Risk of jugular compression blocks in workers exposed to prolonged upright posture

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Parole chiave: Medicina del lavoro, prolungata postura eretta, sindrome compressiva venosa

Abstract

Background. The working posture affects the peripheral venous circulation, although the current literature does not report any correlation between working posture and the abnormalities of the jugular veins flow. The purpose of this preliminary research is to study, in female workers, the prevalence of Venous Compressive Syndrome (VCS) caused by total block of the internal jugular veins flow, so-called “White Compression”. Due to complete compression by postural, muscular, fascial, anatomical or bone anomalies, White Compression is not visible by EchoColorDoppler (ECD) and its flow can only be detected by the rotational movements of the head or by Valsalva’s maneuver.

Methods. We studied a sample of female workers with ECD (n=128), in supine and upright position divided into subgroups according to the obliged posture maintained during working hours: group A, seated work (n = 61; 47.7%); group B, standing work (n = 41; 32.0%); group C, mixed (both standing and seated work) (n = 26; 20.3%). The total sample (n = 128) had the mean age of 46 ± 10 years (minimum 18 and maximum 67 years) and mean Body Mass Index (BMI) of 23 ± 4 kg/m² (min 16 kg/m² and a maximum of 42 kg/m²).

Results. Group A and group C did not show any White Compression in orthostatic and clinostatic position. The 9.75% (p = 0.0125) of Group B had a White Compression in orthostatic position: two female workers on the left side (4.9%) and two female workers on the right side (4.9%).

Conclusions. We conclude that there is a risk of jugular compression blocks in female workers exposed to prolonged upright posture. Yet there is no longitudinal study that identifies the White Compressions as etiology of a chronic neurodegenerative disease.

The authors hope that some wider studies can confirm the prevalence of these compressions in standing posture and their patho-physiological consequences.

Introduction

The working posture has influences venous circulation. While it is known that in some categories of employees the standing position at work can increase the alterations of the venous drainage in the lower limbs (1, 2), with possible risks of infertility (3, 4), we did not find in literature any study on how working posture may affect the internal jugular veins flow.

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We also know that the multiple blocks or stenosis of the internal jugular veins flow cause the hemodynamic condition called Chronic Cerebral Spinal Venous Insufficiency (CCSVI), which affects the main pathways of cerebrospinal venous outflow system: the internal jugular vein, vertebral veins or Azygos (5-7).

The correlation between posture, myofascial tensions, misalignments of cervical vertebrae and Venous Compression Syndrome has been recently defined (8-9).

The aim of this preliminary study is to investigate with the use of Doppler ultrasound the prevalence of Compressive Venous Syndrome (VCS) (10), with a total flow blockage called White Compression (W) in the internal jugular veins, among female workers and to verify whether it is influenced by sustained postures during working hours.

Methods

Between 2014 and 2015, we selected a group of 128 from an initial sample of 182 female workers (subject to sanitary surveillance pursuant to Legislative Decree 81/08) according to the inclusion/exclusion criteria listed in table 1, aged between 18 and 67 years and working in a sitting, standing or mixed position.

The authors measured anthropometric parameters such as height, weight and body mass index (BMI) using a bioelectrical impedance analyzer (BIA) with alternating current at 50 Hz and 800 mA (11-12). All the workers were submitted to an ECD venous examination assessing the flow of the left and right jugular (J) veins in orthostatism and clinostatism in the three segments:

- J1, from the confluence into subclavian vein to the lower level of the thyroid;
- J2, the segment between the lower level of the thyroid and the jugular point; this point is where the vein crosses the bifurcation of the carotid artery (Figure 1);
- J3, from the jugular point to the highest point detectable by ECD.

