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Literature Review

Fatigue Models and Poststroke Fatigue: A Literature Review

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Abstract

Poststroke fatigue (PSF) is a common complication affecting a wide range of stroke patients, yet it remains under-reported and underestimated. PSF's exact underlying cause has not yet been identified and it seems to be multifactorial, with several models developed to answer that question. Identifying the true nature of PSF and its risk factors would help improve the quality of life of stroke patients.

***Keywords:** Fatigue, Models, PSF, Poststroke fatigue*

Introduction

Stroke is one of the main reasons for long-term adult disability throughout the world [1]. Chronic affective symptoms like mood disturbance, pain, and fatigue significantly impact the quality of life and are more difficult to manage [2].

Poststroke fatigue (PSF) is a common and disabling consequence of stroke [3]. PSF affects 25-85% of stroke patients, the wide range is due to different scales in studies [4]. PSF prohibits patients from living their ordinary lives as it affects their quality of life negatively [3] and is associated with a decreased likelihood of return to work, and a higher risk of death, with about 40% of stroke survivors reporting fatigue as their worst or one of their worst symptoms [5, 6]

Literature Review

Everyone understands and has experienced fatigue; however, defining fatigue for study purposes of quantification and comparison among individuals is quite difficult. Hinkel and colleagues provided a definition of fatigue as “a subjective lack of physical or mental energy or both that the individual perceives to interfere with the usual or desired activities” [7]. Annoni states fatigue is a multidimensional motor-perceptual, emotional, and cognitive experience [8].

Staub and Bogousslavsky defined fatigue as a “decrease or loss of abilities associated with a heightened sensation of physical or mental strain, even without obvious effort, an overwhelming feeling of exhaustion, which leads to inability or difficulty to sustain even routine activities and which is commonly expressed verbally as a loss of drive” [9]. All of the preceding definitions demonstrate that fatigue can be determined by a person's subjective perception of the state of one's inner resources as well as the nature of the action being performed.

Fatigue Models

To explain the causes of fatigue, several models have emerged. In 1989, Funk and colleagues proposed a neurophysiological model to describe fatigue in terms of central and peripheral nervous system components [4]. They suggested that central component impairment leads to decreased motivation and transmission of signals from the brain and spinal cord. Additionally, it leads to the exhaustion of brain cells in the hypothalamic region. When the peripheral component is impaired, it can alter complex biochemical interactions between muscles and nerves that produce the force of movement [10].

The physiological model of fatigue was developed in 1992 after St. Pierre and colleagues showed that physical symptoms of fatigue could be explained by changes in metabolite concentration level [11]. In 1993, a viral damage model was proposed as a study indicates that viral damage to the neurons of the reticular activating system impairs attention span and causes "brain fatigue" [12].

Piper fatigue model addressed the multidimensional nature of fatigue by distinguishing between objective dimensions (behavioral, biomechanical, and physiological) and the subjective dimension of fatigue; with 7 subdimensions (temporal, affective, evaluative, intensity, sensory, associated symptoms, and relief) [13].

In 1999, the Portenoy integrated fatigue model was conducted which consists of physiologic (systemic disorder and disease treatment) and psychosocial dimensions (anxiety and depressive disorders) and several potential contributing factors (underlying disease, chronic pain, and sleep disorder) [14]. This fatigue model can be applied to various clinical populations, such as poststroke fatigue, because of several overlapping factors.

Poststroke fatigue

Poststroke fatigue (PSF) is a common and disabling consequence of stroke [3]. Resistance to rest is one of the key distinctions between physiological and pathological fatigue, as PSF is being reported by patients as a distinctly different experience from pre-stroke 'normal' fatigue [3]. PSF was described as significant fatigue with a lack of mental and/or physical energy which interferes with daily activities [15]. It was proven to be reliable and valid in identifying clinically significant fatigue among stroke survivors [16].

a. Multiple longitudinal studies [17-21] have shown that PSF can take any of the following courses:

b. Early fatigue: fatigue at the initial evaluation, usually within the first 3 months following a stroke.

c. Late fatigue: Fatigue started to develop later in the follow-up process.

Persistent fatigue: patients with early fatigue that persist to a later stage, usually beyond 1 year following a stroke.

Risk factors of poststroke fatigue

Multidimensional factors contribute to PSF [7]. Elderly patients [22, 23], females [24, 25], and patients who lack social support [26] are more prone to PSF. Pre-stroke fatigue is considered as a predisposing factor for PSF [27]. Pre-stroke fatigue may worsen PSF intensity because those patients tend to have other medical comorbidities [28].

