscopic third ventriculostomy success score.

Category	Score
Age	• <1 month=0 • 1–<6 months=10 • 6–<12 months=30 • 1–<10 years=40 • ≥10 years=50
Etiology	• Postinfectious=0 • Myelomeningocele, intraventricular hemorrhage, or nontectal brain tumor=20 • Aqueductal stenosis, tectal tumor, or other etiology=30 • Previous shunt=0 • No previous shunt=10

Table 4: House-Brackmann classification for facial nerve palsy.

Grade	Description
1. Normal	
2. Mild dysfunction	Slight weakness and normal symmetry at rest
3. Moderate dysfunction	(Obvious but not disfiguring weakness with synkinesis, normal symmetry at rest) complete eye closure with maximal effort, good forehead movement
4. Moderately severe dysfunction	(Obvious and disfiguring asymmetry, significant synkinesis) incomplete eye closure, moderate forehead movement
5. Severe dysfunction	Barely perceptible motion
6. Total paralysis	No motion

Table 5: Frisen scale for papilledema.

Grade	Description
0	Normal optic disk
1	Minimal papilledema – Subtle C shaped halo of disk edema with a normal temporal disk margin
2	Low degree papilledema – Circumferential halo of disk edema
3	Moderate papilledema – Obscuration of one or more segments of the major blood vessels leaving the disk
4	Marked papilledema – Partial obstruction of a segment of major blood vessel on the disk
5	Severe papilledema – Partial or total obstruction of all the blood vessels on the disk

hemorrhage.[2] There are three stages, 1–3, with worse outcome associated with higher grade. MRI classification proposed by Gentry[20] is shown in Table 6.

The Glasgow outcome scale (GOS)

The GOS aims to assess outcome after head injury.[26] It consists of five grades. This may assist in assessing the patient's requirements, such as rehabilitation needs post brain injury. An extended scale called the 'GOS extended' also exists. The GOS scale is shown in Table 7.

Table 6: MRI grading system for DAI.

Stage	Description
Stage 1	Lobar: diffuse axonal injury lesions confined to the lobar white matter, especially gray-white matter junction
Stage 2	Callosal: diffuse axonal injury lesions in the corpus callosum, almost invariably in addition to the lobar white matter
Stage 3	Brainstem: diffuse axonal injury lesions in the brainstem, almost invariably in addition to the lobar white matter and corpus callosum

Table 7: Glasgow outcome scale.

Grade	Description
1-Death	No recovery of consciousness – Death
2-Persistent vegetative state	Severe damage with prolonged state of unresponsiveness and a lack of higher mental functions
3-Severe disability	Severe injury with permanent need for help with activities of daily living
4-Moderate disability	Does not require assistance in everyday life, employment is possible but may require special equipment
5-Low disability	Light damage with minor neurological and psychological deficits

VASCULAR NEUROSURGERY

Grading systems for subarachnoid hemorrhage (SAH)

There are three main grading systems used for aneurysmal SAH. The Hunt and Hess classification quantifies the severity of SAH to predict mortality.[24] It is based solely on clinical examination findings. The second grading system is the World Federation of Neurological Surgeons system, which is based on GCS and the presence or absence of neurologic deficits and aims to predict outcome based on this.[14] The third system is the Fisher grade and modified Fisher grade, which looks at the distribution and volume of blood on CT brain scan images and aims to predict the occurrence of cerebral vasospasm.[16,18] The three grading systems are highlighted in Table 8.

Spetzler-Martin grade for arteriovenous malformation (AVM)

The Spetzler-Martin grading system [Table 9] aids in estimating the risk of surgical resection of cerebral AVMs.[38] This is based on three areas, eloquence of surrounding brain,

Table 8: Grading systems for aneurysmal SAH.