Table 1 - Inclusion and exclusion criteria

<table>
<thead>
<tr>
<th>Inclusion criteria</th>
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<tr>
<td>women aged between 18 and 67 years</td>
<td>housewives</td>
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<tr>
<td>employees with sedentary office work for at least 20 hours of the workweek (8 hours day for 5 days week)</td>
<td>drivers</td>
</tr>
<tr>
<td>employees working in a standing position for more than 80% of the workweek</td>
<td></td>
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<tr>
<td>employees working in a standing position for 50% of the workweek and with sedentary office job for the remaining 50% of the workweek</td>
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Figure 1 - The arrow shows the J2 segment of right internal jugular vein
Upright posture and venous disease

With the patient’s head in anterior neutral position, “White Compression” block occurs when the internal jugular vein is not visible to ECD due to complete compression by postural, muscle, fascial, anatomical or bone anomalies (Figure 2) and its flow can only be detected by the rotational movements of the head or after Valsalva’s maneuver (13).

The flow of the internal jugular vein is physiological when the cross-sectional area is larger than 6.0 mm² without flow or reflux block (10).

**Statistical analysis**

All data were analyzed by programs from EPI-INFO (14) to perform a stratified data description for parametric numerical variables. Statistical significance “between” and “within” groups on continuous variables was calculated by the analysis of variance (ANOVA) to test the equality of means. The Chi-square ($\chi^2$) Yates corrected test was used for non-continuous variables by StatCalc and Analysis (EPI-INFO). A $p$ value <0.05 was considered significant.

**Results**

The study sample consisted of 128 female workers. Their average age was 46±10 years (from a minimum of 18 to a maximum of 67 years with a median of 45 years and a mode of 50 years).

The working posture of our sample was “sedentary” in 61 workers (47.7% of the sample), group A; “standing” in 41 workers (32.0%), group B, and “mixed” (sedentary and standing) in the remaining 26 workers (20.3%) group C (Table 2 and Figure 3).

The average height was 164±6 cm (from a minimum of 150 to a maximum of 184 cm with a median of 164 centimeters and a mode of 168 cm).

The average weight was 61±10 kg (from a minimum of 41 to a maximum of 101 kg with a median of 60 kg and a mode of 60 kg).

The relative mean body mass index was 23±4 kg/m² (from a minimum of 16 to a maximum of 42 kg/m² with a median of 22 kg/m² and a mode of 21 kg/m²) (Table 3).
There is no statistically significant difference between anthropometric variables according to the type of work performed.

We found no White Compression in group A and group C.

No subject showed any White Compression in the clinostatic position.

In contrast, in Group B we found White Compression in the orthostatic position in 4 subjects (3.12%): 2 on the right jugular and 2 on the left jugular. Considering that the four workers were in the standing posture group, the incidence rises to 4/41 = 9.75% of the subsample for the type of work, or about 1 worker in 10 of the standing group. This difference is statistically significant with a p=0.0125 (= 8.7616 $\chi^2$ with two degrees of freedom) (Table 4).

**Discussion**

Since 1960 physicians have studied the possible relationship between working posture and alterations of venous drainage (15-17). There is a correlation between lower limbs venous insufficiency and the orthostatic prolonged posture which is defined as working in a standing position for more than 50% of the global working time (8 hours) in one square meter (1, 16).

In this preliminary study, we only evaluated the internal jugular vein because in case of blockage of the brain major veins draining as the internal jugular and vertebral veins, the collateral circulation that is established through the external jugular vein, the thyroid vein, the nuchal vein or intrarachideal veins is insufficient for a proper drainage (18).

Chai did a study on the effects of unilateral jugular compressions in pigs which show a cerebral blood flow increase in both hemispheres (19). Tovedal highlighted in pigs that a progressive obstruction of the superior venae cavae leads to measurable signs of impaired cerebral perfusion (20). Frydrychowsky confirmed the same result in humans in a study in which they closed both jugulars for three minutes (21) observing how an acute bilateral jugular congestion leads to an hyperkinetic increase of cerebral circulation with pial arteries pulsation due to the reduction of Windkessel effect. To contrast the high resistance of the venous drainage the pial arteries tend to expand but follow an increase of intracranial pressure (22) due to the sub arachnoid space inextensibility.

