

Review

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Ergonomics to perform thoracic limb musculoskeletal ultrasound

Ergonomía para realizar ecografía musculoesquelética de extremidad torácica

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ABSTRACT. Ergonomics is the science that studies how to adapt the relationship between the human being with its environment. Performing musculoskeletal ultrasound applying appropriate ergonomic techniques both in the patient and by the sonographer, can reduce bodily injuries that are usually generated in repetitive work like this, causing a detriment to the quality of life. The objective of this pictorial is to depict some of the ergonomic characteristics necessary in this work environment by reviewing the literature related to the objective of this work. We conclude that carrying out ergonomic measures during the performance of a musculoskeletal ultrasound study reduces the risk of presenting fatigue and injuries to both the sonographer and the patient.

Keywords: ergonomics, upper limb, sonographer, musculoskeletal disorders.

RESUMEN. La ergonomía es la ciencia que estudia cómo adaptar la relación entre el ser humano y su entorno. El realizar ultrasonido musculoesquelético aplicando técnicas ergonómicas adecuadas, tanto en el paciente como por el ecografista, puede reducir las lesiones corporales que suelen generarse en trabajos repetitivos como éste, ocasionando un detrimento en la calidad de vida. El objetivo de este pictorial es mostrar algunas de las características ergonómicas necesarias en este ambiente laboral mediante revisión de la bibliografía relacionada con el objetivo del presente trabajo. Concluimos que aplicar medidas ergonómicas durante la realización de un estudio ecográfico musculoesquelético reduce el riesgo de presentar fatiga y lesiones tanto al ecografista como al paciente.

Palabras clave: ergonomía, extremidad superior, ecografista, lesiones musculoesqueléticas.

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Introduction

Ergonomics is the science that studies how to adapt the relationship between the human being with its environment [Council of the International Association of Ergonomics]; physical ergonomics study the most appropriate postures to perform household and workplace tasks, handling loads and materials and repetitive movements, among other aspects.^{1,2} Its main objective is to reduce stress and eliminate injuries and disorders associated with the excessive use of certain muscles and by improper postures, or injuries from trades or repetitive tasks.

This is achieved when offices, workspaces, lighting and equipment are designed and adapted to measure, with the capabilities and limitations of the employee to carry out work activities. The benefits include greater job satisfaction, less or no pain, and fewer body injuries.^{2,3}

Ergonomics has been gradually introduced in Mexico, at Universidad Nacional Autónoma de México [UNAM] it is integrated as part of a master's programs.⁴ The Center for Disease Control and Prevention [CDC] recommends using ergonomics for the prevention of related musculoskeletal disorders at work.¹ The National Institute of Occupational Health and Safety suggests training sonographers in the optimization of posture and the use of support equipment.⁵

Applying the correct ergonomics in performing musculoskeletal ultrasound involves properly examining how the sonographer interacts with the equipment and its general environment.

Various musculoskeletal disorders related to different professions have been described, representing a high percentage of all diseases in the workplace. These disorders were first identified in cardiac sonographers in 1993 and later in 1996 and 1997, reaching an incidence of 84 to 90%.⁶ In these specialists, the areas of the body with the greatest affection in decreasing order were shoulder, neck, wrist, back and hands. The most representative disorders were muscle spasm, pain, inflammation, sensitivity changes, tendon and ligament lesions, visual symptoms and headache, among others.^{6,7}

The objective of this pictorial is to highlight the positive aspects of the use of ergonomics to mitigate these disorders and implement prevention measures based on ergonomic studies, that require the participation of health professionals who practice musculoskeletal ultrasound.

Musculoskeletal ultrasound ergonomics
Ergonomic measures:⁸

1. Avoid heavy loads.
2. Perform directed callisthenics before workday or perform stretching and relaxation exercises of the extremities and trunk.
3. 10 to 15 min breaks, every 1-2 hours, both postural and visual.⁹

4. Maintain proper posture and make changes regularly to avoid the early onset of fatigue.
5. Carry out the studies with the appropriate technique.
6. Reduce repetitive tasks.

These changes must be made in three areas:

1. Workspace and environment.
2. Ergonomics applied to the sonographer.
3. Ergonomics for the patient.

Workspace

It is recommended to have adjustable furniture which distribution favours mobility within the work area, sharp colours and self-adjusting white light.

Other recommendations are:

1. Patient table. Adjustable in height, preferably electric, that allows the patient to be easily walked, they must be



Figure 1: Ergonomic benches with back and footrest, and swivel wheels.



Figure 2: Ideal ultrasound area with benches without backrest. Adjustable lights and walls in neutral colors.



Figure 3:

Shoulder examination in an ergonomic position, monitor at adequate height, sonographer close to the patient, non-forced position of neck, trunk, shoulder, and hand.

practical to allow a suitable approach between sonographer, table and patient.

2. Operator's chair. Easy to operate and adjustable from sitting position. Vinyl lining [antimicrobial], ring or foot support, 360° swivel wheels, preferably with backrest. Adjust leg and foot lengths to the floor, lumbar support, the height that allows shoulder rest.
3. Backless height bench. It is easy to operate and adjustable from sitting position. Vinyl lining [antimicrobial], ring or foot support, preferably with 360° swivel wheels. Adjust leg and foot lengths to the floor; patient in the sitting position must be less than that of the operator. To maintain an ergonomic posture, it is recommended to keep the trunk aligned by performing sustained abdominal contraction in comfortable conditions.
4. Adjustable lighting, to adapt before, during and after the ultrasound study, to maintain visual health
5. The temperature according to the requirements of each ultrasound machine.
6. Ultrasound monitor or screen. Wide, articulated and easy to move. Preferable eyes should be at the same level as it (Figures 1 and 2).

