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# Intraoperative Nursing Practices in Laparoscopic Surgery: Challenges Encountered and Modern Technology Supported Solution Suggestions

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## ABSTRACT

Technological developments, which have gained great momentum in recent years, have profoundly affected the field of health services and paved the way for the widespread use of minimally invasive techniques such as laparoscopic interventions, especially in the surgical field. Laparoscopic surgery has gained an important place among modern surgical applications with the development of minimally invasive methods. However, this technological transformation in healthcare has not only brought innovations but also some structural and operational challenges. Laparoscopic surgery creates significant physical strain and cognitive stress on operating room nurses due to limited intraoperative field of view, limited motor range of motion, high level of equipment density and ergonomic limitations due to static working positions. The cables and connection systems used in laparoscopic interventions increase the risks of frequent falls, entrapment, and contamination of the sterile field; they also complicate the coordination of the surgical team. In addition to these situations, the rapid technological advances in the field of surgery and the integration of advanced devices bring about the need for continuous professional development and technological adaptation of operating room nurses. In this review study, the main challenges faced by operating room nurses during laparoscopic

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surgery are discussed in the light of the literature; modern technology-based solutions such as simulation-based trainings, ergonomic arrangements, artificial intelligence-based planning systems and cable management solutions are included. Therefore, in order to make laparoscopic surgery processes safer, more efficient and sustainable, innovative and holistic approaches need to be developed to manage the difficulties experienced by operating room nurses.

**Keywords:** Laparoscopic Surgery, Nursing Workforce, Operating Room Organization, Process Management

## INTRODUCTION

Laparoscopic surgery has been one of the most important developments in medicine in recent years, popularizing the use of minimally invasive surgical techniques. This method allows patients to recover faster, feel less pain and have shorter hospital stays thanks to operations performed through smaller incisions (Siddaiah-Subramanya et al., 2017). These advances in the application of laparoscopic surgery have enabled surgeons to perform more precise and effective operations, while also introducing innovative approaches to operational processes (Choi, 2012).

However, this technological transformation has not only brought several advantages in healthcare, but also new challenges and complications. The advanced equipment, innovative technology integrations and operational processes required by laparoscopic surgery significantly affect the way operating room teams work (Gerbrands et al., 2004). Especially operating room nurses are the main professional group directly affected by this change. The high density of surgical equipment, ergonomic constraints and static working positions increase the physical and cognitive burden of nurses, while also posing risks to patient safety (Schouten et al., 2025).

In this review study, the main challenges faced by operating room nurses during laparoscopic surgery will be discussed and the proposed solutions to overcome these challenges will be discussed. In the light of the literature, solutions based on modern technologies such as simulation-based training, ergonomic adjustments, artificial intelligence-based planning systems and cable management solutions play an important role in overcoming the challenges faced by nurses. In this context, it is critical to develop innovative approaches to perform laparoscopic surgery in a safer, more efficient, and sustainable manner.

## **Basic Features of Laparoscopic Surgery and Its Effects on Operating Room Dynamics**

The Industrial Revolution, which started in England in the second half of the eighteenth century, led to great developments in the field of mechanization and technology; one of the areas most affected by this transformation was the health sector (Dursun & Yılmaz, 2021). Technological developments that gained momentum with the Industrial Revolution caused significant changes in the provision of health services; especially in the surgical field, efforts to minimize surgical trauma and facilitate a faster recovery process led to the emergence of minimally invasive surgery (Barutcu et al., 2020). All over the world, especially since the mid-1990s, there has been a significant trend from open surgery to laparoscopic surgery (Gürbüz et al., 2011). Especially after laparoscopic procedures became well established in the mid-2000s, surgery gained momentum in the field of robotic and image guidance (Siddaiah-Subramanya et al., 2017).

Laparoscopy is performed with specially developed devices and surgical instruments. The endoscopy procedure, which is included in the laparoscopy intervention, is the examination of organs and cavities in the body with an endoscope for diagnostic and therapeutic purposes. The endoscope is long and thin, with a light source and a camera at its tip, enabling high-resolution visualization of the operation area. For laparoscopic surgery to be performed smoothly, not only is the endoscopy system sufficient, but also many specialized equipment must work in synchronization (Fanson et al., 2011).

