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Ergonomics in bronchoscopy: is there a need for better design or a change in the work environment?

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"…the additional physical strain and exposure to cumulative trauma on the person actually performing the [bronchoscopy] is often overlooked."

The field of conventional bronchoscopy has undergone a paradigm shift over the last decade. The ability to visualize peribronchial structures in real time has increased the diagnostic and therapeutic scope of flexible bronchoscopy. Ultrasound engineering and the development of a probe with an interface capable of sound wave transmission, has led to the development of a new procedure, endobronchial ultrasound, which has been widely adapted, both throughout the USA and worldwide [1]. Similarly, techniques such as electromagnetic navigation bronchoscopy, autofluorescence bronchoscopy, optical coherence tomography and other interventional procedures, including bronchial thermoplasty, cryotherapy, brachytherapy, balloon dilatation and stent are increasingly being adopted at large academic centers [2].

Flexible bronchoscopy is an effective alternative to rigid bronchoscopy in treating distal airway lesions and less advanced malignant lesions [3]. The emphasis with all of these procedures is to reduce procedure-related complications and improve patient comfort. However, the additional physical strain and exposure to cumulative trauma on the person actually performing the procedure is often overlooked. The prolonged nature of the procedures combined with unusual postures can result in overuse injuries, such as carpal tunnel syndrome, tendonitis, epicondilitis, neck sprain, shoulder pain and DeQuervain's tenosynovitis. These injuries may be common in bronchoscopists performing a high number of these procedures. Minimal research has been carried out in this regard, and the available data to measure the magnitude of this problem are scarce.

"…there seems to be an increased prevalence of work-related musculoskeletal injuries among bronchoscopists…"

In a recent online survey of practicing pulmonologists, 38.8% of respondents reported experiencing pain while operating a bronchoscope [4]. The most common locations for pain were the back, shoulder, wrist, thumb and neck. The problem is under-appreciated in most instances with 79% respondents seeking no treatment. As expected, longer procedures, lasting on average greater than 30 min, had a relative risk of 1.568 (95% CI: 1.053–2.190; p = 0.024) for being associated with pain compared with shorter procedures. Gender and height did not correlate with increased risk of pain. These results are similar to surveys conducted by gastroenterology physicians performing multiple endoscopies [5]. Thus, there seems to be an increased prevalence of work-related musculoskeletal injuries among bronchoscopists and this is more prone in the region of upper extremities, back and shoulders.

Repeated hand activities, high pinch force, contact stress and awkward postures

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are correlated with overuse injuries of the upper extremity [6]. Overuse injuries are presumed to be related to repeated microtrauma to tendons, ligaments, joints and ischemia to nerves [7]. Most of the available adult fiberoptic bronchoscopes on the market today, such as Olympus™, Fujinon™ and Pentaxial™ have an outer diameter ranging from 5.3 to 6 mm and working channels ranging from 2 to 2.8 mm [8]. The hand piece, usually held in the left hand, includes the tip deflection lever, working channel port, suction valve and buttons for taking photos. The right hand is used to guide the scope, apply torque and to do different procedures, such as biopsy, which require multiple pushing and pulling movements through the working channel. The distal tip has a deflector range of only 180° up and 120–130° down with all types of scopes. The lack of maneuverability, especially when attempting to reach distant lesions in the various segmental bronchi, creates muscular strain and fatigue on the operator. This entails severe wrist flexion and extension and ulnar and radial deviation, with additional stress on the neck and back muscles, plus shoulder and elbow joints for prolonged periods.

> "...there is a need to further explore causative factors and educate physicians regarding ergonomics at work."

Ergonomics is the scientific discipline studying the interactions among humans and other elements at work. The objective is to help design the work environment and optimize human well-being. Work-related injury can have an overwhelming impact on the physician's procedure-related diagnostic skills and adversely affect his/her income potential. Hence, there is a need to further explore causative factors and educate physicians regarding ergonomics at work. This assumes paramount importance along with the development of newer diagnostic procedures.

Several simple measures, such as maintenance of neutral position of the wrist, neck and shoulder postures during the procedure, keeping hand forces low, optimizing the work environment by adjusting the table to monitor height, positioning the monitor directly in front of the operator, ensuring adequate space in the unit for the equipments, as well as all the required personnel and appropriate radiation protection, may reduce the risk of injury. Scheduled mandatory breaks should be implemented between prolonged procedures. An exercise regimen for the wrist, elbow, neck, shoulder and back should be regularly performed. Other measures such as task rotation, alternating hands, changing postures regularly and eliminating holding objects in one hand for prolonged period can be easily carried out. This will help with increased safety, better productivity and job satisfaction for bronchoscopists.

Most importantly, research should be conducted on optimizing the design for the bronchoscope. Research is ongoing for miniaturization of several procedures with nanotechnology and capsule bronchoscopy, which in future will help with targeted therapy [9]. Real-time, 3D image acquisitions combined with endoscopic fiberoptic shape trackers are being developed in research institutions. Nevertheless, there is definitely a need for a more ergonomic design of the flexible bronchoscope to meet the present day challenges.

Currently, there are no specific guidelines in practice for bronchoscopists to follow. Rotating work schedules, proper tool design and exercise programs can improve bronchoscopy-related trauma to physicians. The authors recommend using a team approach, combining the expertise of specialists from occupational medicine, bronchoscopy nurses, technicians and physicians to form an ergonomics committee to study and establish a protocol to be followed in the bronchoscopy suite. Recommendations from other specialties, such as gastroenterology and laproscopic surgery, should be incorporated.

Thus, there is growing evidence that bronchoscopists are at risk for work-related injuries. As more advanced technologies are increasingly adopted for diagnostic precision, and steps are taken for patient safety and comfort, the safety of the person performing the procedure should be considered. The authors feel there is a need for better design of the scope, as well as the bronchoscopy suite to prevent work-related injuries. The simple steps mentioned above can be adopted to improve the work environment. We recommend further scientific study in this regard.

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