Preliminary data from this modest pilot sample highlights the possibility that the upright posture can affect the jugular veins brain drainage in 9.4% of female standing

<table>
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<tr>
<th>Sample (n°)</th>
<th>White Compression in Clinostatic position</th>
<th>White Compression in orthostatic position</th>
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<tr>
<td>Group A (61)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Group B (41)</td>
<td>0</td>
<td>4 (9.75%)</td>
</tr>
<tr>
<td>Group C (26)</td>
<td>0</td>
<td>0</td>
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workers. This calls for a major study of the phenomenon in order to highlight any pathological effect and new strategies for reducing it by reflecting on working environment and postural conditions of the workers.

There are many papers on the possible outcomes of a block flow of the internal jugulars and chronic brain diseases, as in multiple sclerosis (23).

The domain of possible research would aim to study whether block flow of one jugular with transitory bilateral block flow due to postural working position might affect the brain drainage resulting in chronic injury.

Conclusions

The authors suggest that the external myofascial compressions or misalignment of the first cervical vertebrae, induced by head movements or posture changes may have a role in the reduction of Windkessel effect by blocking the venous brain drainage in workers with SCV White Compression of the jugular veins. This condition possibly increases the pulse energy of pial arteries and could create a potential injury in brain microcirculation.

Our results, although on a small sample, show that working in an orthostatic position (rather than in the supine position) may play an important role in determining the presence of a compression syndrome in the internal jugular veins.

This paper suggests further research on the matter to clarify whether the unilateral block of jugular flow is connected or not with the working place.

Riassunto

Rischio di compressione giugulare in lavoratrici esposte a prolungata postura eretta

Premessa. La postura lavorativa influenza sulla circolazione venosa periferica ma, sino ad oggi, non ci sono studi scientifici che correlino la postura lavorativa ad alterazioni del flusso delle vene giugulari.

Lo scopo di questa ricerca preliminare è quello di studiare nelle lavoratrici di genere femminile la prevalenza della Sindrome Venosa Compressiva (VCS) causata da blocco totale del flusso delle vene giugulari interne, definita “White Compression”.

Dovuta da anomalie posturali, muscolari, fasciali, anatomiche o ossee che comprimono la vena, la White Compression non è visibile all’ecocolor doppler (ECD) ed il flusso può essere rilevato solo dai movimenti di rotazione della testa o dalla manovra di Valsalva.

Metodi. Abbiamo studiato un campione di lavoratrici con ECD (n=128) in posizione supina e in ortostatismo suddivisi in sottogruppi in base alla postura mantenuta durante l’orario di lavoro: gruppo A, lavoro da seduti (n = 61; 47,7%); gruppo B, lavoro in piedi (n = 41; 32,0%); gruppo C, misto (lavoro sia in piedi che da seduti) (n = 26; 20,3%). Il campione (n = 128) ha un’età media di 46 ± 10 anni (minimo 18 e massimo 67 anni) e indice di massa corporea (BMI) medio di 23 ± 4 kg/m² (min 16 kg/m² e massimo 42 kg/m²).

Risultati. Il Gruppo A e il gruppo C non hanno mostrato alcuna White Compression in posizione ortostatica e clinostatica. Il 9,75% (p = 0,0125) del gruppo B aveva una White Compression in posizione ortostatica: due lavoratrici a sinistra (4,9%) e due lavoratrici a destra (4,9%).

Conclusioni. Concludiamo che c’è il rischio di blocchi di compressione giugulari nelle lavoratrici sottoposte a prolungata postura eretta. Eppure non c’è studio longitudinale che identifica la White Compression come eziologia di una malattia neurodegenerativa cronica. Gli autori sperano che studi più ampi confermano la prevalenza di queste compressioni dovute alla postura eretta e le sue conseguenze fisiopatologiche.

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