



SPECIAL ARTICLE

Evidence-based position paper on Physical and Rehabilitation Medicine professional practice for Adults with Acquired Brain Injury

The European PRM position (UEMS PRM Section)

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ABSTRACT

BACKGROUND: Acquired brain injury (ABI) is damage to the brain that occurs after birth caused either by a traumatic or by a nontraumatic injury. The rehabilitation process following ABI should be performed by a multi-professional team, working in an interdisciplinary way, with the aim of organizing a comprehensive and holistic approach to persons with every severity of ABI. This Evidence Based Position Paper represents the official position of the European Union through the UEMS Physical and Rehabilitation Medicine (PRM) Section and designates the professional role of PRM physicians for people with ABI. The aim was to formulate recommendations on the PRM physician's professional practice for persons with ABI in order to promote their functioning and enhance quality of life.

METHODS: This paper has been developed according to the methodology defined by the Professional Practice Committee of the UEMS-PRM Section: a systematic literature search has been performed in PubMed and Core Clinical Journals. On the basis of the selected papers, recommendations have been made as a result of five Delphi rounds.

RESULTS: The literature review as well as thirty-one recommendations are presented.

CONCLUSIONS: The expert consensus is that structured, comprehensive and holistic rehabilitation program delivered by the multi-professional team, working in an interdisciplinary way, with the leadership and coordination of the PRM physician, is likely to be effective, especially for those with severe disability after brain injury.

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KEY WORDS: Brain injuries - Evidence-based medicine - Physical and rehabilitation medicine.

Acquired brain injury (ABI) is damage to the brain that occurs after birth caused either by a traumatic or by a nontraumatic injury.¹ For the purposes of this paper, the definition of acquired brain injury used is: Acquired brain injury describes insults to the brain that are not congenital or perinatal, but usually applied to single event pathology and not to progressive degenerative disease.² The most frequent causes of ABI are: trauma, oxygen supply cessation (e.g. after cardio-respiratory arrest), infections, (e.g. meningitis) and tumors.³ The paper is focused mainly on the management of traumatic brain injury (TBI), although the general principles can be adapted to ABI from other causes. Transport accidents, sport accidents, assaults and falls are the primary causes of TBI. Incidence ranges from 200 to 300 cases of TBI per 100.000 inhabitants per year; peak risk of injury occurs between 16 to 25 years, rising again around 65 years.⁴

Few data are available on the long-term physical consequences of moderate to severe TBI. People who have suffered a brain injury have a higher risk of death than people hospitalized for equal durations due to other injuries or people from the general population⁵ and there is a high prevalence of residual disability arising from brain injury.⁶ It has been reported that 90% of people with TBI admitted for rehabilitation will experience one or more problems in the areas of physical functioning and community integration.⁷

The professional role of the PRM physician is to lead and coordinate the multi-professional team, working in an interdisciplinary way, with the aim of organizing a comprehensive and holistic approach to persons with every severity of ABI (severe, moderate and mild) in every stage of rehabilitation – from intensive care, acute and postacute hospital care, as well as throughout their long-term care.⁸

Materials and methods

This paper has been developed according to the methodology defined by the Professional Practice Committee of the UEMS-PRM Section.⁹ The systematic review of the literature has been performed in MEDLINE PubMed and Core Clinical Journals on February 2016. The search terms used in titles and abstracts for the first selection has been: traumatic brain injury AND rehabilitation as well acquired brain injury AND rehabilitation. Exclusion terms in titles were child/infant/adolescent/newborn AND mild/minor traumatic brain injury. Filters used in search methodology were: Last 10 years, English, Controlled Clinical Trial / Systematic Review / Meta-Analysis / Guideline. MeSH

thesaurus: rehabilitation. The Mendeley Reference Management Software was used for titles and abstracts management and reviewing.

The only criteria for including the studies has been the professional relevance for PRM physicians as judged by at least two of the authors, with the main author resolving conflicts. The Strength of Evidence (SoE) and the Strength of Recommendation (SoR) are given according to the Methodology paper. The consensus with Delphi procedure has followed the five steps proposed by the Methodology paper.⁹ The final recommendations were approved by at least ninety percent of the members of Professional Practice Committee or all delegates in the relevant Delphi rounds.