Grade	Hunt and Hess grade	World Federation of Neurological Surgeons grade	Modified Fisher grade
1	Mild headache, alert and oriented, and minimal (if any) neck stiffness	GCS 15, no motor deficit	Focal or diffuse thin SAH and no intraventricular hemorrhage
2	Full neck stiffness, moderate-severe headache, alert and oriented, and no neurodeficit (besides CN palsy)	GCS 13–14, no motor deficit	Focal or diffuse thin SAH and with intraventricular hemorrhage
3	Lethargy or confusion and mild focal neurological deficits	GCS 13–14, with motor deficit	Thick SAH and no intraventricular hemorrhage
4	Stupor, moderate-to-severe hemiparesis, possible early decerebrate rigidity, and vegetative disturbances	GCS 7–12, motor deficit present or absent	Thick SAH and with intraventricular hemorrhage
5	Deep coma, decerebrate rigidity, and moribund	GCS 3–6, motor deficit present or absent	

GCS: Glasgow Coma Scale

Table 9: Spetzler-Martin grade for arteriovenous malformation.

Eloquence of surrounding brain	Presence of deep draining veins	Size of the nidus
Eloquent site – 1 point	Present 1 point	<3 cm – 1 point
Non eloquent site – 0 point	Absent 0 point	3–6 cm – 2 points
		>6 cm – 3 points

presence of deep venous drainage, and the size of the nidus. Each area is given a score. The sum of the allocated points forms the grade. Higher grades (Grades 4 and 5) are generally unsuitable for surgical management.

Alberta stroke program early CT score (ASPECTS)

The ASPECTS is a scoring system based on 10 points and is used to predict outcome of middle cerebral artery stroke.[6] A baseline score of 10 is assigned and points are deducted by 1 point for each of the following areas affected: caudate, putamen, internal capsule, and insular cortex, M1-M6 territories (1 point assigned to each of the M1-M6 territories). Lower scores are associated with worse outcome.

The intracerebral hemorrhage score (ICH)

The ICH score is used to help grade patients with ICH.[21] The scale takes into account the patients' GCS, ICH volume, and intraventricular hemorrhage (IVH), whether or not the origin of the ICH is infratentorial and the age of the patient. Higher scores are associated with an increase in 30-day mortality. The score is graded 0–6 points. This is shown in Table 10.

Papile-Burstein classification for IVH

Another useful and commonly used grading system in neurosurgical patients is a grading system used for IVH proposed by Papile *et al.*[33] This is known as the Papile-Burstein classification for IVH. It consists of four grades, with higher grades associated with a worse prognosis. It is based on CT scan findings. Table 11 shows this.

Table 10: The ICH score.

Category	Points score
GCS	3–4 – 2 points 5–12 – 1 point 13–15 – 0 points
ICH volume	>/=30 cm^3 – 1 point <30 cm^3 – 0 points
IVH	Yes – 1 point no – 0 points
Infratentorial origin of ICH	Yes – 1 point no – 0 points
Age	More than or equal to 80 years – 1 point <80 years – 0 point

ICH: Intracerebral hemorrhage score, GCS: Glasgow Coma Scale

Table 11: Papile-Burstein classification for IVH.

Grade	Description
1	Subependymal germinal matrix hemorrhage
2	Hemorrhage extension into the ventricles – < 50% of the ventricle filled
3	Hemorrhage extension into the ventricles – more than 50% of the ventricle filled
4	IVH with parenchymal extension – associated with periventricular venous infarction

IVH: Intraventricular hemorrhage

Classification systems for dural arteriovenous fistula (DAVF)

Borden *et al*. classification for DAVF was proposed in 1995.[7] It describes different types of DAVF which are grouped into three types. They are grouped based on their cortical venous drainage and their location. Types 2 and 3 tend to have a high risk of bleeding and causing problems such as neurologic deficit,[44] whereas Type 1 DAVF generally behave less aggressively.[39] The Cognard classification system was proposed in 2016 and has five grades and importantly takes into account the presence of venous ectasia and the direction of blood flow.[10] Both grading systems are depicted in Table 12.

