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## Complex rehabilitation and therapeutic care involving a polytraumatized patient with traumatic brain injury, cervical spinal cord injury and multiple associated lesions - case report

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### Abstract

The subject matter of the present scientific paper is the report of the therapeutic and rehabilitation program of a polytraumatized patient with severe traumatic brain injury and mild cervical spinal cord injury, that led to serious functional consequences: psycho-cognitive, neuromotor, neurosensitive and autonomous.

**Key words:** *therapeutic and rehabilitation program, polytrauma, traumatic brain injury,*

### Introduction

The impact of traumatic pathology at the global, national and local population level is that of a pandemic [1]. The mechanism of trauma production is the uncontrolled and damaging transfer of mechanical energies, in form simple or complex trajectories, to biological structures [2] with the possibility of temporary or permanently loss of anatomic and functional integrity. Industrialized geodemographic regions have as main trauma causing agents road accidents, aggressions, work and sports accidents. Road accidents are the most important cause of traumatic injuries, representing the tenth cause of death worldwide [1] and without sustained action, road traffic crashes are predicted to become the seventh leading cause of death by 2030. [3] The consequences of road accidents are mostly suffered by men and women aged between 15 and 29 years; this particular socio-economic burden has determined the appearance of the newly adopted ambitious target of the WHO (World Health Organization) of halving the global number of deaths and injuries from road traffic crashes by 2020 [3]. Due to the fact that *trauma* is an extended term, a specific scientific nomenclature of traumatic conditions has always been a necessity. In this context, "multiple traumatic injuries", "severe injuries" and "polytrauma" are considered to be separate entities. This work will address the particular issue of *polytrauma*, a severe and life-threatening post-traumatic condition. According to the new Berlin definition, polytrauma is quantified by adding to the already implemented number of lesions and their severity, measured by the ISS (Injury Severity Score) and AIS (Abbreviated Injury Scale), the following pathophysiological changes: hypotension  $\leq$

90 mmHg), absence of condition consciousness (GCS  $\leq$  8 score), acidosis (baseline excess  $\leq$  -6.0), coagulopathy (partial thromboplastin time  $\geq$  40 s or INR  $\geq$  1.4) and age ( $\geq$  70 years) [4]. This newly adopted additional parameters underline the high risk and high mortality characteristics of this traumatic pathology. The polytraumatized patient may have one or more of the following symptoms: locomotor dysfunction, respiratory dysfunction, dysphagia and malnutrition, pain. Moreover, cerebral tissue is often targeted in the polytraumatic context and is an important element of mortality: 60% of US road deaths are due to traumatic brain injury (TBI) [5]. Therefore, the previously described clinical picture can be extended with neuro-myo-arthrokinetic (paralysis, balance and coordination dysfunction, dystonia, posttraumatic heterotopic ossification), neurosensitive, psycho-cognitive and psychosocial impairments. In order to perform the medical-rehabilitation treatment of this pathology, the limits of unique specialties must be exceeded and thus a multidisciplinary and / or interdisciplinary approach must be performed, in dedicated institutions, linked by terminology and practice. The acute phase requires quick and vigorous interventions and the moment of vital functions stabilization announces long-term efforts of laborious recovery programs. As a concept, neurorehabilitation aims to influence the posttraumatic remaining structures and residual abilities through dynamic processes and thus to optimize the patients' quality of life. Three levels, in line with the new perceptions of health and disease formulated by the World Health Organization – WHO, are used to set the recovery targets : 1) the somatic level: aims to recover the morphofunctional structures

2) the activity level aims to regain activity control 3) the participation level aims to creating a daily routine with the goal of participating in the neuro-psycho-social dimension [5]. The focus of the therapy involves on one hand the secondary and tertiary prophylaxis of secondary pathological events that may follow after any central nervous system lesion, as well as a complex assistive and supportive program to influence neural self-organization towards relearning and regaining of abilities. Neurorehabilitation treatment may also involve multidisciplinary efforts directed towards the prophylaxis or even treatment of general complications and disorders: metabolic (cachexia, malnutrition), vascular (deep vein thrombosis, pulmonary thromboembolism), osteoarticular (musculo-ligament retractions, articular deformities and depostures, neurogenic heterotopic ossification, osteoporosis, ankylosis), respiratory (infections, aspiration bronchopneumoniae, ventilation and non-productive cough with respiratory insufficiency), urinary (infections, lithiasis, hydronephrosis, hematuria) digestive (constipation, diarrhea and dysmicrobism, upper gastrointestinal bleeding) [5].

#### **Method: case presentation**

The informed consent of the family and the approval of the Ethics Commission of „Bagdar-Arseni Hospital” in Bucharest were obtained for the communication of this case.