Results

Systematic review

Initially 241 titles were found, from which 132 abstracts were selected by the at least two members of the working group and finally 88 articles were used for the final result of 31 recommendations:

Recommendations were prepared according to the chapters proposed in the Methodology paper as defined by the Professional Practice Committee of the UEMS-PRM Section:

- overall general recommendation;
- recommendations on PRM physicians' role in Medical Diagnosis according to ICD;
- recommendations on PRM physicians' role in PRM diagnosis and assessment according to ICF;
- recommendations on PRM management and process;
- recommendations on future research on PRM professional practice Project definition.

Special attention was oriented to the subchapter «PRM Interventions» in Chapter D, where the recommended management of the specific problems of brain injured population is emphasized:

- respiratory problems;
- swallowing problems;
- nutritional and dietary problems;
- spasticity treatment;
- disorders of consciousness assessment and management;
- cognitive problems;
- functional problems and Activities of Daily Living (ADL) problems;
- the use of Virtual Reality (VR);

- problems of cardiorespiratory capacity;
- return to work problems.

Recommendations

A. Overall general recommendation

1. The professional role of the PRM physician is to lead and coordinate the multi-professional team, working in an interdisciplinary way, with the aim of organizing a comprehensive and holistic approach to persons with every severity of ABI (severe, moderate and mild) in every stage of rehabilitation – from intensive care, acute and post-acute hospital care, as well as throughout their long-term care.^{8, 10, 11} [SoR: A; SoE: IV].

B. Recommendations on PRM physicians' role in Medical Diagnosis according to ICD

2. It is recommended that the PRM physician is accurately and without delay conversant with all clinical information regarding the up-to-date Medical Diagnoses, including results of relevant diagnostic procedures.¹² This recommendation has no time limit through the treatment process and has a special relevance for those with an unstable clinical status including current complications and comorbidities. [SoR: A; SoE: IV].

3. The PRM physician should monitor the level of cognitive responsiveness of the person after ABI in intensive and acute care settings with behavioral observations as well one or more appropriate assessment tools (e.g. Westmead Post-Traumatic Amnesia scale, Galvestone Orientation and Amnesia Test, Mini Mental State Examination (MMSE),¹³ Montreal Cognitive Assessment (MoCA),¹⁴ Rancho Los Amigos Level of Cognitive Functioning Scale (RLA LCFS)^{15, 16} and Glasgow Outcome Scale - Extended (GOS-E).¹⁷

The PRM physician should adapt the multidisciplinary therapeutic approach and perform appropriate diagnostic and clinical procedures (clinical examination, US examination, CT scan, MR imaging, etc.) whenever there is a reduction in responsiveness. [SoR: A; SoE: IV].

4. It is recommended that the PRM physician, together with a multi-professional team, performs a thorough assessment of cognitive responses for patients in a Disorder of Consciousness. It is recommended, that term "Vegetative state" is replaced by a term "Unresponsive wakefulness syndrome" in all communications.^{18, 19} The definitive diagnosis of the state of consciousness should not be concluded after a single examination but after repeated assessments and after obtaining information on the patient's past life, to avoid misdiagnosis.²⁰⁻²² It is recommended that the

definition of the awareness state should follow the Royal College of Physicians National Clinical Guidelines for the Prolonged Disorders of Consciousness 2013²³ or American Academy of Neurology.²⁴ [SoR: A; SoE: III].

5. It is recommended that the PRM physician thoroughly and closely observes, detects and starts treatment for any medical complications in ABI person in intensive, acute and postacute phase of treatment, since complications strongly negatively interfere with rehabilitation process as well prolong the acute stage of treatment.²⁵ The life-threatening clinical conditions which are most frequent after severe and moderate ABI and should be clinically diagnosed without delay are:²⁶

- paroxysmal sympathetic activity;
- respiratory complications;
 - respiratory impaired physiology (hypoxia...);
 - pulmonary tract obstruction;
 - tracheostomy problems;
- post-traumatic epilepsy;
- post-traumatic behavior-emotional disturbances, aggression, agitation;
 - post-traumatic hydrocephalus (due to intracranial bleeding, intracranial pressure...);
 - infections (respiratory, urinary tract or central nervous system infections);
 - pressure sores;
 - coagulations disorders (DVT prevention...);
 - gastrointestinal complications (PEG tube problems, transit problems, malabsorption syndrome...);
 - endocrinological problems: post-traumatic hypopituitarism, hyperprolactinemia (due to the seizures or pituitary injury or due to pharmacological agents);
 - bone disorders: osteoporosis, heterotopic ossifications;
 - postintensive care syndrome (PICS).

[SoR: A; SoE: IV].

