Considerations for treatment, diagnosis and risk factors for critical care polyneuropathy

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Introduction

Critical care polyneuropathy is a destructive complication which may occur in patients admitted to an intensive care unit (ICU) post severe burn injury [1]. Henderson et al.[2] first described this phenomenon in burns patients. Critical care polyneuropathy is defined as neuromuscular weakness which develops in patients who are critically ill requiring ventilation for longer than seven days. This neuromuscular abnormality does not have a specific aetiology [3], and in the literature is referred to in varying terms such as peripheral polyneuropathy [2], severe peripheral burn polyneuropathy [4], critically ill polyneuropathy [5], critical illness polyneuropathy [1], severe multiple mononeuropathy [6] and critical illness polyneuromyopathy [7]this compounds the research process. Early diagnosis of critical care polyneuropathy in the ICU setting and early rehabilitation are fundamental to reducing long term disability [8]. The aim of this integrative review is to identify the precipitating factors that contribute to development of critical care polyneuropathy in patients who have sustained a burn injury.

Methods

Inclusion Criteria

Original research and case reports published in the English language that identify the precipitating factors that contribute to development of critical care polyneuropathy in patients who have sustained a burn injury

Exclusion Criteria

Studies reporting mononeuropathy were excluded as mononeuropathy is attributed to localised factors such as local debridement of the burn wound [5].

Literature Research Strategy

A systematic search was undertaken using the following electronic databases PubMed, Scopus, CINHAL and EMBASE. Time frame restrictions were not placed upon this search due to limited published literature in this area. Excluded from the review were opinion pieces, letters to the editor and grey literature .

Data Extraction and synthesis

A total of 10 studies were summarised and systematically synthesised. The reference lists of 8 included studies were also reviewed which resulted in identifying an additional two studies. Case reports were summarised separately to remaining studies.

Results

Study Characteristics

The studies included in this paper were retrospective cohort studies (n=4) including one cross sectional study, single case reports (n=3), prospective cohort studies (n=2) and a retrospective chart review (n=1). No meta-analyses or randomised control trials were identified therefore available evidence was generally low (level III and IV). One study was published 45 years ago adding complexity to the evaluation of evidence. The majority of these studies were published prior to 2000 highlighting the paucity of evidence in the area of critical care polyneuropathy in burns. Collation of a pool data set was limited by the lack of necessary data in these studies. The sample sizes varied widely in each study (n=1 to n= 44) thus indicating overall small sample size. Flame burn was the most frequent mechanism of injury followed by electrical injuries. The age range of patients included in these studies was 15-76 years. Total Body Surface Area (TBSA) % ranged from 14% to 85% with burn depth classified as deep dermal to full thickness. Table 1 includes the pooled data from across the studies and demonstrates descriptive statistics for the cohort and prospective studies.

Case report

All three patients in the case reports were male with an age range of 19 to 30 years. The TBSA % involved ranged from 20-45% with burn depth classified as deep dermal to full thickness. All patients had bilateral upper and lower limb involvement. Each case recorded electromyography (EMG) and nerve conduction studies (NCS) findings.

Prolonged ventilation and development of critical compilations were described with observations of muscle wasting of limbs noted and a clinical diagnosis suspected between four and seven weeks post burn injury

Risk factors for development of critical care polyneuropathy

Length of stay (LOS) was identified as a risk factor for development of critical care polyneuropathy, two of the case reports noted LOS of 91 days and 12 weeks and five of the primary studies recorded LOS up to 301 days. Ventilation times were poorly described in the included studies with only three primary studies reporting ventilation times longer than seven days. Chan et al.[1] study identified issues weaning from ventilator support. Burn depth was an influential element observed across all studies as a risk factor. Four studies reported sepsis as a significant complication. It was noted in three of the studies and two of the case reports that efforts were made to ensure dressing, splinting and positioning did not contribute to the development of critical care polyneuropathy. Chan et al.[1] identified that the presence of burn wounds limited the use of NCS with three patients not receiving this diagnostic evaluation. Oedema was considered a risk factor for development of critical care polyneuropathy in eight of the included studies.

Clinical and electrodiagnostic testing for critical care polyneuropathy

In this integrative review clinical assessment varied across each study and case report. Only two studies reported using manual muscle testing as a method to assess muscle strength. Details of clinical assessments utilised were lacking throughout the studies. Methods of measuring muscle wasting were inconsistent or omitted, thus making comparisons between studies difficult. However EMG and NCS were well reported on in both the primary studies and case reports. However the timing and intervals between testing was inconsistently reported thus brining a challenge to determine the appropriate timing of these assessments.

Outcome and follow up

There was general consensus in the studies and case reports that sensory deficits remained in the upper and lower limbs however never re-innervation occurred within the first 24 months post burn injury. The time frame required for resolution of sensory deficits was not defined, therefore difficulty arises in determining if these deficits are permanent. Long term follow up was reported in only one case report and three primary studies leading to inadequate information regarding patient outcomes and highlighting disparity in the duration and intensity of rehabilitation required

Discussion

The aim of this integrative review was to identify the precipitating factors that contribute to the development of critical care polyneuropathy in patients with a severe burn injury. Critical care polyneuropathy remains difficult to diagnose and treat in the burns population. There was inconsistent reporting of these methods in the included studies and this did not enable cross study analysis or comparisons. To date no specific assessment scale has been developed to measure the severity of critical care polyneuropathy [9]. Duration of mechanical ventilation required and severity of burn injury were identified as risk factors contributing to the development of critical care polyneuropathy. Inadequate details pertaining to clinical testing poses challenges to determine patient outcomes post development of a critical care polyneuropathy in conjunction with a severe burn injury. EMG and NCS are the most prominent electrodiagnostic test to confirm critical care polyneuropathy however it is recommended that these tests are used to determine outcomes in the future. Critical care polyneuropathy in burns remains poorly defined and understood, this can be attributed to multiple terms being used to describe this phenomenon. This review included a small number of primary studies and case reports demonstrating the need for further research in this area.

					Age		%TBSA			Mean days			Incidence
Study	Year	Survey	n	%Male	Mean	sd	Mean	sd	Sepsis	ICU	Ventilation	LOS	(%)
Taman et al	2013	648	15	47%	30	20.2	37.1	12.5	-	-	-	-	2.3%
Chan et al[1]	2010	-	7	100%	34.1	16.3	38.4	17	100%		42	85	-
Lee et al	2008	868	16	-	46	21.0	29.7	20	-	-	46	86.9	1.8%
Kowalske et al	2001	572	18	67%	46.09	-	51.4	-	-	26	15.5	-	3.1%
Margherita et al	1995	297	19	-	-	-	24.4	14.3	-	-	-	-	6.4%
Dagum et al	1993	121	9	9%	38.4	-	52.2	11.8	78%	-	-	-	7.4%
Henderson et al	1971	249	44	-	41	-	43.6	20	-	-	-	120	17.7%
Summary		**2755**	**128**	**71%**	**40.4**		**39.7**						**4.4%**

Table 1: Descriptive statistics and incidence for included cohort and prospective studies

Conclusion

Critical care polyneuropathy is a significant and debilitating condition. Patients who sustained a larger and more severe TBSA % burn injuring requiring management in the ICU setting including ventilator support are at risk of developing a critical care polyneuropathy as a complication. This integrative review highlights the need for further long term studies investigating quality of life and functional outcomes.

The authors declare no known conflicts of interest associated with this publication

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