Traumatic Brain contusions

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Acknowledgement:

We acknowledge Osama Ramadan for his collaboration with the committee during writing this chapter.

Abbreviations

CT: computed tomography

CSF: cerebrospinal fluid

GOS: Glasgow outcome score

GRADE: Grading of Recommendations, Assessment, Development and Evaluation

MRV: magnetic resonance venography

TICH: traumatic intracerebral hemorrhage

WHO: world health organization

Glossary:

Brain contusion refers to a focal region of necrosis and hemorrhage, usually involving the cerebral cortex and subcortical white matter.[1]

Executive Summary:

This topic is concerned with management guidelines of traumatic cerebral contusions

Recommendations:

Initial Management*:*

- Avoid hypoxia.
    - Strong recommendation.
- Avoid hypotension.
    - Strong recommendation
- Secure the airway (endotracheal intubation) in patients with GCS ≤8 who are unable to maintain their airway or who remain hypoxic despite supplemental O2. (if not available refer to a tertiary center)
    - Strong recommendation.
- Brain imaging (CT) must be available and repeated as much as needed. (if not available refer to a tertiary center)
    - Strong recommendation.
- We recommend ICU admission and close neurological observation with CT monitoring for the development and progression of brain stem compression. (if not available refer to a tertiary center)
    - Strong recommendation.
- Follow-up head CT scan within 6 to 8 hours following brain injury must be obtained. (if not available refer to a tertiary center)
    - Strong recommendation.
- The availability of equipped neurosurgery operating room is essential for management. (if not available refer to a tertiary center)
    - Strong recommendation.

Conservative management:

- We recommend seizures prophylaxis in patients with frontal and temporal lobe cerebral contusions
    - Strong recommendation

Mechanisms to reduce ICP is divided into 3 tiers:

If elevation of ICP is confirmed clinically and/or radiologically or ICP monitoring (if available) the priority is control of ICP:

Tier 0

Head elevation and the same measures in the initial management

- Strong recommendation

Tier 1

- We recommend mannitol for control of IC-HTN (within hospitals).
  - Intermittent boluses may be more effective than continuous infusion
  - Effective doses range from 0.25–1 gm/kg body weight
  - Avoid hypotension (SBP < 90mm Hg) which may result from the diuretic effect of mannitol, which can lead to decrease circulating fluid volume
    - Strong recommendation.
- Try to adjust partial pressure of carbon dioxide (PaCO2) at lower ranges of normal values (i.e. 35-38 mmHg).
  - Conditional recommendation.

Tier 2

- Consider the use of neuromuscular blocking agents (NMBAs).
  - Conditional recommendation
- We recommend targeting a cerebral perfusion pressure (CPP) of 60-70mm Hg
  - Strong recommendation.
- Try to adjust the partial pressure of CO2 at 32-35 mmHg (mild hypocapnia)
  - Conditional recommendation

Tier 3

- High-dose barbiturate therapy may be used for IC-HTN refractory to maximal medical and surgical ICP-lowering therapy. Patients should be hemodynamically stable before and during treatment.
  - Conditional recommendation

Surgical intervention: surgery may be indicated in the following indications:

- Progressive neurological deterioration referable to the TICH, medically refractory IC-HTN
- Signs of mass effect on CT
- TICH volume > 50cm3 cc or ml
- GCS = 6–8 with frontal or temporal TICH volume > 20 cm3 with midline shift ≥ 5mm and/or compressed basal cisterns on CT
  - Conditional recommendation

Types of surgery:

- If the contusion with the surrounding edema cause mass effect according to the site you may do frontopolar lobectomy or tempropolar lobectomy
    - Conditional recommendation
- If the hemorrhagic contusion coalesced to form intracerebral hematoma you may do evacuation
    - Conditional recommendation
- Decompressive craniotomy with duroplasty may be indicated in cases in which the usual mechanisms to reduce the ICP are uneffective.
    - Conditional recommendation

Introduction

Cerebral contusion is the classic example of focal traumatic brain injury (TBI). Before evolution of the CT, cerebral contusion could be diagnosed only in the operating room or during autopsy. Thus, contusion was considered only in cases of severe TBI and was therefore thought to be associated with severe injury.[2] Since the advent of CT, contusions have commonly been observed in patients with mild and moderate TBI. It is now recognized that there is a wide range of severity associated with cerebral contusion.[3]

Tiny punctate contusions in patients with mild TBI have little or no clinical significance . At the other end of the spectrum, large contusions with significant mass effect in patients with severe TBI can be life-threatening and need emergent intervention.[4]

Contusions can be classified as coup or contrecoup injuries. Coup contusions occur at the location of impact, whereas contrecoup contusions occur on the opposite side or at a point distant from the impact.[5]

Frontal and temporal lobes are the most common sites for brain contusion. However, brain contusion can be present in any site in the brain.[6]

Contusions often enlarge during the first week after injury. Repeated CT should be considered if the patient shows clinical deterioration. [7]

Surgery may be necessary to resect areas of contused brain if there is significant mass effect with raised ICP. Temporal lobe contusions are particularly ominous because of their proximity to the brainstem and risk of herniation.[8]

Purpose

The purpose of this multidisciplinary guideline is to identify improvement in the diagnostic tools and treatment strategies in managing patients with cerebral contusion and to create actionable recommendations to implement these strategies in clinical practice.