6. It is recommended that the PRM physician recognizes and clearly defines medical conditions which can interfere with transition of ABI person from acute setting to postacute specialized comprehensive care. Those medical conditions should be recognized and resolved before transition to specialized institutions, especially if the postacute care institution has limited facilities for the required clinical diagnostic procedures¹² [SoR: A; SoE: IV].

C. Recommendations on PRM physicians' role in PRM diagnosis and functional assessment according to ICF

7. It is recommended that the PRM physician and the rehabilitation team uses the International Classification of

Functioning, Disability and Health (ICF) taxonomy as a basic tool to collect information about the ABI person's limitations and personal needs as well as to assist planning, implementing and coordinating the rehabilitation process.²⁷⁻²⁹ [SoR: A; SoE: III].

8. It is recommended that the PRM physician uses the ICF core set for Traumatic Brain Injury³⁰ to detect and follow up changes functional status of person with ABI. It is recommended, that a brief ICF core set for Traumatic Brain injury³¹ is used to detect changes before and after every completed comprehensive rehabilitation process (inpatient or outpatient) and for periodical follow up during the comprehensive rehabilitation process and at regular outpatient visits. [SoR: A; SoE: III].

D. Recommendations on PRM management and process

INCLUSION CRITERIA (E.G. WHEN AND WHY TO PRESCRIBE PRM INTERVENTIONS)

9. It is recommended that the PMR physician evaluates persons who sustain a mild, moderate and/or severe ABI. Any short or long-term consequences on cognitive, behavioral or physical functioning not necessarily limited to injury itself, should be included in rehabilitation process. It is recommended that the rehabilitation process begins as early as possible after acute ABI preferably in the intensive care unit or as soon as the clinical status allows acute rehabilitation.^{12, 25, 32, 33} It is recommended that the rehabilitation process continues until the patient achieves the ceiling of his/her functional status. It is recommended that recovery should be objectively proven through functional assessment scales. The pathway of treatment during the acute and postacute phases should follow available national or European guidelines, since the use of standardized pathways achieves a better long-term outcome.³⁴⁻⁴¹ After completing the comprehensive rehabilitation process, persons with ABI should be monitored by periodic rehabilitation interventions to identify and manage any decline of functional status. [SoR: A; SoE: I].

PROJECT DEFINITION (DEFINITION OF THE OVERALL AIMS AND STRATEGY OF PRM INTERVENTIONS)

10. Due to the fact, that ABI is potentially a chronic and lifelong condition, which demands continuous interventions after the hospital treatment has concluded, it is recommended, that the model of care for the persons with ABI is based on a bio – psycho – social model. The ultimate goal for a rehabilitation team is to involve the person with ABI in the domestic or institutional environment

that will promote optimal participation in society, as well provide maximal quality of life, wellbeing and dignity.⁴² [SoR: A; SoE: IV].

11. It is recommended that the PRM physician plans the rehabilitation interventions and agrees realistic goals with the person with ABI and/or his next of kin or caregivers. The rehabilitation team, working in an interdisciplinary form, under the supervision of the PRM physician should adapt the goals to achieve maximal functioning that is meaningful for an ABI person and/or the caregiver which maximizes the ABI person's opportunity for independent living and functioning ideally in the home environment after the conclusion of rehabilitation process.⁴³⁻⁴⁹ [SoR: A; SoE: I].

12. It is recommended that the PRM physician plans the postrehabilitation period of the person with ABI in a domestic or institutional environment in cooperation with those who can assist and coordinate with the person with ABI in organizing his/her activities and participation in the environment when required.⁵⁰ This person can be a relative or spouse of the person with ABI, but preferably, from the outset, be a professional, who is appropriately trained in managing the ABI effects on functioning in society.⁴⁰ This professional may have a professional background as a social worker, care manager, community coordinator, be a trained representative of a recognized Brain Injury Society or any formally educated adult person.³² [SoR: A; SoE: III].

TEAM WORK (PROFESSIONALS INVOLVED AND SPECIFIC MODALITIES OF TEAM WORK)

13. It is recommended that the PRM physician is the leader and coordinator of the multi-professional team which works in an interdisciplinary way and treats the consequences of ABI involving a broad spectrum of impairments on the clinical level, including the neuropsychological, emotional, behavioral, perceptual, linguistic, vocational and social levels. The composition of the multi-professional team may differ at different stages of the recovery process and their roles may change as recovery progresses.^{11, 51} [SoR: A; SoE: IV].