This system, which forms the basis of laparoscopic surgery, includes trocars, laparoscopic camera systems, cold light sources, insufflator devices, electrocautery, monitors and various hand tools (graspers, scissors, clinch, etc.). The instruments used in laparoscopic surgery are identical to those used in open surgery in terms of basic function mechanisms. In laparoscopic surgery, instruments with an average size of 30–35 cm have 2–3 mm miniature tips at the end. Compared to open surgery, the number, diversity and importance of instruments and materials are higher (Gürpınar & Haliloğlu, 2010). The smooth operation of this equipment is critical for the safety of the patient, the safety of the operation and the success of the operation.

During the operation, the abdominal cavity is inflated with carbon dioxide gas using an insufflator (pneumoperitoneum), allowing easier visualization of internal organs and free movement of surgical instruments. The surgeon monitors all operations performed in this area on a monitor and performs interventions with hand manipulations performed with long special instruments

developed for laparoscopic surgery. In this process, both the technical capacity of the equipment and the surgeon's compatibility with technology play a decisive role (Basunbul et al., 2022). However, these technological advantages of laparoscopic surgery bring some difficulties due to the complex equipment density. This need for advanced equipment requires restructuring the operating room organization, training staff to use these systems effectively, and being prepared for technical failures. Furthermore, the installation, sterilization and preoperative control of this equipment are among the factors that directly affect the operation time and preparation stages. Therefore, laparoscopic surgery should be considered not only as a surgical technique but also as a high-tech teamwork. The success of the operation depends on the quality of the equipment used, the technological infrastructure and the coordination of the operating room team, as well as the experience of the surgeon (Berquer et al., 2002).

### **Challenges Encountered by Operating Room Nurses**

The technical nature of laparoscopic surgery brings various challenges for healthcare professionals in the operating room environment with features such as limited field of vision, limited range of motion, use of advanced technology and intensive equipment requirements. As a result of this technical structure, operating room nurses assume multifaceted responsibilities such as ensuring sterility, managing surgical instruments and devices, establishing effective coordination with the surgical team, and adapting to advanced technologies (Pazouki et al., 2017).

However, ergonomic difficulties encountered by nurses in laparoscopic surgeries—factors such as physical loading, cognitive stress and device-related safety risks—directly affect professional practices and may negatively affect patient safety and team collaboration (Gürbüz et al., 2011). Technological and methodological developments in laparoscopic surgery have significant effects not only on patients but also on the job descriptions and work processes of healthcare professionals (Schouten et al., 2025).

Unlike open surgery, in laparoscopic surgery the nurse is not only limited to instrumentation but also actively assists the surgeon. This makes the nurse's role in the intraoperative process more critical and significantly increases the workload. Inadequate knowledge and experience of the nurse may lead to prolonged operation time and increased risk of complications (Mitchell, 2007). Therefore, it is of great importance for laparoscopy nurses to feel that they are an indispensable part of the team and to act with the awareness of this responsibility to manage surgical processes safely and effectively.

Personnel involved in laparoscopic surgery (surgeons, nurses, technicians) experience more physical stress and mental tension compared to open surgery (Matern & Koneczny, 2007). Minimally invasive surgery requires the use of more equipment, limited body movements and prolonged static postures (Alexandre et al., 2017). In addition, loss of tactile feedback, decreased hand-eye coordination and limitation of natural dexterity are among the factors that increase ergonomic risks. The height and width of the operating tables used in laparoscopic surgery are mostly adjusted according to the comfort of the surgeon, which leads to ignoring the ergonomic needs of operating room nurses (Van Veelen et al., 2002). Inappropriate table height or physical force applied during patient transfer can cause musculoskeletal disorders in the neck, back, shoulders, arms and wrists (Özşaker, 2018). In addition, forced movements such as bending or leaning on the accessories fixed next to the operating table create pressure on soft tissues, causing tissue damage and pain (Choi, 2012).