Scope

The guidelines is concerned with recommendation for traumatic brain contusion . selection of management approach (conservative - surgical) is defined. The aim is to achieve clear decision regarding each management line.

The target audience

The guideline is intended for all neurosurgeons who are likely to diagnose and manage patients with post traumatic brain contusions, and it applies to any setting in which patients with post traumatic brain contusions would be identified, monitored, or managed.

Methods

A comprehensive online search for guidelines and articles was undertaken to identify the most relevant articles to be reviewed and guidelines to consider for adaptation.

Inclusion/exclusion criteria followed in the search were:

- Selecting only national and/or international guidelines.
- Specific range of dates for publication (using Guidelines published or updated 2005 and later)
- A large series none controlled, prospective clinical trials of treatment using surgical versus nonsurgical management have been reviewed.
- Selecting peer reviewed publications only.
- Selecting guidelines written in English language.
- Papers with the following characteristics were also excluded: case series with less than 10 patients evaluated by CT scan and with incomplete outcome data (mortality or GOS

(Glasgow outcome score)), case reports, operative series with operations occurring longer than 14 days from injury.

- Excluding guidelines written by a single author, not on behalf of an organization to be valid and comprehensive, a guideline ideally requires multidisciplinary input
- Excluding guidelines published without references
- Selected articles were evaluated for design, prognostic significance, therapeutic efficacy, and overall outcome.
- All retrieved Guidelines were screened and appraised using the AGREE II instrument (www.agreetrust.org) by at least two members. The panel decided on a cut-off point or ranked the guidelines (any guideline scoring above 50% on the rigour dimension was retained). Subsequently. We selected:

  Konar SK, Shukla D, Agrawal A. Posttraumatic brain edema: Pathophysiology, management, and current concept. Apollo Medicine. 2019 Jan 1;16(1):2-7.[8]

  Hawryluk GW, Rubiano AM, Totten AM, O'Reilly C, Ullman JS, Bratton SL, Chesnut R, Harris OA, Kissoon N, Shutter L, Tasker RC. Guidelines for the management of severe traumatic brain injury: 2020 update of the decompressive craniectomy recommendations. Neurosurgery. 2020 Sep;87(3): 427. [9]

- **Evidence assessment**:
- According to the WHO Handbook for Guidelines, we used the GRADE (Grading of Recommendations, Assessment, Development and Evaluation) approach to assess the quality of a body of evidence, develop and report recommendations. GRADE methods represent internationally agreed standards for making transparent recommendations. Detailed GRADE information is available on the following sites:
  - ■ GRADE working group: http://www.gradeworkingroup.org
  - ■ GRADE online training modules: http://cebgrade.mcmaster.ca/
  - ■ GRADE profile software: http://ims.cochrane.org/revman/gradepro

- **Table 1: Quality of evidence in GRADE**

Quality level	Definition
High	We are very confident that the true effect lies close to that of the estimate of the effect.
Moderate	We are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low	Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low	We have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

GRADE: Grading of Recommendations Assessment, Development and Evaluation.

- **Table 2: Significance of the four levels of evidence**

Quality	Definition	Implications
High	The guideline development group is very confident that the true effect lies close to that of the estimate of the effect	Further research is very unlikely to change confidence in the estimate of effect
Moderate	The guideline development group is moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different	Further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate
Low	Confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the true effect	Further research is very likely to have an important impact on confidence in the estimate of effect and is unlikely to change the estimate
Very low	The group has very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of the effect	Any estimate of effect is very uncertain

- **Table 3: Factors that determine How to upgrade or downgrade the quality of Evidence**

Downgrade in presence of	Upgrade in presence of
Study limitations -1 Serious limitations -2 Very serious limitations	Dose-response gradient +1 Evidence of a dose-response gradient
Consistency -1 Important inconsistency	Direction of plausible bias +1 All plausible confounders would have reduced the effect
Directness -1 Some uncertainty -2 Major uncertainty	Magnitude of the effect +1 Strong, no plausible confounders, consistent and direct evidence
Precision -1 Imprecise data	+2 Very strong, no major threats to validity and direct evidence
Reporting bias -1 High probability of reporting bias	

