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Neck and upper extremity pain in sonographers – Associations with occupational factors

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ABSTRACT

Sonographers have a high risk of musculoskeletal disorders. This study explores the associations between working conditions and musculoskeletal pain based on the frequency and intensity of pain in the neck and upper extremities. A questionnaire was answered by 291 female sonographers. High prevalence of neck/shoulder pain was associated with eye complaints and headache related to work on the computer, dissatisfaction with the computer workstation, high mechanical exposure index (MEI) and high demands. The possibility to adjust the keyboard and chair, and adequately corrected eyesight were positive factors. High prevalence of elbow/hand pain was associated with performing echocardiography, computer-related eye complaints, high MEI and high job and sensory demands. In echocardiography, working with a straight wrist and holding the transducer with a two-handed grip or alternating hands was associated with a low prevalence of elbow/hand pain. Thus, further improvements in the working conditions are possible and are recommended.

1. Introduction

Many sonographers experience musculoskeletal pain and discomfort in the neck, upper limbs and back (Morton and Delf, 2008; Muir et al., 2004; Pike et al., 1997; Roll et al., 2012; Russo et al., 2002). Sonographic scanning involves static postures and precise movements of the upper limbs (Kim and Roh, 2014; Pike et al., 1997; Wihlidal and Kumar, 1997), which are well known risk factors for neck and upper limb pain (Hagberg, 1996). Furthermore, it involves considerable computer work, in itself a risk factor for pain (Tornqvist et al., 2009). The scanning usually takes place in a dark room, which may lead to eye strain (Wihlidal and Kumar, 1997). However, the extent to which visual ergonomics affects the prevalence of work-related musculoskeletal disorders (WMSDs) is not known.

Sonography yields information on composition of i.a. internal organs, muscles, blood flow and is used in several specialities, such as cardiology, obstetrics, gynecology and radiology. It provides precise information and there is very little risk of adverse events for the patient (Douglas et al., 2007; Frank et al., 2015). Sonographic examinations have become more common over the past decades (Baker and Coffin, 2013; Schoenfeld et al., 1999), with an increase in the number of examinations and hours of scanning per day for sonographers (Baker and Coffin, 2013; Russo et al., 2002). This may lead to higher prevalence of WMSDs.

Sonography of the heart (echocardiography) has become an invaluable diagnostic tool in daily cardiology practice (Badano et al., 2009; Douglas et al., 2007). Echocardiography requires high grip forces in the transducer hand due to the depth of the scanned organ (Bastian et al., 2009). Increased force in the hand grip may lead to an additionally increased risk of developing musculoskeletal disorders (Vanderpool et al., 1993). Due to the set up in the examination room, echocardiography is performed in one of a limited number of working techniques, but it is not known whether any of these is more favourable in terms of the risk of WMSDs.

The aim of this study was to explore associations between physical and psychosocial working conditions and pain in the neck, shoulders, elbows and hands, in order to propose recommendations for improved working conditions for sonographers. Special attention was paid to the working conditions in echocardiography.

2. Participants and methods

2.1. Study design and population

This cross-sectional study comprised sonographers employed in

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clinical physiology and cardiology departments in hospitals throughout Sweden. A self-administered questionnaire was sent to all sonographers in all hospital departments where biomedical scientists performed sonography (45 departments). Female sonographers who worked at least 20 h per week and performed sonography for a minimum of four hours per week since at least three months were included in the analyses (N = 291, participation rate 86%). Male sonographers (N = 28) were excluded, due to the low number of participants.

For the studied population the ultrasonic equipment consists of a screen, a keyboard or a control panel and a transducer attached to a cable. The examiner usually sits on a chair during the examination and holds the transducer in one hand. With the other hand, she operates the keyboard and at the same time she watches the screen. The patient normally lies on an adjustable table and pressure is applied with the transducer to achieve optimal contact with the skin. During vein mapping of the legs the patient usually sits or stands. The transducers are usually palm sized (Lyon et al., 1997).

The examination room is darkened and the artificial light is low to facilitate viewing the images on the screen. The results are analysed by the sonographer, either on the ultrasound machine or on a separate computer workstation. Examinations are sometimes carried out in a ward with the patient in bed (bedside examination).

This study included echocardiography and other sonographic examinations. Other examinations involved mapping of veins, abdominal aorta scanning, examination of the neck vessels and screening for hip dislocation.

The study was approved by the Regional Ethics Committee at Lund University.

2.2. Data collection

2.2.1. Personal characteristics

The questionnaire included questions on personal characteristics: age, height, body mass index (BMI), smoking habits, personal recovery time, exercise, household work, children under 15 living at home and civil status.

