

SHORT COMMUNICATION

FEVER DURING POST-ACUTE REHABILITATION IN PATIENTS WITH BRAIN INJURY

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Objective: To investigate the incidence of fever during the post-acute rehabilitation phase in patients with brain injury.

Design: Prospective study.

Subjects: Seventy-four patients with brain injury.

Methods: Patients were evaluated for the presence of fever during the rehabilitation phase. Demographics, time since injury, acute hospital and rehabilitation stay, brain injury and clinical characteristics were recorded for all subjects.

Results: Of the study group, 36 patients (36/74; 48.6%) had at least 1 event qualified as fever. The most common cause of fever was urinary tract infection. There were only 2 patients considered as having central fever. Fever was significantly more frequent in patients with a greater number of neurological impairments, more severe neurological impairments and a lower level of independence. The rehabilitation stay was prolonged in patients with fever. The average length of rehabilitation stay was 62.5 days and 49.8 days in patients with or without fever, respectively.

Conclusion: Infection is the most common cause of fever after brain injury and the incidence of central fever is low.

Key words: fever, brain injury, rehabilitation.

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INTRODUCTION

Fever is a common complication of brain injury and frequently occurs in the acute phase and to a lesser extent in the subacute phase of recovery (1). Management and treatment of such fever differs little from that in patients without brain injury. Although it is tempting to attribute fever in brain injury to central dysfunction, this type of hyperthermia is relatively uncommon, occurring in just 4% of patients in one series (2). A thorough and complete work-up is needed to establish other more common aetiologies. It is reasonable to consider infection as the most likely cause, since an individual with brain injury is susceptible to various complications such as urinary tract infection, aspiration pneumonia and atelectasis. Associated injuries make

the individual subject to multiple procedures and instrumentation, such as intracranial, abdominal and orthopaedic surgeries, ventriculostomy, intubation, central venous catheterization and bladder catheterization. Immobility adds to the risk of infection (3). Other, less common causes of fever include medication, intracranial infection, deep vein thrombosis, paranasal sinusitis, heterotopic ossification, endocarditis, occult abscess, spasticity, hydrocephalus and increased intracranial pressure (2, 4).

The aim of this study was to define the incidence of fever in patients with brain injury during post-acute rehabilitation. The relationship between fever and demographics, brain injury and clinical characteristics and length of rehabilitation stay were also identified.

PATIENTS AND METHODS

Seventy-four consecutive brain-injured patients admitted to our centre over a period of 18 months were evaluated prospectively. Demographics, time since injury, acute hospital and rehabilitation stay and associated non-neurological injuries were recorded for all subjects. Injury types included traumatic and anoxic brain injuries. Severity of injury was determined according to the report from the acute care hospital or information from the patients' carers about the length of amnesia and unconsciousness. Mild injury was post-event amnesia of 1–24 hours, moderate injury was post-event amnesia of 1–7 days, and severe injury was post-event amnesia of more than 7 days (3). The 3 groups of neurological impairment types included patients with hemiplegia, ataxia, hemiplegia or tetraplegia with ataxia or other movement problems. Level of independence regarding mobility and locomotion were as follows; totally dependent, wheelchair-bound, ambulation with devices or independent.

Fever assessments were performed by a licensed nurse and fever was defined as any core temperature higher than 36.5°C (5). Axillary temperatures were recorded every 8 hours. Diagnostic work-up of hyperthermia in individuals with brain injury included physical examination, complete blood count with differential count, urinalysis and culture, blood cultures if bacteraemia was suspected, chest radiographs if indicated and other diagnostic examinations as indicated by clinical examination. Some of the causative categories that were reviewed were as follows: urinary tract infection, upper respiratory tract infection, atelectasis/pneumonia, wound infection, heterotopic ossification, deep vein thrombosis and others, such as drug reaction, sepsis, cellulitis, abscess and enteritis. The treatments were started accordingly and the fever was considered to be unexplained if the causative factor could not be determined.

SPSS Software Package was used for statistical analysis. The results were presented as descriptive statistics. Chi-square tests and independent sample *t*-tests were used to compare patients with or without fever for several variables.

Table I. Demographic and injury characteristics of the study group (n = 74)

	Mean (SD)	Median
Age (years)	27.9 (15.3)	26
Length of brain injury (days)	187.7 (117.6)	142.5
Length of acute hospital stay (days)	45.7 (35.6)	34.5
Length of rehabilitation stay (days)	55.9 (35.9)	48.5
	<i>n</i>	%
Gender		
Women	12	16.2
Men	62	83.8
Type of injury		
Traumatic	64	86.5
Anoxic	10	13.5
Severity of injury		
Mild	7	9.5
Moderate	28	37.8
Severe	39	52.7

RESULTS

The demographics and injury characteristics of the patients are shown in Table I. The most common associated non-neurological injury was bone fracture (27%), followed by organ damage (9.5%). One patient also had thoracic spinal cord injury. There were 15 patients with hemiplegia, 19 with ataxia and 40 with hemiplegia or tetraplegia with ataxia or other movement problems. Of the 74 patients, 10 were totally dependent and 20 were wheelchair-bound. Twenty-six patients were able to ambulate with walking aids, whereas 18 were independent. Thirty-six patients (48.6%) had at least 1 event that qualified as fever during their stay. In the whole study group there were 58 events qualified as fever. An origin of fever was found for 34 patients and Table II shows the causes. The most frequent cause of fever was urinary tract infection, followed by upper respiratory tract infection. Of the 34 patients with fever, 12 had a urinary catheter, whereas there were only 4 with catheter in the group without fever ($p=0.036$). Despite the detailed clinical evaluation and diagnostic work-up we were unable to demonstrate the cause of fever in only 2 patients (2.7%). We were able to manage the central fever in these patients by using cooling methods and antipyretics.

