From an urologist view: Are we safe with endoscopic surgery? Overview of ergonomic problems encountered by the urologist during video endoscopic surgery

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D'un point de vue d'un urologue: Est ce que sommes-nous sûrs avec la chirurgie endoscopique ? Aperçu des problèmes ergonomiques rencontrés par l'urologue lors de la chirurgie endoscopique vidéo-assistée

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RÉSUMÉ

Prérequis : L'importance de la chirurgie mini-invasive en urologie a constamment augmenté ces 20 dernières années. La résection endoscopique de le prostate et des tumeurs vésicales est actuellement le traitement de référence, avec de nombreux avantages pour les patients.

But : Analyser les problèmes de santé liés aux conditions de travail rencontrés par les urologues lors de la chirurgie endoscopique a travers une revue récente de la littérature.

Methodes: Les études ergonomiques et les essais expérimentaux menées dans les domaines de l'urologie et la chirurgie endoscopique appliquée pour d'autres types de chirurgies ont été identifiés par la base de recherche PubMed. Les données des études ergonomiques ont été évaluées en terme d'efficacité ainsi que du point de vue confort et sécurité. Les postures de contrainte pour les urologues sont décrites et les exigences ergonomiques pour les positions optimales sont discutées.

Résultats: La chirurgie endoscopique en urologie est une chirurgie à haut risque ergonomique. L'importance de la flexion ou de l'extension du cou, de l'adduction ou de l'abduction de l'épaule, et la stabilité des extrémités supérieures lors de la chirurgie; qui sont maintenus dans une posture statique prolongée sont les principaux facteurs de risque. Toutes ces contraintes peuvent entraîner la fatigue articulaire et musculaire, des douleurs, et une éventuelle blessure musculo-squelettique. En outre, ces éléments peuvent avoir un impact négatif sur la précision chirurgicale.

Conclusion : La position de l'urologue, le temps opératoire et les conditions de formation de base sont des facteurs essentiels durant la chirurgie endoscopique pour la prévention des troubles musculo-squelettiques.

Mots-clés

Chirurgie peu invasive, endoscopie, chirurgie vidéo-assistée, sale opératoire, ingénierie humaine.

SUMMARY

Background : The importance of minimally invasive surgery in urology has constantly increased in the last 20 years. Endoscopic resection of prostate and bladder tumors is actually a gold standard with many advantages for patients.

Aim: To analyze the problems related to the ergonomic conditions faced by urologist during video endoscopic surgery by review of the recent literature.

Methods: All evidence-based experimental ergonomic studies conducted in the fields of urology endoscopic surgery and applied ergonomics for other professions working with a display were identified by PubMed searches. Data from ergonomic studies were evaluated in terms of efficiency as well as comfort and safety aspects. Constraint postures for urologists are described and ergonomic requirements for optimal positions are discussed.

Results: The ergonomics of urological endoscopic surgery place urologists at risk for potential injury. The amount of neck flexion or extension, the amount of shoulder girdle adduction or abduction used, and stability of the upper extremities during surgery; which are maintained in a prolonged static posture; are the main risk factors. All these constraints may lead to muscle and joint fatigue, pain, and eventual musculoskeletal injury. Moreover, these issues may impact surgical accuracy.

Conclusion : Urologist posture, operating period, training are important ergonomic factor during video surgery to prevent musculoskeletal disorders.

Key-words

Minimally invasive surgery, Endoscopy, Video endoscopic surgery, Operating room, Ergonomics, Human engineering.

Today, video endourologic surgery is the main part of urology practice. Scientific and practical knowledge regarding all aspects of this approach is extensive. Endourology offers multiple benefits to the patient, but what are its implications for the urologist? Is it comfortable? What effects could have a discontinued five-hour endoscopic operation have on posture, tiredness levels and the mobility of surgeon? What are the implications that these problems may have on the quality of surgical performance? Are there any long-term effects on the general health of the urologist?

This paper aimed to determine physical, perceptive and cognitive problems encountered by urologist with video endoscopic surgery in optimal ergonomic conditions after reviewing the recent literature. Some guidelines are also formulated.

METHODS

We conducted electronic database searches of PubMed and the Cochrane Library for articles published between January 1990 and June 2011. We used the keywords minimally invasive surgery, endoscopy, video endoscopic surgery, operating room, ergonomics and human engineering. All evidence-based experimental ergonomic studies, literature reviews, and randomized human studies conducted in the fields of urology endoscopic surgery and applied ergonomics for other professions working with a display were reviewed. Data from ergonomic studies were evaluated in terms of efficiency as well as comfort and safety aspects. Constraint postures for urologists are described and ergonomic requirements for optimal positions are discussed.