NIH stroke scale/score (NIHSS)

The NIHSS aims to describe the severity of ischemic stroke, with a score of 0–42 being assigned to patients. Higher scores are associated with greater stroke severity.[29] It is also useful for predicting outcome after ischemic stroke. For every increase in 1 point, the likelihood of excellent outcome was decreased at 7 days by 24% and by 17% at 3 months.[1] A score of 1–4 is classified as a minor stroke and 5–15 is a moderate stroke. Scores above 21 are classified as a severe stroke. The scoring system is highlighted in Table 13.

SPINAL NEUROSURGERY AND MISCELLANEOUS

American spinal injury association (ASIA) impairment scale and grade in spinal cord injury

This is a grading system consisting of five grades, allowing clinicians to assess the severity of spinal cord injury.[5] It also aids in determining rehabilitation requirements and potential for recovery/prognosis. It involves conducting a series of sensory and motor function tests based on a chart proposed by the ASIA.[4] After completing the chart, points are totaled. A maximum of 112 points can be given. The grading system is shown in Table 14.[5] Complete ASIA spinal cord injury chart is not included in this article.

Table 12: Classification systems for dural arteriovenous fistula.

Cognard classification	Borden classification
Type I – drainage into dural venous sinus only, with normal antegrade flow Type II A – drainage into dural venous sinus only, with retrograde flow	Type 1 – Drainage into meningeal veins, spinal epidural veins, or into a dural venous sinus only
Type II B – Drainage into dural venous sinus, with antegrade flow and cortical venous drainage Type II a+b – Drainage into dural venous sinus with retrograde flow and cortical venous drainage	Type 2 – Drainage into meningeal veins, spinal epidural veins, or into a dural venous sinus and cortical venous drainage
Type III – Venous drainage into subarachnoid veins – cortical venous drainage only Type IV – Type III with venous ectasia of the draining subarachnoid veins	Type 3 – Direct drainage into subarachnoid veins (cortical venous drainage only)
Type V – drainage into spinal perimedullary veins	

Medical research council grading system for muscle strength

This is a commonly used grading system in neurosurgical practice to assess patient's muscle strength. Much like the GCS, it serves as a reliable tool for nurses and doctors to utilize and regularly document the clinical status of the patient. In addition, it can guide treatment, assess response to

Table 13: NIH stroke scale/score.

Area assessed	Scale
Level of consciousness	0. Alert 1. Drowsy 2. Obtunded 3. Coma/unresponsive
Orientation questions	0. answers both questions correctly 1. Answers one correctly 2. Answers neither correctly
Response to commands	0. Performs both tasks correctly 1. Performs one task correctly 2. Answers neither
Gaze	0. Normal horizontal movements 1. Partial gaze palsy 2. Complete gaze palsy
Visual field	0. No visual field defect 1. Partial hemianopia 2. Complete hemianopia 3. Bilateral hemianopia
Facial movement	0. Normal 1. Minor facial weakness 2. Partial facial weakness 3. Complete unilateral palsy
Motor function arm (left and right)	0. No drift 1. Drift before 10 s 2. Falls before 10 s 3. No effort against gravity 4. No movement
Motor function leg (left and right)	0. No drift 1. Drift before 5 s 2. Falls before 5 s 3. No effort against gravity 4. No movement
Limb ataxia	0. No ataxia 1. Ataxia in one limb 2. Ataxia in two limbs
Sensory	0. No sensory loss 1. Mild sensory loss 2. Severe sensory loss
Language	0. Normal 1. Mild aphasia 2. Severe aphasia 3. Mute or global aphasia
Articulation	0. Normal 1. Mild dysarthria 2. Severe dysarthria
Extinction or inattention	0.Absent 1. Mild loss (one sensory modality lost)] 2. Severe loss (two modalities lost)

Table 14: ASIA impairment scale for spinal cord injury.

Grade	Impairment
A Complete	No motor or sensory function preserved in the sacral segments S4-S5
B Incomplete	Sensory, but not motor function is preserved below the neurologic level and includes the sacral segments S4-S5
C Incomplete	Motor function preserved below the neurologic level, and more than half of key muscles below the neurologic level have a muscle grade <3
D Incomplete	Motor function preserved below the neurologic level, and at least half of the key muscles below the neurologic level have a muscle grade of 3 or more
E Normal	Motor and sensory function are normal.

