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Associated Movements in Hemiplegic Limbs during Yawning

Ramachandran Meenakshisundaram[a] · Ponniah Thirumalaikolundusubramanian[b] · Olivier Walusinski[d] · Arunachalam Muthusundari[c] · Shah Sweni[e]

[a]Madras Medical College, Chennai, [b]Chennai Medical College Hospital & Research Center, Trichy, [c]Tirunelveli Medical College, Tirunelveli, India; [d]General Practice, Brou, France; [e]University of Debrecen, Medical and Health Science Center, Debrecen, Hungary

Abstract

Background: Yawning is phylogenetically ancient and associated with a stereotyped behavioral pattern. **Objective:** To describe the pattern of associated movements observed in hemiplegic limbs during yawning and its relationship to gender, laterality of hemiplegia and muscle tone. **Material and Methods:** An observational study was designed for 75 patients with newly detected anterior circulatory stroke due to ischemia or hemorrhage in the internal capsule region. The subjects were free from any arthropathy, autoimmune disease, muscular disorders and injury/deformity. **Results:** There were 48 males and 27 females, whose median ages were 48 and 47 years, respectively. The median yawning onset times after stroke in males and females were 36 and 38 h, respectively. Associated movements in hemiplegic limbs during yawning were minimal and observed in 59 hemiplegics (78.6%); significantly more were seen in males (83%) vs. females (70%), left-sided (94%) vs. right-sided hemiplegics (64%), those with hypotonia (87%) vs. hypertonia (61%), and in the upper limbs (91%) vs. lower limbs (83%) and proximal (72%) vs. distal joints (29%), irrespective of limb. **Conclusion:** The appearance of associated movements in hemiplegic limbs indicates the return of ancestral function observed in quadrupeds. However, further studies are needed to ascertain the reasons for such variations and determine how to utilize these movements in rehabilitation programs.

Yawning is a phylogenetically old stereotyped phenomena. A yawn is a paroxysmal cycle characterized by a standard cascade of movements over 5- to 10-second periods, and the pattern is often repetitive. Associated movements in hemiplegic limbs during yawning have rarely been discussed in lecture classes and seldom looked for during clinical rounds. Historically, in the year 1794, Erasmus Darwin [1] was the first to describe movements of a paralyzed arm in hemiplegic limbs which were completely

disobedient to the will. John Abercrombie [2] described the same, with the movements followed by a reduction in paralysis.

The clinical phenomenon of involuntary movements of paralyzed upper limbs in hemiplegics during yawning was coined as 'parakinesia brachialis oscitans' [3]. The reports describing associated movements in hemiplegic limbs during yawning are scarce, and many described upper rather than lower limb movements. Therefore, the present study was undertaken to find out the associated movements in hemiplegic limbs during yawning and their relationship with hemiplegia, muscle tone and gender.

Material and Methods

An observational study was designed to find out the associated movements in hemiplegic limbs after institutional ethical clearance and informed consent. A total of 75 cases of newly diagnosed acute-onset anterior territory stroke due to ischemia or hemorrhage (as evidenced by brain CT) with lesions in the internal capsule were considered. These cases were free from any arthropathy, autoimmune disorders, muscular diseases, or injury/deformity in the limbs. Two of the family members (caregivers) who were looking after the patients were taught and trained to observe the movements of the hemiplegic limbs during yawning by video clips and personal coaching. Then, caregivers were asked to demonstrate the movements they observed in the patient using their limbs while remaining lying. The degree of movement was gauged on a 3-point scale as described by Mulley [4]: no, minimal or considerable movement. Only those who were able to understand the requirements and reproduce the movements were considered for the study.

The clinical details and laboratory investigations were recorded. Neurological status was assessed using the NIH Stroke Scale [5]. These cases were followed up in the hospital during first 7 days. Data were analyzed by simple descriptive statistics and McNemar's test for correlated proportions [6].

Results

There were 48 males and 27 females; their median ages were 48 (27–81) and 47 (36–70) years, respectively. All of them were right-handed. Among the cases, 39 presented with right-sided hemiplegia, 36 with left-sided hemiplegia, 52 with hypotonia and 23 with hypertonia. The time taken to develop the first yawning episode in hemiplegics varied from 12 to 86 h in males and 11 to 70 h in females, with medians of 36 and 38 h, respectively. Associated movements in the hemiplegic limbs were noticed in 78.6% of the cases. These were present more often in males (83%) than in females (70%), and the difference was significant statistically ($p < 0.05$). Among males and females (respectively), associated movements of both upper and lower limbs on the hemiplegic side during yawning were observed in 32 and 12 cases, the upper limbs alone in 7 and 3 cases, and the lower limbs alone in 1 and 4 cases. However, the occurrence of movements of hemiplegic limbs during yawning was independent of the upper and lower limbs.

Associated movements were noticed in 45 hypotonic (87%) and 14 hypertonic (61%) hemiplegic patients, and the difference was significant statistically ($p < 0.01$).