RESULTS

WHAT IS ERGONOMICS ?

Ergonomics is a relatively new field of science that is focused on the improvement of the working conditions (1). The science of ergonomics analyzes challenges and formulates guidelines for creating a work environment that is safe and comfortable for its operators while effectiveness and efficiency of the process are maintained.

Growing amounts of literature concerning the ergonomic problems of video endoscopic surgery are published (2). With the increasing use of endoscopy in urology, this is a very important topic for research. We have to know more about health conditions and general discomforts that may be associated with performing endoscopic surgeries on a long-term basis. These research data, will significantly contribute to improve the urology training project, safely and productivity.

For years, surgeons were used to perform their interventions by classical open surgery instruments that had the advantages of being short, solid, and easy to manipulate. They also had the advantage of direct tissue contact (3). Video endoscopic surgery has changed the bio-mechanical way in which surgeons manipulate tissues. The urologist surgeon loses direct contact with the surgical site. Rather than seeing the entire surgical field including adjacent organs, the surgeon's vision is restricted by an optic and camera system. Thus, things that could have been done in seconds in open surgery may take more time in video endoscopic surgery. This new technique has brought many advantages for the patient: reduction of pain after surgery, rapid recovery, and brief hospital stays (1, 4). However, it has been recognized that, if used improperly, it can also harm the patient. Moreover, owing to ergonomic problems, video endoscopic surgery can also hurt the surgical team.

ERGONOMIC CHALLENGES

The Space:

Usually, operating rooms (video endoscopic surgery room) are still being preferred for open surgery, leaving a narrow working site for the team (Figure 1). Hence, this would decrease efficiency and create physical and mental problems for the surgical team.

Figure 1: The video endoscopic surgery room is always overcrowded.

The instruments:

The ergonomic advantage of the video endoscopic surgery is mainly base on the fait that previous complications due to close coupling between the eye and the endoscope are solved and the surgeon's trunk and head can remain in an almost upright posture during the whole operation.

Actually, one of the main problems is inadequacy in the handle designs of endourologic instruments. The typical design of instrument handles could lead to pressure areas and nerve lesions. All these aspects would force the surgeon into unnatural and uncomfortable body postures (Figure 2-4) which could affect the outcome of the operation (5). Ergonomic measures should to allow urologist to maintain a more comfortable posture.

The monitor position:

Another major problem occurs when performing surgery using a monitor which is mainly due to the non ergonomic positioning of the monitor (6). The visual inspection of the monitor usually requires disadvantageous postures with long-term twisting of

the neck and trunk resulting in deficiencies in the perception-action compatibility (7).

During monitor endoscopy, a clear backward inclination of the head was observed for considerable percentages of time, since the monitor was positioned above eye level of the surgeons (Figure 2). Positioning at a lower level was, however, possible only to a limited extent, since the bottom of the monitor has to stay away from the thorax of the patient in a certain minimum distance. In the sagital plane when a monitor system was used, the trunk and head remain mostly in an upright position (8).

Figure 2: During monitor endoscopy, the operating area is controlled via a monitor. The trunk can be held in an almost upright position.

The urologist posture:

Even if the advantages of the monitor method seems to be obvious with respect to ergonomic work design, complete analysis of the postures which urologists adopted during the performance of endoscopic surgery remains very insufficient (8). Work-related musculoskeletal disorders, particularly of the upper extremities and the neck, have been reported in dentists (9). They have been implicated as the most common reason leading to premature retirement from the dental profession in a cohort of 393 dentists in the United Kingdom (10).

What's the situation for urologists?

No body has the answer. To date, no reports exist on the number of urologists who experience musculoskeletal fatigue and/or injury in the upper extremities, wrists, neck, and back. However, given the restrictions in urological surgery and the need for dexterity and fine motor control, we hypothesize that urologists may adopt suboptimal or inflexible working postures, which if maintained statically for an extended period of time. Furthermore, most urologists adopt operative positions based on their training and personal preferences and not incorporating ergonomically guided principles. These may lead to musculoskeletal disorders of the back, neck, or upper extremities.