ASIA: American Spinal Injury Association

Table 15: Medical Research Council grading for muscle strength.

Grade	Description
0	No visible muscle contraction
1	Flicker of contraction in the muscle
2	Movement with gravity eliminated
3	Movement against gravity
4	Movement against gravity and resistance
5	Normal power

treatment, and aid in prognostication. It consists of six grades (0–5), as depicted in Table 15.[11]

Karnofsky clinical performance status

The Karnofsky clinical performance status is useful in assessing patient's functional status and suitability for treatment such as chemotherapy.[27] It also aids in determining prognosis and response to treatment, especially in chronic disease.[27,31] Patients are given a score between 0 and 100, 100 being the best possible score and 0 being the worst [Table 16].

Modified Rankin scale

The modified Rankin scale is used to assess outcome after stroke. It is also useful to assess rehabilitation requirements[34,42] [Table 17]. Over the years, the mRS has evolved as the primary outcome measure for nearly all acute stroke trials, even though it is considered as a single-item handicap scale. Neurosurgical diagnoses are complex and single-item scales might not be able to capture the depth of the clinical problem. Likewise, such scales are notorious for multiple and variable interpretations based on the person attempting the scoring in diverse settings. Appropriate statistical tests to analyze the scale results are important if study results using this scale are to be implemented in practice guidelines.[35]

Table 16: Karnofsky clinical performance status.

Score	Health status
100	Normal; no complaints; no evidence of disease
90	Able to carry on normal activity; minor signs or symptoms of disease
80	Normal activity with effort; some signs or symptoms of disease
70	Cares for self; unable to carry on normal activity or to do active work
60	Requires occasional assistance, but is able to care for most of their personal needs
50	Requires considerable assistance and frequent medical care.
40	Disabled; requires special care and assistance
30	Severely disabled; hospital admission is indicated although death not imminent
20	Very sick; hospital admission necessary; active supportive treatment necessary
10	Moribund, fatal processes progressing rapidly
0	Dead

Table 17: Modified Rankin score.

Grade	Description
0	No symptoms
1	No significant disability: has symptoms, but able to carry out all usual duties and activities
2	Slight disability: unable to carry out all previous activities, but able to look after own affairs without assistance
3	Moderate disability: requiring some help, but able to walk without assistance
4	Moderately severe disability: unable to walk without assistance, and unable to attend own bodily needs without assistance.
5	Severe disability: bedridden, incontinent, and requiring constant nursing care and attention
6	Dead

Table 18: Simpson grade of meningioma resection.

Grade	Description
1	Macroscopically complete removal of tumor, with excision of its dural attachment, and of any abnormal bone. Includes resection of venous sinus if involved.
2	Macroscopically complete removal of tumor and its visible extensions with coagulation of its dural attachment
3	Macroscopically complete removal of the intradural tumor, without resection or coagulation of its dural attachment or its extradural extensions
4	Partial removal, leaving intradural tumor *in situ*.
5	Simple decompression, with or without biopsy

Simpson grade of meningioma resection

The Simpson grade for meningioma resection aims to correlate the degree of surgical resection with the likelihood of meningioma recurrence.[32,37] There are also other factors, which play a role in determining risk of recurrence. Table 18 gives the grades of resection. The Simpson grade for meningioma was previously considered as the gold standard for defining the surgical extent of resection for the WHO Grade 1 meningioma.[9] The grade is based on intraoperative "eyeballing" of resection, which cannot be considered accurate. This has unearthed many controversies including rendering many previous outcome studies based on this grading system redundant. The technological advancements in the field of neurosurgery have diminished the value of this scale for prognostication of recurrence after meningioma resection. Many recent articles have urged to abandon this system in clinical practice but preserve its original message.[9]

Anderson and D'Alonzo classification of odontoid process fracture

Anderson and D'Alonzo described an important and commonly used classification system for odontoid process fractures.[3] This classification is shown in Table 19. There are three types of fractures, and this helps guide management of these fractures. Type 2 fractures have a higher rate of nonunion and are usually unstable.[3]

Galassi classification of arachnoid cyst

Galassi *et al*. described a classification system for middle cranial fossa arachnoid cysts in 1982.[19] It consists of three types of cysts based on radiological criteria. The classification is utilized to guide surgical management of these cysts. They are highlighted in Table 20.

