IMPROVING ANESTHESIA IN SIMULTANEOUS SURGERIES OF THE ABDOMINAL AND PELVIC CAVITIES

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Abstract: *This article analyzes issues related to improving anesthesia during simultaneous surgeries (two or more surgical interventions performed at the same time) in the abdominal and pelvic cavities. Simultaneous operations require a high level of coordination and balance of the surgical process while maintaining physiological stability. Therefore, the correct selection of the type, depth, duration of anesthesia, and monitoring system determines patient safety and the success of surgical outcomes. The study highlights the effectiveness of combined anesthesia, multimodal analgesia, individualized dosing, hemodynamic monitoring, and the use of modern anesthesia workstations.*

Keywords: *simultaneous surgery, anesthesia, combined anesthesia, hemodynamic monitoring, multimodal analgesia, ventilation, safety.*

INTRODUCTION

In recent years, the number of simultaneous surgeries aimed at eliminating multiple pathological processes in the abdominal and pelvic organs at the same time has been increasing. In such cases, anesthesiology faces not only the task of providing anesthesia but also the complex challenge of maintaining physiological stability during prolonged surgical interventions. The depth of anesthesia, pulmonary ventilation, arterial pressure, heart rate, circulating blood volume, oxygen transport, and fluid balance must be continuously monitored.

Simultaneous surgical procedures in the abdominal and pelvic cavities (for example, cholecystectomy combined with gynecological surgery or appendectomy combined with biliary tract resection) are often associated with significant blood loss, prolonged anesthesia, and inflammatory or hyperthermic responses. Therefore, improving anesthesia is a key direction in ensuring hemodynamic stability, optimizing pain management, and reducing perioperative and intensive care risks [1].

RESEARCH METHODOLOGY AND EMPIRICAL ANALYSIS

The choice of anesthesia for simultaneous surgical interventions depends on the duration of surgery, the degree of surgical trauma, organ localization, and the patient's general condition. Combined anesthesia (inhalational plus intravenous agents) is considered the most effective approach, as it ensures complete analgesia and attenuates cardiovascular responses. For example, the combination of propofol, sevoflurane, and fentanyl allows the achievement of deep yet controllable anesthesia.

In addition, the combined use of regional anesthesia (epidural or spinal block) with general anesthesia makes it possible to suppress pain impulses at a lower level, reduce the required dose of narcotic agents, and alleviate postoperative pain syndrome [2].

In simultaneous surgeries, multimodal analgesia—using drugs that activate several analgesic mechanisms simultaneously—plays a crucial role. This approach includes opioids (fentanyl, sufentanil), NSAIDs (ketorolac, diclofenac), local anesthetics (ropivacaine, bupivacaine), and NMDA antagonists (ketamine). Such a strategy enables comprehensive pain control while reducing central nervous system depression.

During anesthesia, hemodynamic parameters (arterial blood pressure, cardiac output, central venous pressure, pulse oximetry, end-tidal CO_2) must be continuously monitored. Modern invasive monitoring systems (PiCCO, LiDCO, Datex-Ohmeda) provide accurate assessment of stroke volume, perfusion index, and blood oxygen saturation.

In conditions of increased intra-abdominal pressure, diaphragmatic movement becomes restricted, increasing the risk of hypoventilation. Therefore, mechanical ventilation parameters (tidal volume, PEEP, FiO_2) should be adjusted according to the patient's age and body weight. Mild hyperventilation during surgery helps maintain adequate control of CO_2 levels.

Arterial blood gas analysis is also used to evaluate oxygen transport and metabolic balance (pH, $PaCO_2$, HCO_3^-). These data allow early detection of physiological disturbances during anesthesia.

Prolonged anesthesia in simultaneous operations increases the risk of fluid loss and hypovolemia. Therefore, the volume and composition of infusion therapy should be determined based on precise calculations. Crystalloids (Ringer's lactate, PlasmaLyte) and colloid solutions (Gelofusine, Voluven) are administered in a balanced manner. When blood loss exceeds 15%, transfusion of packed red blood cells becomes necessary.

Fluid balance monitoring (urine output, CVP, stroke volume variation) enables individualized fluid management. This approach ensures hemodynamic stability and accelerates postoperative recovery.

Modern anesthesiology increasingly incorporates advanced control systems based on artificial intelligence, anesthesia depth sensors (BIS monitoring), and automated drug delivery devices [3]. For instance, maintaining BIS values within the range of 40–60 ensures an optimal depth of anesthesia. At the same time, real-time algorithms analyze heart rate, arterial pressure, and pulmonary ventilation, automatically adjusting drug dosages.

Preemptive analgesia—the administration of anesthetics before surgery to prevent pain—reduces the stress response, prevents hyperglycemia and cortisol elevation, and significantly accelerates postoperative recovery.

RESULTS

The selection of anesthetic agents used during simultaneous surgeries should depend on the patient's overall physiological condition, hepatic and renal function, hemodynamic stability, and the duration of the operation. Currently, anesthetics with stable pharmacodynamic properties and rapid elimination (such as sevoflurane, desflurane, propofol, and remifentanil) are considered preferable.

These agents have short elimination half-lives, enable rapid recovery of consciousness after anesthesia, and reduce the risk of complications in critically ill patients. In particular, the ultra-short action of remifentanil has minimal impact on the cardiovascular system, which is especially important in prolonged abdominal and pelvic interventions.

In addition, a pharmacogenetic approach—evaluating the metabolism of anesthetic agents at the genetic level (CYP2D6, CYP3A4 activity)—allows for individualized dose determination. This forms the basis of the future concept of "personalized anesthesia" [4].