2.2.2. General working conditions

The questionnaire included questions on seniority as a sonographer, working hours per week, number of hours of sonography per week, types of examinations and whether bedside examinations were performed. Questions were also asked about the equipment, for example the possibility of adjusting the position of the screen, the keyboard and the chair, the use of a specially designed examination table and where the analysis and reporting were carried out. We also asked about the use of and need for glasses or contact lenses and about eye strain and headache related to computer work.

Physical workload was assessed using a mechanical exposure index (MEI) and a physical exposure index (PHYI) (Balogh et al., 2001; Östergren et al., 2005). The MEI is based on 11 items concerning awkward work postures, static workload and precise movements. The PHYI is based on 7 items concerning material handling including lifting (Balogh et al., 2001). The participants answered each item on a three-point scale 1 = "hardly anything/not at all", 2 = "somewhat" or 3 = "a great deal". The total scores were calculated for each scale (MEI: 11–33; PHYI: 7–21) for each individual. The participants were then categorized according to the level of mechanical exposure: unexposed (11–12), low (13–15), medium (16–19) and high (20–33) and for physical score: unexposed (7–8), low (9–10), medium (11–13) and high (14–21), according to the recommendation of Balogh et al. (2001). The participants were also asked about satisfaction with ergonomic conditions during computer work.

We assessed the psychosocial conditions in terms of *job demands*, *job control* and *job support* using a Swedish version of the Job Content Questionnaire (JCQ) (Karasek et al., 1998; Karasek and Theorell, 1990). Job demands, job control and job support were calculated as the means of nine, nine and eight items, respectively. Each item was assessed using a four-point scale indicating the degree of agreement with various statements concerning conditions at work. Higher values on the scale indicated higher demands, better control and better support.

One dimension of the Copenhagen Psychosocial Questionnaire (COPSOQ) (Kristensen et al., 2005) was used to obtain an estimate of sensory demands, by the five questions that concern eye sight, precision, attention, focus and control of body movements. The participants answered the questions on a five-point scale (0 = hardly ever/to a very little extent, 25 = seldom/to little extent, 50 = sometimes/to some extent, 75 = often/to a large extent and 100 = always/to a very large extent) and the mean value was calculated for each participant.

2.2.3. Working conditions in echocardiography

Through the questionnaire, echocardiographers, i.e. sonographers who performed echocardiography at least ten hours per week, were identified. The questionnaire included detailed questions about echocardiographic examinations, such as the number of hours worked per week, the number of examinations per day and transducer time (the time during which the echocardiographer uses the transducer during an examination).

We also asked which hand was used to hold the transducer, dominant, non-dominant or two-handed/alternating grip. Further we asked whether the patient was lying towards or away from the examiner on the table. This led to four possible working techniques:

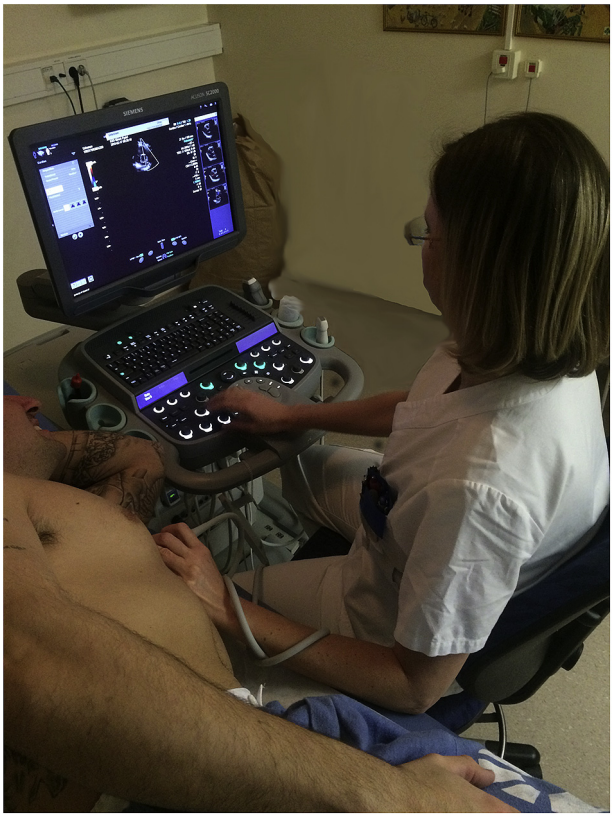

Fig. 1. Working technique 1: the patient was facing the examiner, who held the transducer in the left hand.