- The strength of the recommendation
- The strength of a recommendation communicates the importance of adherence to the recommendation.
- Strong recommendations
- With strong recommendations, the guideline communicates the message that the desirable effects of adherence to the recommendation outweigh the undesirable effects. This means that in most situations the recommendation can be adopted as policy.
- Conditional recommendations
- These are made when there is greater uncertainty about the four factors above or if local adaptation has to account for a greater variety in values and preferences, or when resource use makes the intervention suitable for some, but not for other locations. This means that there is a need for substantial debate and involvement of stakeholders before this recommendation can be adopted as policy.
- When not to make recommendations
- When there is lack of evidence on the effectiveness of an intervention, it may be appropriate not to make a recommendation.

Recommendations:

Table 4: Conservative Management

Items:	Strength of Recommendations:	Level of evidence
• Avoid hypoxia	Strong	Moderate quality evidance[9]
• Avoid hypotension	Strong	Moderate quality evidance[9]
• Secure the airway (endotracheal intubation) in patients with GCS ≤8 who are unable to maintain their airway or who remain hypoxic despite supplemental O2. (if not available refer to a tertiary center)	Strong	Moderate quality evidance[9]

• Brain imaging (CT) must be available and repeated as much as needed. (if not available refer to a tertiary center)	Strong	Moderate quality evidance[9]
• We recommend ICU admission and close neurological observation with CT monitoring for the development and progression of brain stem compression. (if not available refer to a tertiary center)	Strong	Moderate quality evidance[9]
• Follow-up head CT scan within 6 to 8 hours following brain injury must be obtained. (if not available refer to a tertiary center	Strong	Moderate quality evidance[9]
• The availability of equipped neurosurgery operating room is essential for management. (if not available refer to a tertiary center)	Strong	Moderate quality evidance[9]
• We recommend seizures prophylaxis in patients with frontal and temporal lobe cerebral contusions	Strong	Moderate quality evidance[9]
• Head elevation and the same measures in the initial management	Strong	Moderate quality evidance[9]
• We recommend mannitol for control of IC-HTN (within hospitals). ▪ Intermittent boluses may be more effective than continuous infusion ▪ Effective doses range from 0.25–1 gm/kg body weight ▪ Avoid hypotension (SBP < 90mm Hg) which may result from the diuretic effect of mannitol, which can lead to decrease circulating fluid volume	Strong	Moderate quality evidance[9]
• Try to adjust partial pressure of carbon dioxide (PaCO2) at lower ranges of normal values (i.e. 35-38 mmHg).	Conditional	Low quality evidance[9]
• Consider the use of neuromuscular blocking agents (NMBAs).	Conditional	Moderate quality evidance[9]
• We recommend targeting a cerebral perfusion pressure (CPP) of 60-70mm Hg	Strong	High-Quality Evidence [10]

• Try to adjust the partial pressure of CO2 at 32-35 mmHg (mild hypocapnia)	Conditional	High-Quality Evidence [10]
• High-dose barbiturate therapy may be used for IC-HTN refractory to maximal medical and surgical ICP-lowering therapy. Patients should be hemodynamically stable before and during treatment.	Conditional recommendation.	Moderate-Quality Evidence [10]

Table 5: Surgical Intervention

Items:	Strength of Recommendations:	Level of Evidence:
• Surgery may be indicated in the following indications: ▪ Progressive neurological deterioration referable to the TICH, medically refractory IC-HTN ▪ Signs of mass effect on CT ▪ TICH volume > 50cm3 cc or ml ▪ GCS = 6–8 with frontal or temporal TICH volume > 20cm3 with midline shift ≥ 5mm and/or compressed basal cisterns on CT	Conditional	High-Quality Evidence [10]
• If the contusion with the surrounding edema cause mass effect according to the site you may do frontopolar lobectomy or tempropolar lobectomy	Conditional	High-Quality Evidence [10]
• If the hemorrhagic contusion coalesced to form intracerebral hematoma you may do evacuation	Conditional	High-Quality Evidence [10]
• Decompressive craniectomy with duroplasty may be indicated in cases in which the usual mechanisms to reduce the ICP are uneffective	Conditional	High-Quality Evidence [10]

Implementation Considerations:

Training of neurosurgeons on guideline application

Research gaps:

Outcome of decompressive craniectomy in patients with huge hemorrhagic contusion.

Clinical / Radiological Indicators:

- Glascow coma scale (GCS) recording
- CT brain request.

Updating the guideline:

To keep these recommendations up to date and ensure its validity it will be periodically updated. This will be done whenever strong new evidence is available and necessitates updating.

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