14. It is recommended, that the goal setting process is derived with the reference to the patient and family own life goals and priorities.³⁹ There is evidence that goal setting may improve some outcomes for adults receiving rehabilitation for acquired disability. The best of this evidence appears to favor positive effects for psychosocial outcomes (*i.e.* health-related quality of life, emotional status, and self-efficacy) rather than physical ones.^{49, 52} [SoR: A; SoE: III].

PRM INTERVENTIONS

15. It is recommended that the PRM physician together with the multi-professional team have adequate theoretical knowledge, clinical skills and therapeutic equipment for clinical and functional assessment to provide a base for planning and performing PRM interventions through all stages of rehabilitation.^{8, 11} [SoR: A; SoE: IV].

16. It is recommended, that all persons with moderate or severe ABI trauma are supported by a respiratory team, which provides adequate chest mobilization, maintains proper positioning, oxygenation and manual respiratory techniques during the acute phase of rehabilitation.^{32, 33} [SoR: A; SoE: I].

17. It is recommended to assess swallowing safety in all patients who had a moderate or severe Acquired Brain Injury. PRM physicians should be trained in the clinical assessment to determine the existence of dysphagia in particular where there is a suspicion of a “silent” aspiration. Complementary tests should be done such a Videofluoroscopy or a fibroscopy (FEES - Fiberoptic Endoscopic Evaluation of Swallowing). When artificial nutrition is likely to be required for more than one month, Percutaneous Gastrostomy (PEG) should be considered in those patients with swallowing problems requiring a nasogastric tube.^{32, 33, 53, 54} [SoR: A; SoE: I].

18. It is recommended that all persons with ABI have a dietary and nutritional analysis performed in cooperation with a clinical dietitian not later than 48 hours after transition from intensive to an acute setting.^{55, 56} [SoR: B; SoE: III].

19. It is recommended that for all persons with ABI who develop spasticity and/or muscle shortening, the following protocol represents the minimal interventional standard:⁵⁷⁻⁶⁴

- elimination of triggering factors (pain, infection, constipation);
- use of the custom or individual orthoses / serial casting for joint position maintaining;
- use of drug therapy, including injection of botulinum toxin and intrathecal drug delivery - for spasticity in combination with serial casting and positioning. [SoR: A; SoE: II].

20. It is recommended that for all persons after ABI with disorders of consciousness a detailed evaluation of cognitive responsiveness should be performed by a multi-professional team with knowledge of diagnostic criteria of Minimally Conscious State and Unresponsive Wakefulness Syndrome, using standardized assessment tools with

adequate psychometric and diagnostic properties. There is low evidence that a structured neurostimulation program adapted to the persons level of responsiveness – in young adults - is potentially effective in raising the level of consciousness.⁶⁵⁻⁶⁸ [SoR: A; SoE: III].

21. It is recommended that a cognitive evaluation is performed on all persons after ABI who regain consciousness and awareness, followed by a cognitive neurorehabilitation/training which involves a systematic, functionally oriented service of therapeutic activities based on assessment and understanding of the patient’s behavioral deficits.^{23, 32, 69} [SoR: A; SoE: III].

22. It is recommended that occupational therapy interventions are performed in realistic and where possible the patient’s domestic environment. Such interventions can achieve meaningful functional training as they are oriented to foster the maximal functional independence in activities of daily living after discharge from institutional care. When medical devices, including devices for mobility are necessary for performing daily activities, the ABI person should be equipped with those devices and trained how to use them before being discharged to home.^{70, 71} [SoR: A; SoE: IV].

23. It is recommended that the PRM physician implements Virtual reality (VR) based therapy and Computer based cognitive training, as well strategy-oriented approaches for persons after ABI to improve cognitive functioning and balance deficits.⁷²⁻⁷⁵ [SoR: A; SoE: III].

24. It is recommended that the PRM physician prescribes a physical activity program which consists of aerobic exercises that can be performed in various ways⁷⁶⁻⁸³ in the chronic phase after ABI, to improve cardio-respiratory capacities, mood and self-esteem in persons after ABI. [SoR: A; SoE: III].

25. It is recommended that the PRM physician adapts a vocational rehabilitation (VR) program for the person after ABI, in order to enhance patient’s return to work.⁸⁴⁻⁸⁹ [SoR: A; SoE: III].

