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Original Article

Clinical characteristics affecting motor recovery and ambulation in stroke patients

Alparslan Yetisgin, MD[1)]

[1)] *Department of Physical Medicine and Rehabilitation, Harran University Medical School: Sanliurfa, Turkey*

Abstract. [Purpose] To describe the clinical characteristics affecting motor recovery and ambulation in stroke patients. [Subjects and Methods] Demographic and clinical characteristics of 53 stroke patients (31 M, 22 F), such as age, gender, etiology, hemiplegic side, Brunnstrom stage, functional ambulation scale scores, history of rehabilitation, and presence of shoulder pain and complex regional pain syndrome were evaluated. [Results] The etiology was ischemic in 79.2% of patients and hemorrhagic in 20.8%. Brunnstrom hand and upper extremity values in females were lower than in males. Complex regional pain syndrome was observed at a level of 18.9% in all patients (more common in females). Brunnstrom hand stage was lower in complex regional pain syndrome patients than in those without the syndrome. Shoulder pain was present in 44.4% of patients. Brunnstrom lower extremity values and functional ambulation scale scores were higher in rehabilitated than in non-rehabilitated cases. [Conclusion] Brunnstrom stages of hand and upper extremity were lower and complex regional pain syndrome was more common in female stroke patients. Shoulder pain and lower Brunnstrom hand stages were related to the presence of complex regional pain syndrome.

Key words: Stroke, Functional ambulation scale, Brunnstrom stage

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INTRODUCTION

The World Health Organization (WHO) has defined stroke as a focal or generalized neurological deficit related to vascular causes that develop suddenly with the impairment of cerebral function, lasting for more than 24 h, which may result in death within this period[1)]. Stroke is a primary cause of mortality, leading to the death of 6 million people worldwide annually[2)]. Two-thirds of patients experiencing stroke for the first time can survive, and various levels of complications develop in about half of these survivors[3)].

The most common sign of stroke is paralysis[4)]. Although it varies, according to the affected site of the brain, it most commonly presents as hemiplegia. Hemiplegia can be defined as a clinical pattern that may cause a loss of voluntary movement in the contralateral side of the body, sensory disorders, and various neurological signs that are due to vascular lesions in the brain[5)].

The Brunnstrom staging system is used to evaluate motor functions in stroke patients[4)], which describes the process of recovery with synergic models, includes six stages for evaluating the hands and upper and lower extremities[6)]. The functional ambulation scale (FAS) is commonly used to evaluate levels of patient ambulation[7)].

Complications related to the upper extremities develop in many patients following stroke, and among these, shoulder problems are the most important. The primary cause is impairment of shoulder biomechanics due to stroke, and shoulder pain is present in 24% of the patients[4)]. Another common upper extremity problem observed after stroke is complex regional pain syndrome (CRPS). Various studies have reported that CRPS may develop in 12–34% of patients after stroke, between

Corresponding author. Alparslan Yetisgin (E-mail: dra_yetisgin@yahoo.com)

the 2nd week and 15th month[8, 9].

We evaluated the clinical characteristics (including shoulder pain and CRPS) affecting motor recovery and ambulation in stroke patients who were admitted to a physical medicine and rehabilitation (PMR) outpatient clinic, who had experienced a stroke within the previous year, and who had hemiplegia as a complication.

SUBJECTS AND METHODS

Medical records held at the PMR outpatient clinic of Harran University Medical School from January 2015 to May 2016 were investigated retrospectively by the same physician. The consent of the Harran University local ethics committee was obtained prior to the study.

Among the 13,502 records, 223 were related to stroke patients with hemiplegia. The patients older than 18 years and who had experienced stroke for the first time within the previous year were determined. Those patients with a history of neurological pathologies, such as Parkinson's disease, multiple sclerosis, poliomyelitis, myopathy, polyneuropathy, head trauma, spinal cord/brain tumor, and brain metastases that may affect present functional status, and those with hip/knee prostheses and a history of malignancies, were not included. Patients who could not walk independently without support before the stroke, and those who could not be optimally examined in the clinic for reasons such as limitations in cognitive functions and hearing problems were also excluded. In the patients who were seen at our clinic more than once between the investigation dates, signs determined at the last admission were included. Beyond the evaluation of the demographic and clinical characteristics of the patients, such as age, gender, etiology (ischemic/hemorrhagic), and hemiplegic side, they were also investigated for Brunnstrom stages, FAS scores, history of rehabilitation application following stroke, shoulder pain, and the presence of CRPS in the upper extremities, and relationships among these variables were evaluated.

All patients received rehabilitation program five times a week for one month. The rehabilitation program was set individually acoording to the patient's status, consisting neurophysiological exercises, range of motion exercises, posture, balance, and gait training, and ergotheraphy.