The USA National Institute of Occupational Safety and Health (NIOSH) reports that there is strong evidence that working groups with high levels of static contraction, prolonged static loads, or extreme working postures involving the neck/shoulder muscles are at increased risk for neck, shoulder and back musculoskeletal disorders (11). Maintaining an extension neck posture of neck flexion greater than 15° to 20° for a prolonged period of time is an at-risk posture (11, 12). In an experimental study in healthy volunteers, cervical disc compression was insignificant for those maintaining their head in a neutral position (0°) for 1 hour when compared to those maintaining mild flexed neck positions (20° and 40°). The higher degree of neck flexion causes a considerable amount of cervical disc compression (13).

A relationship between muscle strength and strain has been proven (14). When maintaining these contractile forces and necessitating continuous and increasing muscle strength, the neck musculature is strained as increased and constant forces require continuous contraction, leading to prolonged fatigue.

Moreover, muscular strain was found to depend on the anthropometry of the surgeons: For surgeons with a body height over 180 cm, higher muscular activities were observed in the shoulder region than for smaller persons (15), even if the height of the operation table and the seat of the operating chair were adjusted according to the individual anthropometry.

Time

Whenever muscular activity leads to fatigue it can only be performed for a limited period of time and a loss in muscular performance is to be expected (16). An endoscopic resection may last up to two hours. During this time the surgeon's body posture must remain more or less static in order to stabilize the position of the endoscope. The rigidity of the body and the endoscope results in prolonged static load on the musculature, in particular in the shoulder region. This leads immediately to the development of fatigue in the muscles and a decline in muscular performance, with potentially negative consequences for the quality of the operation and significant complication risk (16).

Similar to the rising trends for intensive computer use in office workers, the risk of developing musculoskeletal disorders in urologist surgeons will be further increased due to the long hours of work and maintaining a static posture while performing movements of very fine eye-hand coordination (17). As a result, surgeons started to complain about fatigue, numbness, and tremor. Some studies demonstrate the increase on the electromyogram (EMG) of surgeons' forearms when laparoscopic instruments are used instead of classic instruments (18). It may be the same for endoscopic surgery.

In Tunisia, urologists in public hospitals usually perform the surgeries on 2-3 days weekly. The most commonly performed procedures are endourology. Thus, we can't ask them to operate for long hours (more than 3-4 hours/day) as done, irrationally, in most Tunisian University hospital. One solution would be alternating endoscopic and open surgery or alternating more than one urologist in the same operating room.

DISCUSSION

Urological endoscopic surgery places urologists at high risk for potential injury. The amount of neck flexion or extension, the amount of shoulder girdle adduction or abduction used, and stability of the upper extremities during surgery; which are maintained in a prolonged static posture; are the main risk factors. All these non ergonomic positions may lead to muscle and joint fatigue, pain, and eventual musculoskeletal injury which have an important impact on surgical accuracy.

The NIOSH recommended the avoidance of static loads, fixed work postures, and job requirements in which operators must for long periods lean to the front or to the side, hold a limb in a bent or extended position, or tilt the head forward more than 15° (19).

With respect to the reduction of postural stress, a chair with back support was proven to be a successful tool. Back support, used for a considerable time of more than one third of the operation duration; permit a considerable reduction in the myoelectrical activity of the erector spinae (8).

For the armrests, it is difficult to make a quantitative assessment regarding their benefit (8). Even if the time for the use of the left-hand armrest (right-hand for the left-handed) was not previously evaluated, its advantage seems to be obvious, since the left hand is used to stabilise the position of the rectoscope and the fixation of the instrument is effectively supported when the left elbow (right elbow for the left-handed) is placed on the armrest. The monitor position is an important ergonomic factor during video surgery. In the horizontal plain, the monitor should be straight in front of the surgeon and aligned with the forearm-instrument motor axis to avoid axial rotation of the spine. In the sagittal plain, the monitor should be positioned lower than eye level to avoid neck extension.

Thus, the reduction in muscular strain and fatigue may have a positive influence on the quality of the operation. If the urologist is not distracted to the same extent by the effects of fatigue, he is, better able to concentrate on the primary goals of an operation, e.g. the discrimination between pathological and healthy tissue and the complete endoscopic resection of lesions (20).

Many of these questions and others are being investigated. Several extensive studies and large surveys should be performed to investigate the ergonomics of endoscopic surgery in urology and to evaluate the awareness of urologists concerning the ergonomics of this procedure.

CONCLUSION

The ergonomics of urological endoscopic surgery place urologists at risk for potential injury.

The amount of neck flexion or extension performed, the amount of shoulder adduction or abduction used, and stability of the upper extremities during surgery; which are maintained in a prolonged static posture; are the main risk factors.

All these constraints may lead to muscle and joint fatigue, pain, and eventual musculoskeletal injury. Furthermore, these issues may impact surgical accuracy.

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