Table II. Causes of fever in 34 patients

	<i>n</i>	%
Urinary tract infection	13	38.2
Upper respiratory tract infection	8	23.5
Heterotopic ossification	2	5.9
Pressure ulcer	2	5.9
Deep vein thrombosis	1	2.9
Pneumonia	1	2.9
More than 1 aetiology (UTI, URI, HO, DVT, or pressure ulcer)	7	20.6

UTI = urinary tract infection; URI = upper respiratory tract infection; HO = heterotopic ossification; DVT = deep vein thrombosis.

There was no relationship between the presence of fever and age, gender, type of brain injury and the presence of non-neurological injury. The average length of rehabilitation stay in patients with or without fever was 62.5 days and 49.8 days, respectively, and this difference was not significant. We carried out further analysis to determine whether this longer stay was due to the increased rehabilitation needs of patients with associated non-neurological injuries. The length of rehabilitation stay was insignificantly a week longer in patients with both non-neurological injuries and fever compared with the patients without such findings. Additionally, the average of rehabilitation stay was only 2 days longer in patients with fractures or organ damage but without fever. The patients with more neurological impairments, more severe neurological impairments and lower level of independence tended to have a higher incidence of fever ($p=0.015$).

DISCUSSION

The differential diagnosis for fever of unknown origin is extensive and includes infectious, neoplastic, autoimmune, granulomatous, metabolic, inherited, psychogenic, periodic and thermoregulatory disorders (6). The list of likely sources of fever after brain injury is less extensive, but the same framework is often useful for accurate diagnosis (7).

Urinary tract infections affect approximately 40% of traumatic brain injury survivors during the rehabilitation phase of recovery and ureteral obstruction is seen in approximately 1% of patients. Other potential genitourinary sources of fever include pyelonephritis, perinephric abscess and prostatic abscess (8). Clinchot et al. (9) found that the urinary tract infections were the most common cause of fever after brain injury. Approximately 34% of brain injury survivors develop respiratory complications that predispose to pulmonary infections (8). Endotracheal and tracheostomy tubes predispose patients to bacterial colonization and a greater risk of secondary lung infection. Enteral feeding may also increase the probability of aspiration pneumonia by as much as 25% (10). In Clinchot's study the incidence of fever attributed to respiratory complications was high in subjects with aneurysmal subarachnoid haemorrhage; almost half of the explained fevers had this origin (9).

In our study, the incidence of fever was quite high. The most common cause was urinary tract infection followed by upper respiratory tract infection. Thirty-three percent of patients with fever had a urinary catheter, which highlights the importance of neurogenic bladder evaluations and of implementing better ways of bladder management. Our patients had upper respiratory tract infection as the most common second cause of fever, there was only 1 case of pneumonia, which might be explained by late admission of our patients when compared with the above studies.

A few of our patients had fever because of heterotopic ossification, deep vein thrombosis or pressure ulcers. These results are compatible with other reports (9).

There are a few reports about central fever as a manifestation of thermoregulatory dysfunction after traumatic brain injury

both during the acute phase and rehabilitation phase (11–13). In our sample, there were only 2 patients with unexplained fever events. Thermoregulatory dysfunction, which is a well-known sequelae of acute traumatic brain injury, is explained by the high incidence of hypothalamic lesions after brain injury (1, 14–16). The hypothalamus is believed to be the temperature regulatory centre of the brain. Through multiple cortical and subcortical connections, the hypothalamus is able to keep the core temperature in a defined narrow range. Hypothalamic dysfunction can often lead to wide fluctuations in core body temperature. Central fever usually results in a modest temperature elevation. In some cases, it can present as temperature lability. The decision to treat central fever depends partly on the degree of temperature elevation as well as the time since brain injury. There is evidence suggesting that treatment is the more prudent course, especially during the early period after the injury, since the elevation of body temperature is associated with increased metabolic demands, exacerbation of neuronal excitotoxicity and disruption of the blood-brain barrier. Management includes the use of cooling blankets and antipyretics. Other medications that have been used include dopaminergics (bromocriptine, amantadine), dantrolene sodium, chlorpromazine, clonidine and propranolol (1, 3, 10).

This study of 74 subjects with brain injury revealed that fever during the post-acute rehabilitation phase might be an important problem and it might cause prolongation in rehabilitation length of stay. Additionally, our results suggest that fever is more common in patients with more severe neurological impairments and severe injury. Urinary tract infection was the most common cause of fever and there were only 2 patients with central fever. We believe that evaluation of fever during rehabilitation after brain injury must exclude the treatable conditions before a diagnosis of central fever is reached as there is a high incidence of explained fever events compared with a much lower incidence of unexplained fever events.

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