All data were recorded in the SPSS software (ver. 18; SPSS Inc., Chicago, IL, USA). Results are expressed as means ± SD or medians (minimum–maximum). The Kolmogorov-Smirnov test was used to determine whether the measured variables were normally distributed. Student's t-test was used in the analysis of measured parametric data. Categorical variables were compared using the χ^2 or Fisher's exact test, as appropriate. Relationships between variables were defined using Pearson's correlation analysis. A p value<0.05 was considered to indicate statistical significance.

RESULTS

Demographic and clinical characteristics of the patients are summarized in Table 1. We investigated the records of the 53 patients with hemiplegia (31 males, 22 females) who met the study criteria. The etiology was ischemic in 79.2% of the patients, whereas it was hemorrhagic in 20.8%. The mean age of the patients with ischemic strokes (61.7 ± 12.6 years) was higher than those with hemorrhagic strokes (53.3 ± 14.3 years), although this difference was not statistically significant (p>0.05). The mean age, etiology, whether rehabilitated, hemiplegic side, and duration after stroke were similar in male and female patients (all p>0.05), whereas the Brunnstrom hand and upper extremity values in female patients were lower than in males (both p<0.05). CRPS was observed in 18.9% of all patients; it was more common in females than in males (p=0.011).

Demographic and clinical characteristics of the patients with and without CRPS are summarized in Table 2. Only the Brunnstrom hand stage was lower in patients with CRPS than in those without (p=0.029). Shoulder pain was present in 44.4% of patients. Age, Brunnstrom stage, and FAS score did not differ between patients with and without shoulder pain (all p>0.05). The duration after stroke was longer (but not statistically significantly so) in patients with shoulder pain (6.9 ± 2.8 months) than in those without shoulder pain (5.1 ± 3.7 months; p>0.05). Only shoulder pain was associated with the presence of CRPS (more common in the cases with shoulder pain; p<0.001).

When the patients were grouped in terms of being rehabilitated or not, the mean ages were similar (p>0.05), while the duration after stroke was longer in rehabilitated cases (6.7 ± 3.2 months) than in non-rehabilitated ones (3.4 ± 2.8 months, p=0.002). The Brunnstrom lower extremity value [4 (2–5)] and FAS score [3 (0–5) vs. 1.5 (0–5)] were higher in rehabilitated than in non-rehabilitated cases (p 0.005 and 0.002, respectively).

DISCUSSION

In this study, the Brunnstrom stages of the hands and upper extremities were lower in females with stroke than in males. The frequency of CRPS was also higher in females. When the Brunnstrom stages were evaluated in all patients with CRPS, only the Brunnstrom hand stage was lower than in those without CRPS. Shoulder pain was also more common in patients with CRPS. The Brunnstrom lower extremity stage and FAS score were better in rehabilitated than in non-rehabilitated patients.

The stroke etiology was ischemic in 79.2% of our patients; this result was consistent with those in the literature, namely, that 80–90% of all strokes are due to ischemia[10]. The mean age of the cases with ischemic stroke was higher than that of

Table 1. Demographic and clinical characteristics of the patients

	Males (n=31)	Females (n=22)
Age (years)	59.9 ± 11.1	60.0 ± 16.1
Etiology (ischemic/hemorrhagic)	24/7	18/4
Hemiplegic side (L/R)	16/15	14/8
Duration after stroke (months)	6.5 ± 3.7	5.0 ± 2.7
Patients being Rehabilitated	22/31	18/22
Brunnstrom stages		
Hand *	4 (1–6)	2 (1–5)
Upper extremity **	4 (1–6)	2 (1–5)
Lower extremity	4 (2–5)	3 (1–6)
FAS	3 (0–5)	1.5 (0–5)
Presence of shoulder pain	12	12
Presence of CRPS ***	2	8

Data are means ± SD, medians (min–max), or ratios.
L: left; R: right; FAS: functional ambulation scale; CRPS: complex regional pain syndrome
*p=0.046, **p=0.010, ***p=0.011

Table 2. Demographic and clinical characteristics of the patient groups according to the presence or absence of complex regional pain syndrome (CRPS)

Characteristics	Patients with CRPS (n=10)	Patients without CRPS (n=43)
Age (years)	60.6 ± 16.2	59.8 ± 12.7
Gender (F/M) *	8/2	14/29
Etiology (ischemic/hemorrhagic)	9/1	33/10
Hemiplegic side (L/R)	8/2	22/21
Duration after stroke (months)	6.6 ± 2.7	5.7 ± 3.5
Patients being Rehabilitated	9/10	31/43
Brunnstrom stage		
Hand **	2 (1–5)	3 (1–6)
Upper extremity	2.5 (1–4)	3 (1–6)
Lower extremity	3 (1–5)	4 (1–6)
Functional ambulation scale	2 (0–4)	3 (0–5)
Presence of shoulder pain ***	10	14

Data are means ± SD, medians (min–max), or ratios.
F: female; M: male; L: left; R: right; FAS: functional ambulation scale
*p=0.011, ** p=0.029, *** p<0.001

the cases with hemorrhagic stroke; however, the difference was not statistically significant. A similar result was obtained by Soyuer et al.[11], reporting that the mean age of patients with ischemic stroke was higher than that of the cases with hemorrhagic stroke, but that the difference was not statistically significant.