Table 19: Anderson and D'Alonzo classification of odontoid process fracture.

Classification	Description
Type 1	Fracture through the tip of the odontoid process, associated with apical ligament avulsion – Usually stable
Type 2	Fracture through the body or base of the peg – Usually unstable
Type 3	Body of C2 involved with comminuted fragments – Unstable fracture

Table 20: Galassi classification of arachnoid cyst.

Type	Description
1	Small and limited to anterior part of the middle cranial fossa – communicates freely with the subarachnoid space
2	Extend along the Sylvian fissure and can displace the temporal lobe – slow communication with the subarachnoid space
3	Large cyst, occupies whole of middle cranial fossa, displaces multiple lobes, and presence of midline shift. Little communication with the subarachnoid space.

DISCUSSION

There are a vast number of common and obscure grading systems in clinical and research practice. Sifting out the most relevant one for the clinical scenario is not an easy task for clinicians. Only by incorporating them into routine practice that one realizes that there is no single "gold standard" scale, rather many scales albeit with different properties. Based on your clinical requirement, one should choose the most appropriate grading system. The grading system should have the ability to be incorporated seamlessly into routine clinical use. Moreover, it should be reliable, repeatable, and provide a valid measurement for the specific outcome.

Over the past two decades, there has been an explosion of psychometric methods using statistical techniques in an attempt to provide strength to the measurements obtained from grading systems.[36] Measurements or scores obtained from scales are dependent on the scale itself as well as the subjects. These nonlinear variables can be transformed into interval measures, which give a more objective result, negating many problems such as underestimation.

Tremendous amount of work and expertise have gone into the creation of grading systems over the years and this article is an attempt to acknowledge these contributions to health measurements. In the process, I would like to draw the attention of clinicians to the nuances, limitations, and benefits of such systems, as pointed out by Massof[30] about two decades ago. The cardinal point to remember when we use these systems is to understand that "observations are always ordinal: measurements, however, must be interval" as aptly titled in their article by Wright and Linacre.[43]

