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Authors: Julia Nekrasova, Mikhail Kanarskii, Elena Manzha, Ilya Borisov, Pramil Pradhan, Denis Shunenkov, Anna Kirillova, Sergey Tsyganov, Vera Pasko, Marina Petrova, Igor Pryanikov

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Original article

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Julia Nekrasova¹, Mikhail Kanarskii¹, Elena Manzha^{1,2}, Ilya Borisov¹, Pranil Pradhan¹, Denis Shunenkov¹, Anna Kirillova¹, Sergey Tsyganov^{1,2}, Vera Pasko¹, Marina Petrova^{1,3} Igor Pryanikov¹

¹Federal Research and Clinical Center of Intensive Care Medicine and Rehabilitation
Moscow, Russian Federation

²Konchalovsky City Clinical Hospital

³People's Friendship University of Russia, Moscow, Russian Federation

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Address for correspondence:

Denis Shunenkov

Federal Research and Clinical Center of Intensive Care Medicine and Rehabilitation
Moscow, Russian Federation

phone: +7 (915) 833 32 53

e-mail: voksined@yandex.ru

Abstract

The observational study aimed to analyze the neurogenic bladder dysfunction in patients during the recovery from the chronic disorder of consciousness. We compared etiology, level of consciousness, age with the neurogenic bladder dysfunction in these cases. The study result suggested that the increase in the consciousness level partially restores the bladder function, which significantly reduces the risk of infections and somatic disorders, thereby affecting the duration and quality of life. Recovery of the bladder function also depends on the etiology of the disorder of consciousness: patients in the anoxic group had the least chance of bladder function recovery making global brain ischemia an unfavorable factor. Correlations between urination dysfunctions with age and level of consciousness at admission have not been found.

Key words: chronic disorders of consciousness, hyperactive bladder, neurogenic bladder, vegetative state, anoxic brain injury, traumatic brain injury

Introduction

The post-comatose condition with a significant loss of cognitive functions is known as chronic disorder of consciousness [1, 2]. Giacino et al. [3] considered 28 days after the injury as a chronic period. Disorders of consciousness (DOC) transit into a vegetative state (VS) and minimally conscious state (MCS). Vegetative state (VS) is a condition without any self and surrounding awareness whereas minimally conscious state (MCS) is a condition with some level of self-recognition and interaction [4]. The causes for chronic DOC: traumatic brain injury (TBI), cerebrovascular injury, anoxic/hypoxic brain injury, and infections of the central nervous system (CNS) [5]. The life expectancy of patients in the VS ranges from 3 to 5 years [6]. One of the dominant causes of mortality in these patients is urinary tract infections (UTI). Patients frequently have an atonic bladder and later ascending pyelonephritis because of impaired physiological functions and prolonged immobilization. The urinary catheters also exacerbate ongoing UTI [7]. A study about urinary incontinence in stroke patients [8] established the presence of neurogenic bladder dysfunctions as the main culprit for the significant adverse outcome. Several studies have found no correlation between the area of damage and subsequent neurogenic dysfunction [9–12].

Currently, we did not find any significant work on neurogenic bladder dysfunctions in chronic DOC. We searched the Web of Science, Scopus, PubMed, Google Scholar databases for the following keywords in various combinations: disorders of consciousness (DOC), vegetative state (VS, UWS), minimally conscious state (MCS), traumatic brain injury (TBI), urology, neurogenic bladder, micturition, and incontinence. We aimed to compare and analyze data from other related studies but could not find any significant work. Without proper scientific research on this subject, it is quite challenging for health providers to diagnose, treat, prevent, and provide rehabilitation. We aimed to assess functions of urinary tract in patients who emerge from VS and MCS. The etiologies considered were TBI, anoxic injury, and cerebrovascular injury.

Patients and methods

We collected data for our observational study from the beginning of 2019 to the end of 2020 on neurogenic bladder dysfunctions in DOC patients who were admitted and discharged from the Federal Research and Clinical Center for Intensive Care Medicine and Rehabilitation. Team of neurologists diagnosed different forms of chronic disorder of consciousness (DOC) — vegetative state (VS) and minimally conscious state +/- (MCS+/-), based on standard diagnostic criteria available currently. Also, we thoroughly interviewed other medical staff in contact with patients to know the patients' level of communication. At the time of diagnosis, electrolytes were in the normal range; infectious, metabolic, and other disorders that could lead to change in the level of consciousness were absent.