OUTCOME CRITERIA

26. It is recommended that the PRM physician decides on the outcome criteria during the assessment and goal-setting processes using the functional scales which suit the ICF framework.^{10, 29}

- 1) Global outcome:
 - * GOS-E,
 - * MPAI-4,
 - * DRS
 - * SF-36

2) ICF domain of function

- * Recovery of consciousness: CRS-R, SMART
- * Post-traumatic Amnesia (Post-traumatic Confusional State): Confusion Assessment Protocol
 - CAP, GOAT, Westmead.
- * Agitation: ABS
- * Neuropsychological assessment: RAVLT, TMT, Processing Speeding index form, WAIS-III or WAIS-IV, SASNOS
- * Physical function: FIM motor subscale, Barthel
- * Balance: BERG
- * Spasticity: Ashworth Scale, Modified Ashworth Scale
- * Hand Upper Limb function: Fugl Meyer motor subscale
- * Gait: FAC, 10 meters walking test (10-MWT), 6 minutes walking test (6-MWT)

3) ICF domain of Activity and participation

- * FIM/FAM subscale
 - * CIQ
 - * CHART.
- [SoR: A; SoE: IV].

LENGTH/DURATION/INTENSITY OF TREATMENT (OVERALL PRACTICAL PRM APPROACH)

27. It is recommended that the PRM physician prepares and evaluates treatment decisions/plans/programs according to the specific needs of person with ABI to prescribe the duration and intensity of a specific treatment in agreement with rehabilitation team and patient.⁹⁰⁻⁹³ [SoR: A; SoE: III].

DISCHARGE CRITERIA (E.G. WHEN AND WHY TO END PRM INTERVENTIONS)

28. It is recommended that a person with an ABI concludes the rehabilitation program and is transferred to a domestic environment after reaching the long-term goals set at the beginning of the rehabilitation program, or when there has not been any further progress in his/her functional capacity recorded for defined time period, or when he or she is not able to participate in the rehabilitation program due to deterioration in his/her health or the onset of a significant comorbidity.^{10, 93} [SoR: A; SoE: III].

FOLLOW-UP CRITERIA AND AGENDA

29. It is recommended that the PRM physician plans the follow up visits for the person with ABI on a regular time basis. The schedule for reviews should be consistent with the clinical and functional status of the person with ABI.

Where further rehabilitation is indicated for patients with brain injury after discharge from inpatient care, this may be offered by tele-medicine solutions or face-to-face engagement to alleviate long term burdens due to depression, behavioural and cognitive consequence.^{32, 94} [SoR: A; SoE: I]

E. Recommendations on future research on PRM professional practice Project definition

30. It is recommended that the PRM physician participates in future research on PRM professional practice projects that are targeting effective treatments and interventions to address the multitude of physical, behavioral and cognitive problems caused by ABI, including the research on drug therapy. Research on epidemiology, survival rates and prognostic factors of ABI could contribute to better utilization of rehabilitation resources and long-term management planning. It is recommended that focus is also on the field of post-ABI-life: caregiver's burden, socialization of ABI families and interpersonal relationship problems of persons after ABI.⁹⁵ [SoR: A; SoE: III].

31. It is recommended that future research projects in the field of ABI rehabilitation concur to improve evidence-based practice and undergo rigorous peer reviewed evaluation. This review process is intended to reduce the likelihood of new interventions being introduced which have little or no scientific evidence base.⁹⁶ [SoR: A; SoE: IV].

Discussion

This paper includes 31 recommendations on rehabilitation of persons with acquired brain injury. It was produced with the aim to strengthen and emphasize the role of the PRM physician in the process of rehabilitation of patients with Acquired Brain Injury. The decision to expand the topic from traumatic brain injury to acquired brain injury was accepted after a thorough discussion inside the Professional Practice Committee, in order to cover the greater population of subjects with injuries and diseases of the brain. This paper however does not include recommendations for rehabilitation after stroke, since this topic is covered in a separate paper.

This paper is not intended to be construed or to serve as a standard of care. Standards of care are determined on the basis of all clinical data available for an individual case and are subject to change as scientific knowledge and technology advance and patterns of care evolve. Adherence to recommendations will not ensure a successful outcome in every case, nor should they be construed as including

all proper methods of care or excluding other acceptable methods of care aimed at the same results.

Acquired brain injury is a complex condition that can have unpredictable long-term effects on a person depending on the nature of the injury, the medical history of that person and their exposure to other wider economic and social factors.

Conclusions

The expert consensus is that a structured, comprehensive and holistic rehabilitation programme delivered by the multi-professional team, working in an interdisciplinary way, with the leadership and coordination of the PRM physician, is likely to be effective, especially for persons with severe disability after acquired brain injury.

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