Medical comorbidities to stroke itself such as heart failure and kidney disorders [25] may influence PSF, but neither hypertension [29] nor diabetes mellitus [30] was related to PSF. Depression and PSF had a strong relationship [31]. The effect of depression on PSF may vary according to the phase of the stroke. Though stroke severity and neurological disability cause exertional fatigue in the early phase of stroke [20], depression appears to play an important role in the long-term phases of stroke [32]. Drugs used in management as hypnotics [33] and antidepressants [34] were correlated to fatigue.

Based on previous studies, they found that impairment of attention [20], executive functions, or memory [35] is related to the mental component of PSF. Sleep disturbances, pain, and cognitive impairment were suggested to contribute to PSF [36, 37]. Most previous studies didn't find a relationship between stroke type or location and PSF [38]. Snaphaan's study only found an association between lesion location (particularly infratentorial) and early but not late fatigue [19]. Glader and colleagues found that patients with recurrent stroke have a greater risk for PSF than first-stroke patients [39].

Management of poststroke fatigue:

The exact reasons why patients develop fatigue are largely unknown [5]. PSF has a complex and multifactorial etiology that necessitates a personalized approach to treatment [33]. There is insufficient evidence to support pharmacological or non-pharmacological interventions for the management of PSF. [26]. Multidisciplinary teams containing different professionals including physicians, psychologists, nurses, nutritionists, physical and occupational therapists, and counsellors are essential to effectively address the many aspects of fatigue.

Non-pharmacological interventions

Given the complex nature of PSF, it makes sense to hypothesize that non-pharmacological approaches, such as fatigue education, healthy nutrition, physical exercise, sleep intervention, relaxation techniques and meditation, biofeedback, music therapy, and recreational therapy may be beneficial [40]. A pilot study suggested that a group education program comprising fatigue management strategies, sleep hygiene, relaxation exercise, physical exercise, and healthy nutrition significantly improved PSF symptoms [41].

The American Heart Association and American Stroke Association suggest that a sedentary lifestyle may worsen PSF and encourage physical activity. [42]. Graded physical activity programs are recommended for treating PSF. Exercise improves both physical and functional outcomes and reduces fatigue [42, 43]. Aerobic exercise is recommended by the guidelines for adult stroke rehabilitation and recovery as a means to lower PSF. [44].

Pharmacological interventions

Pain management helps improve PSF, encouraging participation in exercises that improve pain-related mood disturbances [45]. Antidepressants commonly used to treat poststroke depression, including fluoxetine, citalopram, duloxetine, and sertraline, have been found ineffective in improving PSF despite their beneficial effects on related emotional disturbances [46]. The evidence suggests that the serotonergic system may not be as strongly connected to PSF as it is to emotional disorders. This indicates that PSF, depression, and anxiety may be distinct phenomena. However, mental therapies like antidepressants or counseling may help address the mental aspects of fatigue [45].

Supplementation with vitamins has been reported to have a positive impact on improving PSF [7]. Three vitamins are being considered: B12, B1, and idebenone (synthetic coenzyme Q10 analog). One observational study found that vitamin B12 deficiency was linked to fatigue in lacunar stroke and that vitamin B12 supplementation may be an effective strategy for alleviating fatigue in these patients [47]. One small trial reported that enerion, a synthetic derivative of vitamin B1, was effective in reducing PSF [7]. Antioxidant idebenone, a synthetic coenzyme Q10 analog, was reported to be effective in improving PSF [26].

Modafinil is a wakefulness-promoting agent that regulates neuroendocrine pathways, stimulates monoaminergic pathways, and has neuroprotective properties. Its use can significantly improve quality of life and reduce PSF without significant adverse events [48].

Conclusion

In recent years, a lot of studies have been done to investigate either predictors or the impact of poststroke fatigue. PSF determinants reported in previous studies were depression [34], neurological deficit [7], infarction site [30], pain [33], and many biological factors and systemic inflammation [38].

Till now, Health professionals and stroke survivors alike have ranked the method of managing PSF as one of the top 10 research priorities relating to life after stroke [24]. The exact reasons why patients develop fatigue are largely unknown [5]. It is suggested that PSF has a multifactorial etiology and therefore may require person-centered treatment [33].

Conflict of Interest

The authors declare no conflict of interest.

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