



Scanning through the pain: Ergonomic considerations for performing echocardiography of animals

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Abstract Work-related musculoskeletal disorders (MSD) are a common problem among sonographers, with prevalence in human sonographers of 80–90%. However, this problem appears to be largely neglected in the veterinary literature. Awareness of MSDs, ergonomic redesign, workplace management, and physical self-care are components to reducing the risk of developing MSDs. Work-place redesign and alterations in work flow management are discussed, and a template for a more ergonomically favorable echocardiogram table is provided.

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Work related musculoskeletal disorders (MSDs) are infrequently discussed during training, in journals, or at cardiology meetings. However, professionals such as sonographers are at risk for developing work related MSDs due to repetitive use injury and the unfavorable body position required to perform echocardiography in patients. Consultation with a physical therapist and ergonomic specialist can provide vital information to prevent or reduce injury when performing echocardiography.

Abbreviations: MSD, musculoskeletal disorders.

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What is a work-related musculoskeletal disorder?

Work related MSDs are conditions that involve nerves, tendons, muscles, and supporting structures of the body, as a result of cumulative over-use, non-neutral body postures, sustained static postures, and repetitive motions.^{1–6} Initial injuries may be mild and include symptoms of dull pain or tingling sensation of the affected area, which improve with rest, and are characterized as reversible over-use injuries. If the condition is not addressed, moderate injury may occur, including

recurrent pain, aching, and/or fatigue that occurs earlier in the work-day and persists at night. Moderate injuries may be reversible if complete rest for a period of time is given. Severe injuries consist of pain, weakness, and fatigue that can be felt even at rest, disturb sleep, and limit the ability to perform even mundane daily tasks, and may result in permanent damage.

The neck, upper back, shoulder, and wrist are the most common sites of pain reported among human sonographers. The pain associated with performing ultrasounds is innately linked with the awkward, unbalanced body position required in both human and veterinary sonographers. Non-neutral body positions intrinsic to performing ultrasounds include: a twisted or bent back, head, and neck, a flexed and/or twisted wrist, an unsupported and extended elbow, and an elevated abducted shoulder with an extended arm that concurrently applies upward-sustained pressure. Muscle strain and fatigue occur when the arm is abducted greater than thirty degrees from the front of the body, which is a common problem in sonographers. Veterinary echocardiographers typically scan from beneath the animal to optimize acoustic windows and minimize lung-air interference, which creates additional ergonomic strain on the shoulder muscles caused by pushing up while abducting the shoulder. Muscles held in a static position with applied sustained force fatigue quickly, and if not allowed to recover prior to repeating the same activity, microscopic injury may occur, which may lead to repetitive strain injury. Consistent among several studies, the following factors are correlated to development of work related MSDs: scan time and number of scans, number of hours and days a week worked, twisted posture, and maintaining a high-pressure handgrip.¹⁻⁴

An ergonomic specialist's view of the problem

The root of ergonomic problems associated with performing echocardiography lie in the awkward arrangement of ultrasound machine, animal, and sonographer. Ideally, the body should be maintained in a neutral posture, where the joints are unrestricted and near the middle of their range of motion. The muscles are relatively relaxed and the ligaments are not limiting movement. A neutral sitting posture for work at a computer includes feet flat on the floor, hips flexed to approximately 90°, an upright spine with head facing forward, elbows near the trunk and flexed approximately 90°, and hands in front of the body. This posture is comfortable and well-tolerated because the body

is well supported with little muscular effort required. There is evidence that maintaining a non-neutral or imbalanced posture results in increased muscle strain or MSDs. For example, muscle tension quantified by surface electromyography in people typing at a computer was lowest in people using a neutral body position compared to other common body positions used when typing.⁷ Similarly, in human sonographers, a non-neutral, bent or twisted posture was positively associated with occurrence of MSD, and sonographers with more upright neutral body position reported fewer complaints of MSDs.¹

Ideally, the animal and the ultrasound machine would be positioned directly in front of the sonographer, eliminating the need for abduction of the arm, twisting of the neck and back, and reaching. Unfortunately, when performing echocardiograms, the ideal neutral posture is not very feasible so the challenge is to make the current arrangement of table, animal, machine, and chair in a fashion that causes the least amount of musculoskeletal stress on the body.

To organize a work area, it is helpful to break the tasks into 3 reach zones. The near reach zone is nearest to the body. The hands are in front of and within approximately 35 cm (14") of the body. In the middle reach zone, the hands reach approximately 53 cm (21") from the body. A far reach zone may extend approximately 68 cm (27") from the trunk. As the hands move further forward or apart, a greater effort is needed to raise the arms and the shoulder moves further away from its comfortable neutral position. Highly repetitive tasks and tasks requiring a continuous effort, such as typing or holding an ultrasound probe, should be performed in the near reach zone. The far reach zone has a higher risk of shoulder strain and fatigue and should only be used for the occasional reach. Once the arm is extended more than 30° from the body, muscle strain and fatigue occur, since the shoulder muscles are continuously contracting to maintain this position.

The primary reason repetitive or static postures in the middle and far reach zones are avoided is the amount of effort required by the shoulder muscles, as shoulder muscles fatigue quickly in those zones. When an individual remains focused on the exam while ignoring shoulder fatigue, the muscles may become strained and weaken, ultimately leading to injury. Unfortunately, most professionals fail to recognize the early signs of fatigue and strain, and may push on until they have problems functioning without pain. A large proportion of these disorders are preventable by reduction of adverse exposure, yet treatment of MSDs will likely fail if these adverse ergonomic exposures are not controlled.⁸ Ergonomic

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