The main inclusion criterion was the subsequent increase in the level of consciousness after VS or MCS- to the level allowing communication (MCS+, emergence from MCS, clear consciousness). The change in the level of consciousness was detected both in hospital environment and by means of telephone interviews of relatives or caregivers to find whether or not they could communicate with patients. Since the number of patients restoring consciousness after DOC is generally small, 20 people entered the study group. The exclusion criteria comprised ongoing brain strokes, mental disorders, and acute urinary tract disorders.

The urologist performed the urological evaluation of patients with chronic DOC to determine neurogenic bladder dysfunctions. After being discharged the urological evaluation was based on the patient's urge to urinate and other physiological functions. The study also includes patients' demographic data, their level of consciousness, etiology, and the bladder dysfunction (Table 1). To analyze data Statistica 10 program package (developed by StatSoft.Inc) was used. The tests used were: The Kolmogorov-Smirnov test — to check the nature of the distribution of interval variables, Wilcoxon test — to determine the significant difference in quantitative traits between two independent groups, Spearman's rank correlation coefficient – to study the relationship between the phenomena represented by quantitative data and the distribution differing from the normal, and Chaddock scale — to assess the direction and strength of the correlation. A p-value < 0.05 is considered statistically significant. The study follows the WMA Declaration of Helsinki Adopted by the 18th WMA General Assembly, Helsinki, Finland, June 1964 and amended by the: 59th WMA General Assembly, Seoul, Republic of Korea, October 2008; article 17 of the Principles of Public Health Legislation, orders, and instructions issued by Ministry of the health of the Russian Federation.

Results

Demographical and clinical data of all patients enrolled in the study are presented in Table 1. Out of 20 patients, TBI, subarachnoid hemorrhage (SAH), and anoxic brain injuries (ABI) cases accounted for 45%, 30%, and 25% accordingly (Fig. 1A).

At the initial level of consciousness, all patients belonged to non-communicating group, i.e. they were in VS (11 people) or MCS– (9 people) (Fig. 1B). For such a category of patients, we considered the appearance of the ability to communicate a significant improvement (see Patients and methods chapter), therefore, according to the final level of consciousness, a group of participants was divided into patients in MCS+ (3 people) and patients in conscious state (17 people) (Fig. 1C).

A moderate correlation was found between the final level of consciousness and etiology in the sequence of “anoxia — traumatic brain injury — subarachnoid hemorrhage” (Spearman's rank correlation coefficient $r_s = 0.46$) but it cannot be considered a significant statistical difference between etiological groups according to Mann-Whitney U-test. Probably, the small amount of patients in nosology groups contributed to this result.

A weak positive correlation ($r_s = 0.18$) between etiology and urination dysfunction was established. The follow-up data showed us that all TBI cases had controlled bladder emptying after regaining consciousness, including 2 MCS+ cases. In anoxic patients and SAH, 2 out of 5 (40%) and 4 out of 6 (66.7%) patients respectively urinated voluntarily.

Among MCS+ 3 patients (42.8%) did not restore arbitrary urination. Urinary incontinence is noticeably lower 15.3% (2 people out of 13) in patients who emerged from DOC to consciousness. No correlations were found between age, urinary incontinence, and primary level of consciousness. Frequent urination was preserved in all the study cases.

Discussion

This observational study aimed to analyze the neurogenic bladder dysfunction in chronic DOC patients during and after the recovery of consciousness based on etiology, final consciousness level, and age. The results obtained allow to conclude that after regaining consciousness, arbitrary urination is restored in 75% of cases. However, the restoration of normal function of urination does not occur. The hyperactive bladder functions usually stand and cause several inconveniences for both patients and caregivers. The urinary bladder function is restored in the least number of anoxic brain injury cases meaning that global brain ischemia is an unfavorable

factor for the restoration of urinary function. All TBI cases in our study fully restored voluntary urination, which corresponds with another study that note that this etiological group has a more significant functional recovery [13].

In this paper, it was emphasized the importance of the recovery of consciousness in the process of restoring functional abilities of the urinary system, the pathology of which is a frequent cause of complications and mortality in this patient group. In turn, this allows to conclude, that the realization of rehabilitation potential in terms of cognitive function may have a positive impact on the restoration and other functions of the body, which generally contributes to improving the quality of life and an increase in its duration. A multidisciplinary rehabilitation approach more targeted towards cognitive-behavioral therapy in patients with DOC is recommended.

A major limitation of the study is the small sample size, which is associated with the rarity of both DOC cases and, in particular, positive outcomes. A more comprehensive study could recognize correlations between the level of consciousness, etiology, and urinary inconsistency. Other possible scaling methods, demographic and clinical data that are not available in this study should also be considered in future research.