CONCLUSION

Conclusions drawn from the various measurements used in grading systems dictate patient care. Some of them such as GCS scoring have immediate outcomes, whereas many disability ratings have significant long-term impact including health-care expenditure, clinical guidelines, and even policy-making. Therefore, it is crucial that those of us using them are aware of the validity and quality of the rating scales used in clinical settings. Many variables such as patient perspectives and quality of life indices studies do need stringent measurement criteria as they can change some clinical practices. These facts have been pointed out by studies of rating scales in the field of neurology, where the choice of rating scales had affected the clinical course of diseases such as multiple sclerosis.[22] Rigorous statistical analyses of the outcomes from grading systems are not a solution for the inherent issues with the scale itself. The above listed grading systems are some of the most commonly used in neurosurgical practice. As mentioned before, there are many other useful grading systems used in various areas of neurosurgery not included in this article. I hope that this summary will benefit the neurosurgical community and wider audience and serve as a handy reference tool.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Adams HP Jr., Davis PH, Leira EC, Chang KC, Bendixen BH, Clarke WR, *et al*. Baseline NIH stroke scale score strongly predicts outcome after stroke: A report of the trial of org 10172 in acute stroke treatment (TOAST). Neurology 1999;53:126-31.
2. Adams JH, Doyle D, Ford I, Gennarelli TA, Graham DI, McLellan DR, *et al*. Diffuse axonal injury in head injury: Definition, diagnosis and grading. Histopathology 1989;15:49-59.
3. Anderson LD, D'Alonzo RT. Fractures of the odontoid process of the axis. J Bone Joint Surg Am 1974;56:1663-74.
4. ASIA and ISCoS International Standards Committee. The 2019 revision of the international standards for neurological classification of spinal cord injury (ISNCSCI)-what's new? Spinal Cord 2019;57:815-7.
5. Association American Spinal Injury. Standards for Neurological Classification of Spinal Injury Patients. Chicago, IL: American Spinal Injury Association; 1982.
6. Barber PA, Demchuk AM, Zhang J, Buchan AM. Validity and reliability of a quantitative computed tomography score in predicting outcome of hyperacute stroke before thrombolytic therapy. ASPECTS study group. Alberta stroke programme early CT score. Lancet 2000;355:1670-4.
7. Borden JA, Wu JK, Shucart WA. A proposed classification for spinal and cranial dural arteriovenous fistulous malformations and implications for treatment. J Neurosurg 1995;82:166-79.
8. Borgialli DA, Mahajan P, Hoyle JD Jr., Powell EC, Nadel FM, Tunik MG, *et al*. Performance of the pediatric glasgow coma scale score in the evaluation of children with blunt head trauma. Acad Emerg Med 2016;23:878-84.
9. Chotai S, Schwartz TH. The simpson grading: Is it still valid? Cancers (Basel) 2022;14:2007.
10. Cognard C, Gobin YP, Pierot L, Bailly AL, Houdart E, Casasco A, *et al*. Cerebral dural arteriovenous fistulas: Clinical and angiographic correlation with a revised classification of venous drainage. Radiology 1995;194:671-80.
11. Compston A. Aids to the investigation of peripheral nerve injuries. Medical research council: Nerve injuries research committee. His majesty's stationery office: 1942; pp. 48 (iii) and 74 figures and 7 diagrams; with aids to the examination of the peripheral nervous system. By michael O'brien for the guarantors of brain. Saunders Elsevier: 2010; pp. [8] 64 and 94 figures. Brain 2010;133:2838-44.
12. Das S, Montemurro N, Ashfaq M, Ghosh D, Sarker AC, Khan AH, *et al*. Resolution of papilledema following ventriculoperitoneal shunt or endoscopic third ventriculostomy for obstructive hydrocephalus: A pilot study. Medicina (Kaunas) 2022;58:281.
13. Demerdash A, Rocque BG, Johnston J, Rozzelle CJ, Yalcin B, Oskouian R, *et al*. Endoscopic third ventriculostomy: A historical review. Br J Neurosurg 2017;31:28-32.
14. Drake CG, Hunt WE, Sano K, Kassell N, Teasdale G, Pertuiset B, *et al*. Report of world federation of neurological surgeons committee on a universal subarachnoid haemorrhage grading scale. J Neurosurg 1988;68:985-6.
15. Dunn LT. Raised intracranial pressure. J Neurol Neurosurg Psychiatry 2002;73:i23-7.
16. Fisher CM, Kistler JP, Davis JM. Relation of cerebral vasospasm to subarachnoid haemorrhage visualized by computerized tomographic scanning. Neurosurgery 1980;6:1-9.
17. Frisén L. Swelling of the optic nerve head: A staging scheme. J Neurol Neurosurg Psychiatry 1982;45:13-8.
18. Frontera JA, Claassen J, Schmidt JM, Wartenberg KE, Temes R, Connolly ES Jr., *et al*. Prediction of symptomatic vasospasm after subarachnoid haemorrhage: The modified fisher scale. Neurosurgery 2006;59:21-7.
19. Galassi E, Tognetti F, Gaist G, Fagioli L, Frank F, Frank G. CT scan and metrizamide CT cisternography in arachnoid cysts of the middle cranial fossa: Classification and pathophysiological aspects. Surg Neurol 1982;17:363-9.
20. Gentry LR. Imaging of closed head injury. Radiology 1994;191:1-17.
21. Hemphill JC 3rd., Bonovich DC, Besmertis L, Manley GT, Johnston SC. The ICH score: A simple, reliable grading scale for intracerebral hemorrhage. Stroke 2001;32:891-7.
22. Hobart J. Rating scales for neurologists. J Neurol Neurosurg Psychiatry 2003;74:iv22-6.
23. House JW, Brackmann DE. Facial nerve grading system. Otolaryngol Head Neck Surg 1985;93:146-7.
24. Hunt WE, Hess RM. Surgical risk as related to time of intervention in the repair of intracranial aneurysms. J Neurosurg 1968;28:14-20.
25. James HE. Neurologic evaluation and support in the child with an acute brain insult. Pediatr Ann 1986;15:16-22.
26. Jennett B, Bond M. Assessment of outcome after severe brain damage. Lancet 1975;1:480-4.
27. Karnofsky DA, Burchenal JH. The clinical evaluation of chemotherapeutic agents in cancer. In: MacLeod CM, editor. Evaluation of Chemotherapeutic Agents. New York: Columbia University Press; 1949. p. 196-196.
28. Kulkarni AV, Drake JM, Mallucci CL, Sgouros S, Roth J, Constantini S, *et al*. Endoscopic third ventriculostomy in the treatment of childhood hydrocephalus. J Paediatr 2009;155:254-9.e1.
29. Lyden P, Brott T, Tilley B, Welch KM, Mascha EJ, Levine S,