Similarly, nurses cannot see the monitor clearly because the monitor placement in the operating room is mostly arranged according to the surgeon's angle of view, which causes challenging positions for the head, neck and trunk (Mitchell, 2007). Frequent posture changes and prolonged standing work to get a better view of the monitor cause discomfort in the lower extremities, especially in the thigh area (Gerbrands et al., 2004). In addition, perioperative nurses are exposed to high levels of mental ergonomic risks in the operating room environment. Rapidly changing shifts, frequent technology updates, unclear job descriptions, and equipment shortages lead to both impairments in perceptual-motor functions and increased mental stress (Haynes et al., 2015; Matern & Koneczny, 2007). Inadequate training, inadequate instrument use, and communication breakdowns between surgeons and nurses are among the main sources of this stress.

Due to the nature of laparoscopic surgery, many cables and connections are involved. Studies have shown that in 83% of operating rooms, equipment cables are placed irregularly; 79% of surgeons step on these cables during surgery and 53% think that this situation negatively affects the surgical process (Matern & Koneczny, 2007). The irregular placement of cables not only brings physical hazards such as falls and bumps, but also operational problems such as sterility deterioration and confusion (Haynes et al., 2015). Poorly designed instruments and equipment and ergonomically inadequate operating room designs can lead to increased fatigue and increased risk of medical errors (Alexandre et al., 2017). In conclusion, the physical and mental ergonomic challenges that operating room nurses working in laparoscopic surgery are

exposed to directly affect not only staff health but also the quality of the surgical process, patient safety and team collaboration. Therefore, systematic assessment of ergonomic risks and improvement of operating room design and working conditions accordingly are of great importance.

### **Technology Supported Solutions**

Posture disorders, inadequate equipment placement and communication deficiencies faced by surgeons in laparoscopic surgery negatively affect surgical efficiency and staff health. In this context, the use of adjustable operating tables offers a significant ergonomic improvement. Electric surgical tables, which can be adjusted in height over a wide range between 29 cm and 122 cm from floor level, reduce the burden on the musculoskeletal system by allowing the surgeon to work at elbow level (Berquer et al., 2002). New generation operating tables are equipped with sensors that can automatically adjust themselves by detecting the surgeon's center of gravity, thus eliminating the need for manual intervention. In addition, foam-backed surfaces placed on the sides of the table prevent tissue damage, especially in positions where nurses need to lean. Imaging monitors also play a critical role in ergonomics. Monitors should be mounted on ceiling boom systems that can be automatically aligned according to the surgeon's height and posture, making them viewable with a neutral posture; in this way, head and neck strains can be minimized (Choi, 2012). Studies show that positioning the monitor 15–45 degrees below eye level significantly reduces fatigue while improving surgical performance (Choi, 2012). On the other hand, breakdowns in communication between surgeons and nurses threaten the correct use of devices and operational continuity. Thanks to voice-controlled systems developed to address this situation, surgeons can manage devices such as light sources, insufflators and electrocautery with direct commands without disturbing sterility (Choi, 2012). In addition, intraoperative training seminars and simulation-based programs should be implemented to ensure more effective participation of operating room nurses and technicians in the process. The literature reveals that in minimally invasive surgical procedures, a fixed team performs faster, and error-free tasks than randomly assigned personnel (Choi, 2012; Fanson et al., 2011; Reddy et al., 2011). In conclusion, restructuring operating room ergonomics with technology-enabled solutions is a sustainable step towards preserving not only surgical efficiency but also the long-term occupational health of the surgical team.

## CONCLUSION AND RECOMMENDATIONS

Laparoscopic surgery has gained an important place in modern medicine with the development of minimally invasive surgical techniques and has offered many advantages in patient care. However, this technological transformation has brought with it the use of advanced equipment, complex operational processes and high levels of physical and mental burden.

The findings in the literature clearly demonstrate that nurses involved in laparoscopic surgery are exposed to multidimensional risks both physically and mentally. These difficulties can only be overcome by addressing both individual and system-based approaches together. In this context, it is recommended that the architecturally appropriate design and physical conditions of the operating rooms in the laparoscopic surgery process should be fully provided, the instruments and equipment used in surgery should be designed in accordance with ergonomic principles suitable for the use of the surgical team and qualified studies should be carried out in this field.

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