Table 1. Pattern of movements in hemiplegic limbs during yawning

	Males (n = 40)			Females (n = 19)			Males and females		Grand total (n = 59)
	right	left	total	right	left	total	right	left	
Shoulder									
Abduction	9	8	17	4	4	8	13	12	25
Flexion	8	8	16	4	1	5	12	9	21
Extension	1	4	5	–	1	1	1	5	6
Elbow									
Flexion	3	3	6	3	–	3	6	3	9
Extension	–	1	1	–	–	–	–	1	1
Hand (Wrist)									
Extension	–	2	2	–	–	–	–	2	2
Flexion	–	1	1	1	–	1	1	1	2
Closing finger	–	–	–	–	2	2	–	2	2
Stretching finger	–	–	–	–	2	2	–	2	2
Hip									
Flexion	8	9	17	5	3	8	13	12	25
Extension	1	–	1	–	–	–	1	–	1
Abduction	–	–	–	–	2	2	–	2	2
External rotation	–	2	2	2	–	2	2	2	4
Internal rotation	–	1	1	–	–	–	–	1	1
Knee									
Flexion	2	3	5	3	1	4	5	4	9
Ankle									
Plantar flexion	1	3	4	–	–	–	1	3	4

Also, associated movements observed in 34 left-sided (94%) and 25 right-sided (64%) hemiplegics, although this was not significant. The pattern of movements observed in hemiplegic limbs in relation to gender and laterality of hemiplegia is depicted in table 1. Patterns of associated movements observed among patients with one or other movement (n = 59) were: abduction, flexion and extension in the shoulder among 42, 36 and 10%, respectively; flexion and extension of the elbow in 15 and 1.6%, respectively; flexion and extension of the wrist in 3.3% each; closing and stretching of the fingers in 3.3% each. Similarly associated movements observed in the hip of hemiplegic side were flexion, external rotation, abduction, extension and internal rotation (42, 7, 3.3, 1.6 and 1.6% respectively). Flexion of the knee was seen in 15.3% and plantar flexion of the ankle in 6.7%. In our group, movement in the proximal joints alone was seen in 33 cases, distal joints alone in 7 cases, and both in 10 cases.

Table 2. Statistical association of the factors among hemiplegic patients with movements associated to yawning

	2-tailed p value	OR	95% CI
Males (40) vs. females (19)	0.0086*	2.11	1.22–3.63
Isolated upper (10) vs. lower limbs (5)	0.3017	2.00	0.68–5.85
Left- (34) vs. right-sided hemiplegia (25)	0.2975	1.36	0.81–2.28
Hypotonia (45) vs. hypertonia (14)	0.00006*	3.21	1.76–5.86
Isolated proximal (33) vs. distal joints (7)	0.00004*	4.71	2.09–10.66

Figures in parentheses refer to the number of cases. * $p \leq 0.01$.

Proximal joints include the shoulder and hip; joints distal to these were considered distal joints. There was no significant difference with regard to movement at the shoulder and hip joints. The movements were far less distal, and the difference was significant statistically ($p < 0.001$). The details of the statistical analysis are provided in table 2.

Discussion

Yawning has become a subject of interest to physiologists, pharmacologists, neurologists, psychologists and biologists, and their contributions have been recently reviewed [7]. As a result, many observations, theories and explanations have accumulated. Only at the start of 21st century, have the neurohormonal mechanisms for yawning been established. Although a final answer has not yet been agreed upon, yawning is considered to be a marker of activity of D_3 dopamine receptors.

In the present study, associated movements in hemiplegic limbs were observed in 80% of cases, which is similar to the values reported by Mulley [4]. The patterns of movement noticed in the study were minimal, and there were no violent movements. The patterns of associated movements in hemiplegic limbs are seen at different joints and vary across different series [4, 7–10]. These variations may be related to the individual responses to stimuli or the reversal of functioning capacity of adjacent neurological structures. Interestingly, such movements are more common in proximal than distal joints. This may be due to increased muscle bulk in the proximal joints. It has been suggested that comparing the associated limb movements during yawning before and after the onset of hemiplegia in the same individual will throw more light on these variations in movement patterns.

An ischemic attack affecting the territory of lenticulostriate arteries and damaging the internal capsule leads to complete hemiplegia due to the lesion of the pyramidal tract with sparing of the extrapyramidal pathways. Automatic synchronization of the ventilatory cycle with gait is observed in quadrupeds, but not in humans due to bipedalism. After the onset of stroke, cortical control is interrupted and the adjacent neurological structures retrieve the ancestral function. Hence, during movement of the diaphragm while yawning, the paralyzed arm receives motor stimulation from the lateral reticular nucleus of medulla, which is involved in ventilation and locomotion in animals. Topper et al. [11] suggested the possibility of an emotional motor system to explain these movements in the hemiplegic limbs during yawning.

Though associated movements have been noticed in the hemiplegic limbs, doctors and physiotherapists taking care of such patients should realize that associated movement has no prognostic value [4]. Mulley [4] did not find any association between associated movements and gender or laterality of hemiplegia. In this study, movements were noticed more in males, proximal joints and those with left-sided hemiplegia and hypotonia. Further studies are warranted to find out the reasons for variation in the movements and optimal ways of utilizing these results in the rehabilitation programs.

Strength and Limitations

The strengths of our study were rigid inclusion and exclusion criteria as well as careful monitoring of movements. Interestingly, passive movements of hemiplegic limbs during sneezing, coughing and laughing were not monitored.

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Ramachandran Meenakshisundaram
69 Pasupathy Nagar
Madurai 625017 (India)
Tel. 0091 9486258115, Fax 0091 431 4298877
E-Mail rmsundar_chandran@yahoo.co.in