Based on data obtained it can be concluded that an increase in the level of consciousness lead to a partial restoration of the urinary tract functions, which significantly reduces the risk of somatic and infectious pathologies, thereby affecting the duration and quality of life. A tendency in etiological differentiation between anoxic and traumatic lesions is maintained in relation to the dynamics of the level of consciousness and functional recovery of the urinary system.

Declaration of conflict of interests

The authors declare that there is no conflict of interest.

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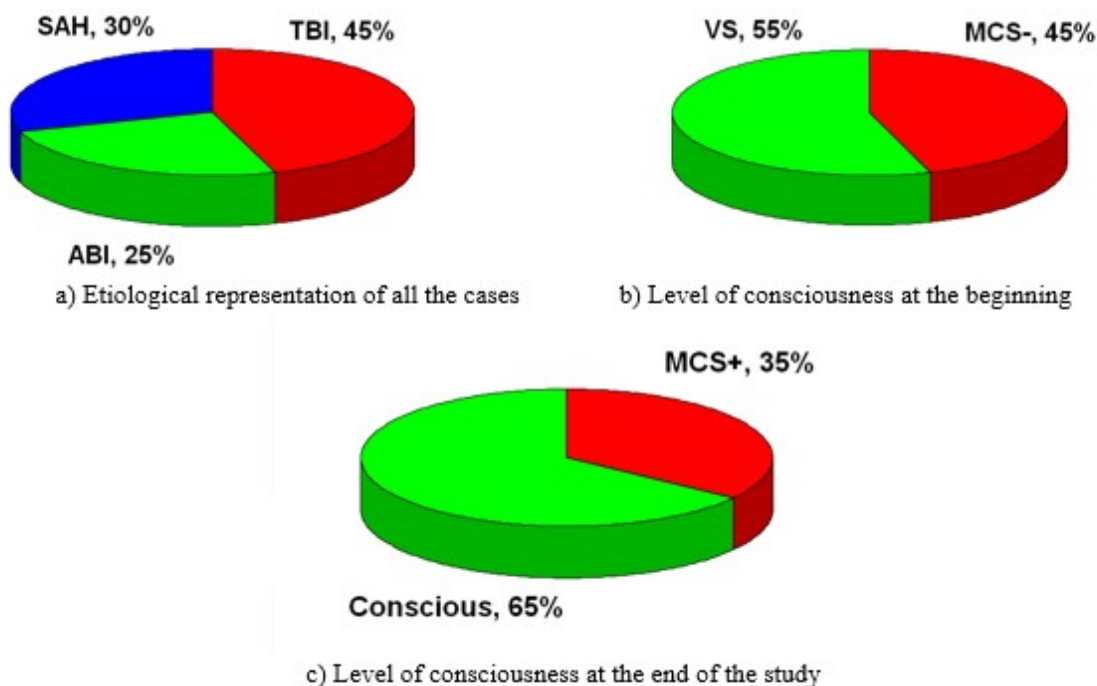


Figure 1. Characteristics of the main group of research participants

Table 1. Patient's demographical and clinical data

No	Age	Initial level of consciousness	Final level of consciousness	Etiology	Final urination	Final frequency of urination
1	42	VS	MCS+	ABI	Involuntary	Frequent
2	46	MCS-	MCS+	ABI	Involuntary	Frequent
3	25	MCS-	Conscious	ABI	Voluntary	Frequent
4	40	VS	MCS+	ABI	Involuntary	Frequent
5	37	VS	MCS+	ABI	Voluntary	Frequent
6	32	MCS-	Conscious	SAH	Involuntary	Frequent
7	45	VS	MCS+	SAH	Voluntary	Frequent
8	53	MCS-	Conscious	SAH	Involuntary	Frequent
9	53	VS	Conscious	SAH	Voluntary	Frequent
10	38	VS	Conscious	SAH	Voluntary	Frequent

11	28	VS	Conscious	SAH	Voluntary	Frequent
12	22	MCS-	MCS+	TBI	Voluntary	Frequent
13	29	MCS-	Conscious	TBI	Voluntary	Frequent
14	26	VS	Conscious	TBI	Voluntary	Frequent
15	45	VS	MCS+	TBI	Voluntary	Frequent
16	57	MCS-	Conscious	TBI	Voluntary	Frequent
17	61	VS	Conscious	TBI	Voluntary	Frequent
18	19	VS	Conscious	TBI	Voluntary	Frequent
19	20	MCS-	Conscious	TBI	Voluntary	Frequent
20	40	MCS-	Conscious	TBI	Voluntary	Frequent

ABI — anoxic brain injury; SAH — subarachnoid hemorrhage; TBI — traumatic brain injury;
VS — vegetative state; MCS — minimally conscious state