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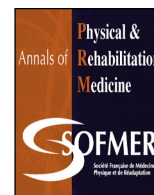

Review

# What are the disruptive symptoms of behavioral disorders after traumatic brain injury? A systematic review leading to recommendations for good practices

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ABSTRACT

Behavioral disorders are major sequelae of severe traumatic brain injury. Before considering care management of these disorders, and in the absence of a precise definition for TBI-related behavioral disorder, it is essential to refine, according to the data from the literature, incidence, prevalence, predictive factors of commonly admitted disruptive symptoms.

*Methods:* Systematic review of the literature targeting epidemiological data related to behavioral disorders after traumatic brain injury in order to elaborate good practice recommendations according to the methodology established by the French High Authority for Health.

*Results:* Two hundred and ninety-nine articles were identified. The responsibility of traumatic brain injury (TBI) in the onset of behavioral disorders is unequivocal. Globally, behavioral disorders are twice more frequent after TBI than orthopedic trauma without TBI (Masson et al., 1996). These disorders are classified into disruptive primary behaviors by excess (agitation 11–70%, aggression 25–39%, irritability 29–71%, alcohol abuse 7–26% drug abuse 2–20%), disruptive primary behaviors by default (apathy 20–71%), affective disorders – anxiety – psychosis (depression 12–76%, anxiety 0.8–24,5%, posttraumatic stress 11–18%, obsessive-compulsive disorders 1.2–30%, psychosis 0.7%), suicide attempts and suicide 1%.

*Discussion:* The improvement of care management for behavioral disorders goes through a first step of defining a common terminology. Four categories of posttraumatic behavioral clinical symptoms are defined: disruptive primary behaviors by excess, by default, affective disorders-psychosis-anxiety, suicide attempts and suicide. All these symptoms yield a higher prevalence than in the general population. They impact all of life's domains and are sustainable over time.

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## 1. Introduction

Behavioral disorders are common and contribute to the severity of the trauma, around 62% at one year from trauma, regardless of the initial TBI severity [1]. These disorders are still present at 5 years posttrauma [2]. They frequently appear right from the awakening period and family members of patients with severe TBI report at 3 months post-TBI that patients "are not the way they used to be" in 49% of cases vs. 60% at one year and 74% at 5 years [3]. In this latter study by Brooks et al., the most frequently reported behavioral, affective or psychological changes concerned irritability (64%), bad temper (64%), tiredness (62%), depression (57%), rapid mood change (57%), anxiety (57%) and threat of violence (54%). At two years post-TBI, irritability was also reported as one of the most common problems by Ponsford et al. [4]. Furthermore, authors noted that lack of initiative was present in 44% of cases, and inappropriate social behavior in 26% of cases.

However, no systematic review of the literature was recently conducted. Furthermore, no precise definition of behavioral disorder post-TBI was found. In the population of persons with intellectual disabilities, Tassé et al. [5] defined serious behavioral disorders as "behaviors that are noxious for the health or physical integrity of the person". One can consider that a behavioral disorder exists when the behavior of a person is deemed deviant, unacceptable or dangerous compared to what would be considered normal within a group of person sharing the same values and a common culture.

The objective of this work was to refine the incidence, predictive factors and progression of the different behavioral disorders encountered after moderate or severe traumatic brain injury in adults. These recommendations were elaborated by a group of expert following the HAS protocol (http://www.has-sante.fr/portail/jcms/c_431294/recommandations-pour-la-pratique-clinique-rpc)

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that includes several criteria of the PRISMA method (criteria 1, 2, 3, 6, 7, 13, 15) [6].

## 2. Methods

The steering group of this project, consisting of several experts in TBI care management, proposed to differentiate disruptive primary behaviors by excess from disruptive primary behaviors by default. Four subgroups of behavioral disorders were considered in this work:

- disruptive primary behaviors by excess;
- disruptive primary behaviors by default;
- affective disorders, anxiety and psychosis;
- suicide attempts and suicide.

Cognitive disorders were considered as a different entity and are not included in the framework of this article.

The review of the literature was conducted on Medline, in French and English from January 1990 to March 2012 as well as in books and articles not referenced in the Medline database, this search was conducted by the French High Authority for Health services. An additional search was conducted up to June 2015 without the help of the French High Authority for Health. Keywords used for the Medline search were the following: ("Craniocerebral Trauma" [Majr]) OR "Brain Injuries" [Majr] Or (Brain injur* Or Brain trauma* Or Head injur* Or Head trauma*) [title] AND "Mental Disorders" [Mesh] OR "Mood Disorders" [Mesh] OR "Anxiety" [Mesh] OR "Anxiety Disorders" [Mesh] OR "Depression" [Mesh] OR "Depressive Disorder" [Mesh] OR "Depressive Disorder, Major" [Mesh] OR "Psychotic Disorders" [Mesh] OR "Apathy" [Mesh] OR "Aggression" [Mesh] OR "Irritable Mood" [Mesh] OR "Anger" [Mesh] OR "Psychomotor Agitation" [Mesh] OR "Substance-Related Disorders" [Mesh] OR "Cognition Disorders" [Mesh] OR "Executive Function" [Mesh] OR "Awareness" [Mesh] OR "Agnosia" [Mesh] AND "Epidemiology" [Mesh] OR "Prevalence" [Mesh] OR "Incidence" [Mesh] NOT "Critical Care" [Mesh] OR "Child" [Mesh] OR "Infant" [Mesh]OR "Pediatrics" [Mesh] OR "Adolescent" [Mesh] Or (Critical care OR child* OR infan* Or paediatr* or pediatr* OR adolescent*).