Motor recovery in cases of stroke is more rapid in the early period; it occurs commonly within the first 3 months, and may continue until the sixth month[4]. A measurable recovery at the 12th month has been reported in only 5% of patients[12]. Our study included patients experiencing stroke within the previous year, and at least 1 month ago, because we sought to investigate the efficacy of rehabilitation over the course of this period in which functional improvement was maintained.

Many studies have reported that females experience strokes at more advanced ages and they have more severe clinical features[13–15]. Yildiz et al. did not find a correlation between gender and functional improvement[16]. There are also a few studies indicating that clinical features are more severe in male stroke patients[17]. This study indicated that the Brunnstrom hand and upper extremity stages were lower in females, so the clinical features were more severe in women.

In most patients who experience hemiplegia after stroke, the upper extremities are affected more than the lower extremities, and motor recovery is typically slower and to a lesser degree than in the lower extremities[18]. In our study, the Brunnstrom lower extremity stage was higher than that of the upper extremities, consistent with the literature. When we compared patients in terms of rehabilitation, the Brunnstrom upper extremity stage did not differ between rehabilitated and non-rehabilitated patients. Rehabilitated patients experienced stroke in a period nearly 3 months earlier, whereas the Brunnstrom lower extremity stage and the values of FAS differed. This result is also consistent with motor improvement in the lower extremities being more rapid and marked than that of the upper extremities, depending on the time after stroke and rehabilitation. Rehabilitation of the upper limbs is commonly less successful than that of the lower limbs; the main reason for this is that the upper limbs perform more complex functions.

A negative correlation was found between the degree of recovery in motor function in hemiplegic patients and the frequency of upper extremity complications[19, 20]. In our study, the Brunnstrom and FAS values did not differ between patients with and without shoulder pain. The small number of patients in our study and the inclusion of cases with certain criteria may have led to this result. Nadler et al. reported that shoulder pain developed within the first week in 17% of patients surviving a stroke, and within the first 4–6 months in 22–40% of them[21]. Aras et al. reported correlations between shoulder pain and advanced age and low Brunnstrom stages in stroke patients[22]. Çağlar et al. detected shoulder pain in ~24% of hemiplegic patients and stated that it was the most common type of pain[23]. In the current study, the corresponding level was 44%, within the wide range of 5% to 84% reported in the literature[24, 25]. In our study, the presence of shoulder pain was associated with an increasing frequency of CRPS.

In addition, in the present study, CRPS was significantly more common in women. All of the mean Brunnstrom and FAS values were lower in cases with CRPS in the upper limbs, although only the Brunnstrom hand value showed a statistically significant difference. The main risk factors for CRPS following stroke are shoulder subluxation, weakness in the upper limbs in the early period, spasticity, neglect, and visual field disorders[4]. Consistent with this, we found that shoulder pain was

more common and the Brunnstrom hand stages were lower in patients with CRPS. The level of CRPS in our study was 19%, consistent with levels reported in the stroke literature (12–25%)[26, 27]. The range in the literature may be related to the selected patient groups or diagnostic methods used. It has been reported that the prevalence of CRPS was not associated with gender or the involved side[19]. Gökkaya et al. noted that the Brunnstrom stages were lower, that glenohumeral subluxation was more common, and that the duration of hospitalization for rehabilitation was longer in stroke patients with CRPS[28]. We did not find a study investigating gender differences in the frequency of CRPS in stroke cases. Nevertheless, in a population-based study with a large sample size, the incidence and prevalence of type 1 CRPS were investigated, and the cases with stroke were included among the etiological causes; this study reported that CRPS was four times more common in women[29]. In the same study, the age at initiation did not differ between genders, and the gender-specific incidence rates were 8.6/100.000 per year in females and 2/100.000 per year in males[29]. In another study investigating the incidence of CRPS, it was reported that it was 3.4 times more common in females than in males; however, the gender distribution was reported to be similar in terms of the causes, except for fractures, the most common cause[30].

The major limitations of our study were its retrospective nature and the small number of patients. Furthermore, additional systemic diseases that might affect patient prognosis in terms of functional improvement could not be determined. Although we determined whether the patients had undergone rehabilitation, we did not assess whether present complications (e.g., shoulder pain, CRPS) were treated; this is another limitation.

In conclusion, the Brunnstrom stages of the hands and upper extremities were lower and CRPS was more common in female patients with stroke. The presence of shoulder pain and lower Brunnstrom hand stages were related to the presence of CRPS. Further studies conducted with larger sample sizes will help to confirm these findings and decrease the frequency of complications by determining predisposing factors more clearly.

Conflict of interest

The authors declare that they have no conflict of interest.

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