We present the case of a 45-year-old patient who suffered a road accident in 2016. At the time of the first medical contact the local examine revealed: loss of consciousness with spontaneous opening of the eyes and paralysis of the right cranial nerve III (GCS =3), vegetative state, ventilation through tracheostomy cannula, flaccid tetraplegia. After complete analysis of the injuries, the patient underwent diagnostic radiology investigations of the cranial, cervical, thoracic, pelvic and limb regions and diagnostic ultrasound investigation of the abdomen. The results of these investigations reveal thoracic lesions: multiple rib fractures, pelvic lesions: left acetabular fracture with coxofemoral joint involvement; shoulder lesions: left traumatic injuries without visible fractureal traits [Fig.1] and cranio-cerebral lesions: hemorrhagic frontal contusion and hematic accumulation in the form of a hygroma with a maximum thickness of 1.1 cm, minimal left lateral tentorial and left parietal subarachnoid haemorrhage and 2 cm thick left temporal arachnoid cyst. [Fig.2 -

left]. Abdominal ultrasound does not objectify abdominal rupture or active peritoneal bleeding. Subsequently, an MRI investigation of the cervical spine showing a traumatic cervical spinal cord injury is performed: C3-C5 disc-shaped protrusions with spinal stenosis.



Figure 1 : Left shoulder radiography showing slight shoulder subluxation without visible fractureal traits. In the very early stage, a prompt intensive care treatment as well as therapeutic interventions targeting complications were applied. For the control of swallowing and the maintenance of hydration and nutrition a nasogastric tube was installed. The effective control of the micturition was done by mounting a Foley urinary catheter. The tracheal cannula was cared by bronchial drainage techniques. The patient performed two neurosurgical interventions, at an interval of 4 months, for the treatment of secondary hydrocephalus and hygroma drainage and receives a ventriculoperitoneal shunt mounting.[Fig.2-right]. After the priority neurosurgical interventions, the orthopedic treatment of the pelvic fracture is performed by a total hip arthroplasty. [Fig.3]. The patient was then transferred to our Unit to establish a neurorehabilitaiton program.

In our neurorehabilitation unit the patient presented a minimally conscious state and the the absence of the tracheal cannula and Foley urinary catheter. The locomotor dysfunction in form of a complete tetraplegia was improved by minimal motor acquisitions. The deficit was mainly a predominant left hemiplegia. Motor control was present at all levels: proximal, intermediate and distal, at both the upper and lower limbs, with muscle strength of 2/5 MRC (Medical Research Council scale).

For the swallowing disorders the patient is still fed on the nasogastric tube. Clinical and functional evaluation is also performed on the basis of the protocols implemented in our clinic, with the following results: FAC (Functional Ambulation Categories Scale) = 0; GOS (Glasgow Outcome Scale) = 2; RANKIN scale = 5, Motor FIM (Functional Independence Scale) = 30, cognitive FIM = 5, MMSE (Mini-Mental State Examination)= untestable.

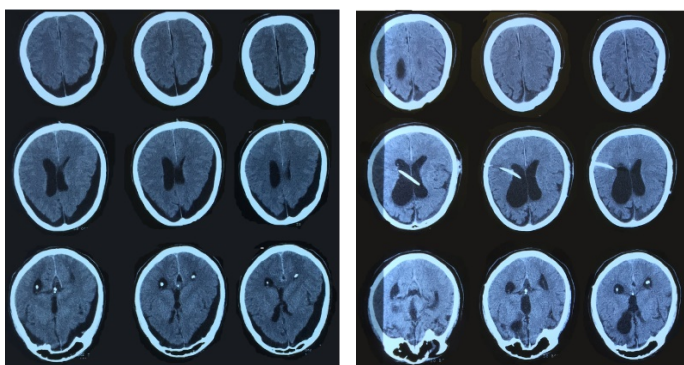


Figure 2: Head computed tomography in axial plane 3 month after TBI (left image) and 6 month after TBI (right image) showing: hematic accumulation in the form of a hygroma with a maximum thickness of 1.1 cm (left image) and secondary hydrocephalus with ventriculoperitoneal shunt and hygroma drainage (right image)



Figure 3: Right hip radiography, showing total hip arthroplasty

The patient presents a severe level of dependence, is bedridden and requires permanent care and supervision. From a neuro-psycho-cognitive point of view, the patient has motor responses to pain, responds to auditory stimuli by simple verbal responses and executes simple commands. In the particular case of this rather young patient, married and having two children, for whom the results of the quality of life improvement are critical, the objectives of the neurorehabilitation program were to: 1) treat associated diseases (cardiovascular, orthopedic, respiratory, digestive, renumeric) and perform the prophylaxis of their complications; 2) improve mental and communication status; 3) regain self-care and locomotor abilities; 4) regain the family reintegration.

### Results:

The practical principles of the neurorehabilitation management of this case address the clinical problems encountered and can be divided into four categories: 1) hygienic-dietary measures and specific pharmacological treatment, 2) physical-kinetic rehabilitation program, 3) Speech and language

therapy, 4) multidisciplinary management of associated diseases.