Articles focusing on the prevalence or incidence of all types of behavioral disorders post-TBI were kept for this analysis (follow-up of cohorts, cross-sectional studies, longitudinal studies, case studies). Studies that had a more general approach on neuropsychiatric disorders post-TBI were also considered. Articles related to evaluation scales were not kept for this analysis, they are the focus of another article in this special thematic issue. Studies targeting other pathologies than moderate to severe TBI (other neurological diseases, mild TBI, TBI in war veterans) were excluded. Articles were analyzed taking into account potential biases (selection bias, heterogeneity of the population, inclusion delay, use of specific adapted scales).

## 3. Results

The electronic searches (Medline 1990–2012) returned 162 citations and 42 in the additional research (Medline 2012–2015). After screening titles and abstracts, 124 records were discarded as irrelevant or obviously not meeting the selection criteria. Hand-searching identified 219 additional eligible articles, hence leaving a total of 299 articles.

### *3.1. Disruptive primary behaviors by excess*

The analysis of the literature unveiled several symptoms such as agitation, opposition, wandering behaviors, disinhibition, irritability, impulsivity, screams and shouting, risk-taking attitudes, bulimia, addictions, hypersexuality, exhibitionism, Kluver-Bucy* syndrome, hostility, aggression, verbal and physical violence. Some themes such as opposition, aggression, circadian rhythm disorders, inappropriate wandering or motor behaviors, screams, motor disinhibition are symptoms similar to the ones present in Alzheimer's disease and answer to the same characteristics (good practices recommendations: Alzheimer's disease and related disorders: management of disruptive behavioral disorders – HAS website 2009). It was decided to classify the disorders into 5 subchapters:

- agitation;
- aggression;
- irritability;
- substance abuse: at-risk, excessive, dependent behavior;
- behavior with medicolegal consequences, felony and crime.

#### *3.1.1. Posttraumatic agitation*

Posttraumatic agitation is a common if not unavoidable characteristic of the coma-awakening period [7]. It is related to the altered state of consciousness [8] posttraumatic amnesia period [9], and decreases when cognitive functions improve [10]. The duration is usually short (1 to 14 days) but can sometimes last longer or appear later on [10,11]. No type of behavior defines agitation, it can be a combination of aggression, akathisia, disinhibition, emotional lability, motor restlessness [9] or for others, impulsivity, disorganized thinking, perceptual disturbances, impaired capacity to sustain attention or reduced adaptation [12]. The mean incidence of agitation is estimated at 46% with ranges going from 11 to 70%. Environmental causes, sleep disorders, pain promote agitation [13]. The functional future is related to the duration and severity of the agitation [14] (see Table 1: main studies on agitation after TBI).

#### *3.1.2. Aggression*

Aggression includes verbal aggression, physical aggression against objects, physical aggression against self, other persons [19] but also severe irritability, violent, hostile, or assaultive behavior and "episodic dyscontrol" [20]. After traumatic brain injury, hostile or explosive aggression is more frequent than goal-directed aggression [21]. Aggression incidence varies between 25 and 39%. It is related to the severity of the initial trauma [22] and the existence of a prefrontal injury (orbitofrontal) [23]. Aggressive behaviors are more frequent in older male subjects, when there is associated language disorders, in a noisy environment, in the 24 hours following epileptic seizure [24]. Depression and anxiety are more common in the aggressive TBI patient [23,25]. Anger is more frequent in patients with executive function disorders [26] (see Table 2: main studies on aggression after TBI). More recently, a link between history of aggression and verbal aggression post-TBI was evidenced [27,28].

#### *3.1.3. Irritability*

Irritability can be defined as an excessive reaction with unjustified anger fits. Its incidence ranges from 29 to 71% according to studies in patients with severe TBI. Risk factors of an irritable behavior in patients with TBI are: being male, age between 15 and 34, unemployment, social isolation, depression [36,37]. Contrarily to irritability occurring after mild TBI, authors reported the absence of a correlation between cognitive impairment and irritability after severe TBI [38].

#### *3.1.4. Addictions with abuse and excesses*

If addictions with abuse and excesses of alcohol or illicit substances are problematic in the care pathway after TBI, the

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