Ergonomic according to the anatomical region

1. Shoulder

- a. Patient sitting on the height bench, straight trunk, in relaxation, sonographer with necessary abduction of his shoulder without forcing [position the patient as close as possible, adjusting the height of the bench], without elevation above the scapular level.
- b. Support the wrist and hand in the area to be explored to avoid ischemia and muscle fatigue. For cable control, clamping clamps² can be used, avoiding putting the cable on the neck to diminish tension.
- c. Sometimes it is necessary to sit the patient on the examination bed to facilitate the evaluation; the patient can even be put to bed if required.



Figure 4: Shoulder examination with a sitting patient, standing sonographer, straight trunk, shoulder abduction 30°, with the proximity of the area to be explored, with adequate wrist support.

- d. To explore regions contrary to the specialist's hand, he may request to change the patient's position or get a little close to the sonographer so that the area to be explored is closer.
 - e. Head and neck observing the monitor directly at the appropriate height without making forced turns.²
 - f. A forced flexion, extension or rotation of the neck can generate muscle spasms and pain, with subsequent muscle contraction and/or injury to intervertebral discs, ligaments or joints.²
 - g. Trunk. Position in front of the monitor, adequate height of the monitor, control and examination table, avoid forced turns, as well as forced trunk flexion or extension. These inadequate positions can generate low back pain, muscle contractures and subsequent intervertebral involvement² (Figures 3 to 6).
- #### 2. Elbow
- a. Patient seated with the elbow resting on the examination table with support or aid to hold the arm, not more than 30 degrees to achieve full extension; sonographer with

neutral shoulder, neutral wrist, fingers with a full hold of the transducer (*Figure 7*).

3. Wrist

- a. Avoid flexion, extension or forced deviations since they favour muscle contraction, ischemia, fatigue and affection of the carpal area.²

- b. Try to keep the transducer in a neutral position, with the presence of the thumb as a support, and the end fingers resting on the area to be explored or the table.⁵
- c. Decrease the tension force on the transducer with your hand, as it can generate muscle fatigue and pain, which could cause problems in the upper limb such as contractures and tendinitis.⁸

Figure 5:

Inappropriate postures to perform shoulder ultrasound, forced abduction of the shoulder, forced flexion of the wrist and phalanges; in a lateral view, with the monitor in the wrong position causing forced neck extension of the sonographer.



Figure 6:

Inappropriate positioning of the patient with the upper limb in a position that generates fatigue while observing the monitor, with the cable of the probe over the neck that generates fatigue and inadequate traction on the shoulder.



Figure 7:

Ergonomic position for elbow examination, with a support under the patient's elbow, as well as the flexed wrist and finger position necessary for taking and positioning the transducer.



Figure 8:

Ultrasound of the wrist region, with ergonomics of the upper extremity of the explorer and the patient, enhancing the correct probe holding.



Figure 9:

A suitable position with ergonomics, to hold the transducer without forced flexion of fingers and hand and adequate thumb opposition.

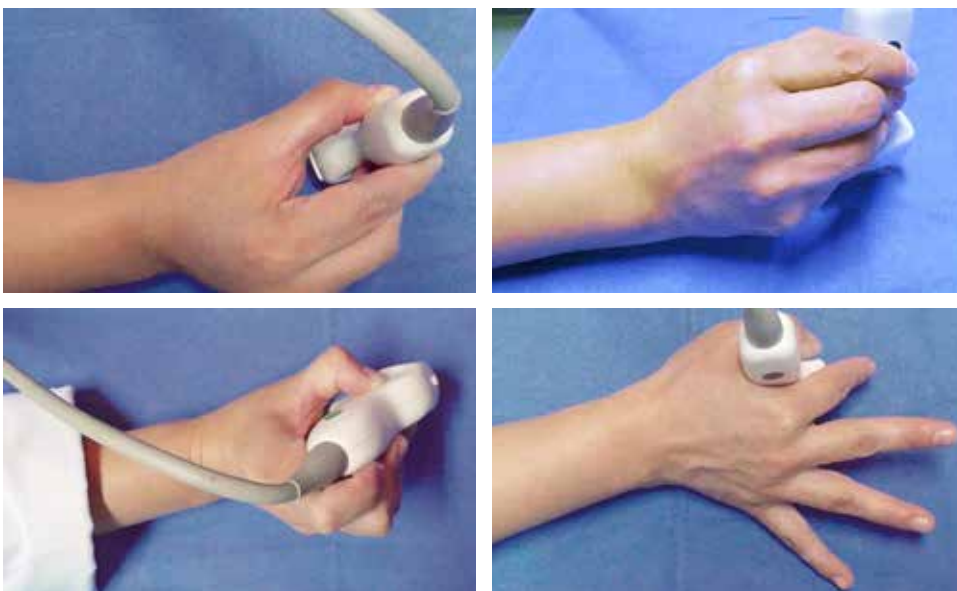


Figure 10:

Postures holding the transducer improperly. With exaggerated force for grip, without joint support of hand, fingers and wrist, generating fatigue and muscle pain.

- d. With your hand on the monitor, avoid pulling or pushing the device, use your leg or foot as support.
- e. Avoid grasping the transducer with your fingers in forced flexion since it produces muscle fatigue due to requiring greater muscle and tendon strength; try to use the palm, making the tension in the forearm⁵ (Figures 8 to 10).

Conclusions

Carrying out ergonomic measures during the performance of a musculoskeletal ultrasound study reduces the risk of presenting fatigue and injuries to both the sonographer and the patient. Detecting risks and

correcting them in the work area additionally reduces stress during the working day and improves sonographer practice.

The ergonomic changes additionally represent improvements in the quality of work as well as quality of life of those who apply and practice them.

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