1) Hygienic-dietary measures and specific pharmacological treatment. These steps involved the prophylaxis of the complications due to bed rest: the use of equipment such as anti-bedsores mattress and pillows for the wheelchair, as well as the initiation of mobilization and posturing at the bed level. In the context of dysphagia, altered consciousness and hypercatabolic status the patient required the maintenance of adequate nutrition and hydration. The medical team assisted of the evacuation of biological waste and the restoration of a physiological pattern of defecation by selecting laxative and hydration foods, rhythmization of the meals and stimulation the defecation reflexes. The management of secondary hydrocephalus was done using cerebrospinal fluid volume depletive medication (Acetazolamide). Pharmacological treatment is performed with: an injectable anticoagulant type LMWH (low-molecular-weight heparin), neurotrophic, neuroprotective, urinary antiseptic, gastric protector medication and hydroelectrolytic supplements.

2) The physical-kinetic rehabilitation program firstly aimed at the prevention and correction of vicious postures due to spasticity and the prevention of amyotrophy and maintenance of joint mobility and quality of articular movement. With the recovery of the consciousness, the aims were to reeducate the patients' orthostatic posture and subsequently, to learn him to perform the transfer from bed to wheelchair and vice versa. The last objective was the relearning of the fine motor skills of the wrists, hands, fingers through an occupational therapy program. This kinetic program expects cardiovascular and circulatory rehabilitation, optimization of the respiratory function and improvement of intestinal transit.

3) The speech and language therapy performed in our Unit after the patients' consciousness recovery have laid the foundations towards communication and psycho-cognitive improvement and also towards the involvement of the family in the development of appropriate strategies in this particular context. Also, the sensory functions, auditory and ophthalmic, were investigated with this occasion.

4) The multidisciplinary management of this patient was necessary in order to treat multiple complications



that occurred during the two year surveillance and active treatment: urinary tract infections with various infectious agents (E. Coli, Kl.spp, Proteus.spp), clostridial enterocolitis. The patient developed a febrile episode during one of the hospitalizations and was diagnosed with right renal hydronephrosis (II – second grade) and bilateral renal lithiasis, more severe in the right kidney. Following this episode the patient needed a tight interdisciplinary urological collaboration, finalized with multiple interventions of JJ urinary stent mounting and lithotripsy.

The long-term neurorehabilitation program which involved successive admissions, often marked by complications, has achieved the following results in the present:

The patient is orally fed, without swallowing problems. From the psycho-cognitive point of view, the patient has gradually regained a state of consciousness. Currently he is partially oriented to place and person, verbally communicates his needs and cooperates, understands and performs simple orders. The cognition and short-term memory impairment persist and the integration in the socio-professional sphere is currently impossible. From the locomotor point of view, a noticeable improvement in motor control and muscle strength has been achieved: -4/5 MRC at all levels of the right hemibody and +3/5 MRC for the left hemibody. In the context of the posttraumatic lesion of the left shoulder, we consider that the persistence of a diminished muscle force in the intermediate and distal segments of the left upper limb (2/5 MRC) might have a medical explanation; for this diagnostic elucidation an electromyographic testing is needed to be performed. During the neurological evolution the pyramidal syndrome installed progressively. The average spasticity (3/5 Asworth) is treated by the continuity of the kinetic program and with appropriate pharmaceutical drugs. The patient has an important deoposturation of the head, which he cannot maintain straight in the ortostatic posture, still, he can maintain the orthostatic posture, perform the transfers from the bed to the wheelchair and back and can achieve short-distance locomotion (20 m), all with unilateral manual support from a person.

In terms of comorbidities, the patient is in the care of a urologist for the specialized treatment of urinary tract complications.

Clinical-functional evaluation at first admission	Clinical-functional evaluation at last admission
1) FAC scale = 0; GOS scale = 2; RANKIN scale = 5;	1) FAC scale = 2; GOS scale = 3; RANKIN scale = 4;
2) FIM scale MOTOR FIM = 27 COGNITIV FIM = 5	2) FIM scale MOTOR FIM = 37 COGNITIV FIM = 17
3) MMSE scale, QOL (Quality of Life) scale = Untestable	MMSE scale = 14 QOL scale = 66

Figure 4: Evaluation scales at first admission and last admission

## Discussion

In the efficient assessment of a polytrauma case, the rehabilitation physician intervenes in the moment when the patients' vital functions have been stabilized, sometimes after surgical interventions in the neurosurgery sphere. His role is to evaluate both the lesional diagnosis, the multisystemic condition and the actual complications, as well as the level of functional dependence and cognitive and social skills of the polytraumatized patient [5]. Depending on their particularities and also on the needs of the patient, the objectives of the short-term, medium and long-term therapeutic-recovery program, performed in larg teams, are established. These are desired to lead to an individualized improvement of the quality of life of the patient[5].

The results of the neurorehabilitation program in this case of polytrauma associated with severe neurological lesions produced a marked improvement in reducing the degree of dependence and disability of the patient.

The families remain the important stimulus of activity and participation of these patients, through persistent and long-lasting efforts of adaptation to their new neuro-psycho-somatic condition. In this way, they prepare the ground for the society to perceive the persons with special needs and to further validate them for community integration. [5]

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