et al. Improved reliability of the NIH stroke scale using video training. NINDS TPA stroke study group. Stroke 1994;25:2220-6.
30. Massof RW. The measurement of vision disability. Optom Vis Sci 2002;79:516-52.
31. O'Toole DM, Golden AM. Evaluating cancer patients for rehabilitation potential. West J Med 1991;155:384-7.
32. Oya S, Kawai K, Nakatomi H, Saito N. Significance of Simpson grading system in modern meningioma surgery: Integration of the grade with MIB-1 labeling index as a key to predict the recurrence of WHO Grade I meningiomas. J Neurosurg 2012;117:121-8.
33. Papile LA, Burstein J, Burstein R, Koffler H. Incidence and evolution of subependymal and intraventricular hemorrhage: A study of infants with birth weights less than 1,500 gm. J Pediatr 1978;92:529-34.
34. Quinn TJ, Dawson J, Walters M. Dr John Rankin; His life, legacy and the 50th anniversary of the Rankin stroke scale. Scott Med J 2008;53:44-7.
35. Quinn TJ, Dawson J, Walters MR, Lees KR. Reliability of the modified Rankin scale: A systematic review. Stroke 2009;40:3393-5.
36. Rasch G. Probabilistic Models for Some Intelligence and Attainment Tests. Chicago: University of Chicago Press; 1960.
37. Simpson D. The recurrence of intracranial meningiomas after surgical treatment. J Neurol Neurosurg Psychiatr 1957;20:22-39.
38. Spetzler RF, Martin NA. A proposed grading system for arteriovenous malformations. J Neurosurg 1986;65:476-83.
39. Strom RG, Botros JA, Refai D, Moran CJ, Cross DT 3rd., Chicoine MR, *et al*. Cranial dural arteriovenous fistulae: Asymptomatic cortical venous drainage portends less aggressive clinical course. Neurosurgery 2009;64:241-7.
40. Sun MZ, Oh MC, Safaee M, Kaur G, Parsa AT. Neuroanatomical correlation of the House-Brackmann grading system in the microsurgical treatment of vestibular schwannoma. Neurosurg Focus 2012;33:E7.
41. Teasdale G, Jennett B. Assessment of coma and impaired consciousness. A practical scale. Lancet 1974;2:81-4.
42. Van Swieten JC, Koudstaal PJ, Visser MC, Schouten HJ, van Gijn J. Interobserver agreement for the assessment of handicap in stroke patients. Stroke 1988;19:604-7.
43. Wright BD, Linacre JM. Observations are always ordinal: Measurements, however, must be interval. Arch Phys Med Rehabil 1989;70:857-60.
44. Zipfel GJ, Shah MN, Refai D, Dacey RG Jr., Derdeyn CP. Cranial dural arteriovenous fistulas: Modification of angiographic classification scales based on new natural history data. Neurosurg Focus 2009;26:E14.

How to cite this article: Kutty S. A summary of common grading systems used in neurosurgical practice. Surg Neurol Int 2022;13:497.