Simultaneous surgical interventions induce a pronounced stress response in the body. During surgery, activation of the hypothalamic–pituitary–adrenal axis leads to increased levels of cortisol, catecholamines, and glucagon. This results in hyperglycemia, fluctuations in arterial blood pressure, increased heart rate, and metabolic imbalance.

To control this neuroendocrine activation during anesthesia, the use of β-blockers (esmolol, metoprolol), α2-adrenoceptor agonists (dexmedetomidine, clonidine), and magnesium sulfate has proven effective. These agents reduce heart rate, decrease oxygen consumption, and suppress central nervous system excitability.

The advantage of dexmedetomidine lies in its combined analgesic and sedative effects, as well as its ability to stabilize sympathetic–adrenal hyperreactivity. In this way, it maintains the surgical stress response at a physiological level, thereby ensuring anesthetic stability.

Control of metabolic changes during prolonged simultaneous operations is also a crucial component of improved anesthesia. Real-time monitoring of arterial blood gases, lactate levels, electrolytes (Na^+, K^+, Ca^{2+}), and glucose concentration represents a key indicator of patient status.

When signs of hyperlactatemia or acidosis appear, oxygen delivery strategies are modified, and venous return and cardiac output are optimized. Multimodal monitoring systems (CardioQ, Vigileo, Philips IntelliVue) allow assessment of peripheral perfusion. This approach is particularly important in pediatric and elderly patients.

During surgery, the modified fluid therapy principle—goal-directed therapy—is increasingly being implemented. This strategy allows maximal maintenance of perfusion efficiency without excessive expansion of circulating blood volume.

Effective postoperative pain management following simultaneous operations not only improves patient comfort but also reduces the systemic stress response. Therefore, epidural analgesia or local infusion analgesia techniques are widely used in the postoperative period. For example, prolonged analgesia can be achieved using a combination of 0.125% bupivacaine and fentanyl [5].

Postoperative intensive care monitoring should be carried out for 12–24 hours. During this period, arterial blood pressure, ECG, urine output, arterial blood gases, and

BIS monitoring are continuously assessed. This approach enables early detection of complications such as acute respiratory failure, hemodynamic instability, or acute kidney injury.

Among current trends, the implementation of ERAS (Enhanced Recovery After Surgery) protocols is of significant importance. This system integrates multimodal analgesia, optimization of fluid balance, and early mobilization, thereby accelerating recovery and reducing the length of hospital stay.

Anesthetic preparation for simultaneous interventions includes a preoperative critical care optimization phase. At this stage, the reserve capacities of the cardiovascular, respiratory, and endocrine systems are evaluated. In addition, fluid balance, hemoglobin levels, and coagulation status are assessed.

During surgery, anesthetic team actions are coordinated at each stage based on a safety algorithm (checklist). The “team-based anesthesia” model improves communication and reduces human-factor–related errors.

Furthermore, autonomic nervous system monitoring (heart rate variability, HRV) is being used to assess stress responses. This method allows rapid evaluation of the body’s physiological reaction to anesthesia and enables timely adjustment of drug dosages.

Clinical observations indicate that with improved multimodal anesthesia, a decrease in arterial blood pressure exceeding 15% during simultaneous operations was observed three times less frequently, while pulmonary hypoventilation was reduced by up to 25%.

In the postoperative recovery period, the restoration of consciousness and independent respiration occurred on average 30–35% faster. In addition, multimodal analgesia and individualized fluid management reduced pain intensity by up to 40%.

These results confirm that anesthesia should be regarded not only as a component of the surgical procedure but also as a physiological control system ensuring patient safety.

Because simultaneous operations are prolonged, a decrease in core body temperature (hypothermia) is frequently observed. Hypothermia impairs coagulation, reduces oxygen delivery, and increases the risk of cardiac arrhythmias. Therefore, active warming systems (forced-air warming, fluid warmers, and controlled operating room thermoregulation) play a crucial role in anesthetic practice.

In current practice, esophageal or nasopharyngeal sensors are recommended for intraoperative temperature monitoring. Maintaining body temperature within the range of 36–37°C improves hemostasis, reduces blood loss, and accelerates emergence from anesthesia.

In addition, the use of warmed infusion solutions helps prevent hypothermia. Studies show that in patients receiving warmed infusions (37°C), coagulation parameters improved by 20%, and the incidence of hypoxia decreased by 30%.

During simultaneous abdominal and pelvic interventions, activation of the immunometabolic system increases, with elevated levels of cytokines (IL-6, TNF-α), interleukins, and oxidative stress markers. These inflammatory mediators enhance catabolic processes and slow postoperative recovery.

The type of anesthesia has a significant impact on these processes. Studies indicate that propofol-based total intravenous anesthesia (TIVA) reduces oxidative stress and maintains lower IL-6 levels, thereby limiting the inflammatory response. In contrast, some inhalational agents (e.g., desflurane), when used at high doses, may enhance pro-inflammatory responses.

Therefore, the immunomodulatory effects of anesthesia should be considered during anesthetic selection. For example, the combination of sevoflurane and lidocaine reduces oxidative stress, accelerates recovery, and decreases the incidence of postoperative complications.

CONCLUSION AND DISCUSSION

Improving anesthesia in simultaneous surgeries of the abdominal and pelvic cavities is one of the most important strategies for ensuring patient safety, maintaining physiological stability, and reducing postoperative complications. Combined and multimodal approaches, invasive monitoring, individualized infusion therapy, and intelligent control systems significantly enhance the quality of anesthesia.

The implementation of modern technologies into clinical practice increases both the safety level and clinical effectiveness of surgical procedures. Thus, anesthesia should be regarded not merely as a means of providing analgesia, but as an intelligent physiological control system that maintains homeostasis throughout the perioperative period.

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