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Pressurized Intraperitoneal Aerosol Chemotherapy (PIPAC) Procedure, Complications and Nursing Care

Basınçlı İntraperitoneal Aerosol Kemoterapi (PIPAC) Prosedürü, Komplikasyonları ve Hemşirelik Bakımı

This review was presented by the researcher the 5th International 13th National Turkish Surgical and Operating Room Nursing Congress - 2023, poster form.

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Abstract

Pressurized Intraperitoneal Aerosol Chemotherapy (PIPAC) is a minimally invasive procedure used to treat cancer. It involves using trocars to deliver aerosolized chemotherapy drugs directly into the abdominal cavity, aiming to target cancer cells while minimizing systemic toxicity. Although the procedure has advantages, it can also lead to several complications, including abdominal pain, bleeding, deep vein thrombosis, intestinal obstruction, ascites, and chemotherapy-related side effects. Common side effects include nausea, vomiting, diarrhea, loss of taste, allergies, and intestinal irritation, all of which can affect the patient's quality of life and adherence to treatment. The role of the operating room nurse is critical in managing these complications. Nurses are responsible for monitoring patients closely, identifying early signs of complications, and ensuring that patients are properly informed about how to manage potential issues. They also play a key role in administering medications and providing necessary psychosocial support. Effective nursing care before, during, and after the procedure helps to mitigate complications and improve patient outcomes. Nurses must remain vigilant throughout the process, ensuring that patients receive comprehensive care and support. In conclusion, nurses play an essential role in managing PIPAC patients and should be actively involved at every stage of the procedure.

Keywords: Chemotherapy**,** intraperitoneal chemotherapy, nursing care

Özet

Basınçlı İntraperitoneal Aerosol Kemoterapi (PIPAC) kanser tedavisinde kullanılan minimal invaziv bir prosedürdür. Aerosolize kemoterapi ilaçlarını doğrudan karın boşluğuna vermek için trokarların kullanılmasını içerir ve sistemik toksisiteyi en aza indirirken kanser hücrelerini hedeflemeyi amaçlar. Prosedürün avantajları olmasına rağmen, karın ağrısı, kanama, derin ven trombozu, bağırsak tıkanıklığı, asit ve kemoterapiye bağlı yan etkiler gibi çeşitli komplikasyonlara da yol açabilir. Yaygın yan etkiler arasında bulantı, kusma, ishal, tat kaybı, alerji ve bağırsak tahrişi yer alır ve bunların tümü hastanın yaşam kalitesini ve tedaviye bağlılığını etkileyebilir. Ameliyathane hemşiresinin rolü, bu komplikasyonların yönetilmesinde kritik öneme sahiptir. Hemşireler hastaları yakından izlemekten, komplikasyonların erken belirtilerini tespit etmekten ve hastaların olası sorunları nasıl yönetecekleri konusunda doğru şekilde bilgilendirilmelerini sağlamaktan sorumludur. Ayrıca ilaçların uygulanmasında ve gerekli psikososyal desteğin sağlanmasında da kilit rol oynarlar. İşlem öncesinde, sırasında ve sonrasında etkili hemşirelik bakımı, komplikasyonların azaltılmasına ve hasta sonuçlarının iyileştirilmesine yardımcı olur. Hemşireler süreç boyunca tetikte olmalı ve hastaların kapsamlı bakım ve destek almasını sağlamalıdır. Sonuç olarak, hemşireler PIPAC hastalarının yönetiminde önemli bir rol oynamaktadır ve prosedürün her aşamasında aktif olarak yer almalıdır.

Anahtar Kelimeler: Hemşirelik bakımı, intraperitoneal kemoterapi, kemoterapi

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1. Introduction

1.1. Pressurized Intraperitoneal Aerosol Chemotheraphy Procedure

Pressurized Intraperitoneal Aerosol Chemotherapy (PIPAC), developed in recent years, is a minimally invasive approach based on physical principles to enhance the efficiency of intraperitoneal drug delivery targeting cancer cells within the abdominal cavity. PIPAC is administered under general anesthesia and during the surgical procedure, the drug solution in aerosol form is sprayed into the abdominal cavity under specific pressure. To ensure the expected therapeutic effect of the drug in tissues, environmental parameters (temperature, pH, etc.) need to be optimized. The drug solution is homogeneously dispersed. It acts directly on the cancer cells, inhibiting their growth or causing cell death (Balmer et al., 2022; Shree et al., 2020).

When administered intravenously, drugs can progress more easily and exhibit orientation towards areas with less resistance. Chemotherapy drugs also have this property when administered as liquids. Therefore, when chemotherapy drugs are administered as liquids, they interact with tissues outside the intended cancerous area (Ben Aziz et al., 2023; Nadiradze et al., 2019; Park et al., 2022). PIPAC, performed by placing a specialized catheter into the peritoneum, is a laparoscopic procedure. It is implemented during surgical intervention with the following steps:

- Maintaining intra-abdominal pressure at 12 mmHg, normothermic CO2 insufflation is applied using two standard balloon trocars.
- The chemotherapy drug is administered in aerosol form within this gas.
- The surface of the peritoneum is covered with the aerosolized chemotherapy drug, with a temperature of 42.5-43 °C.
- 30 minute waiting period is observed for the aerosol to take effect and the procedure is concluded.
- The PIPAC procedure can be repeated if necessary (at intervals of 6-8 weeks) (Graversen et al., 2018; Nadiradze et al., 2020; Solanki et al., 2019).

According to the literature, PIPAC alone or in combination with systemic chemotherapy is more effective than intravenous chemotherapy alone. In particular, PIPAC delivers high concentrations of drugs directly to the tumor site in intraabdominal metastases, resulting in better treatment responses and reduced systemic toxicity (Alyami et al., 2019; Tidadini et al., 2022). Although PIPAC is a method that enhances the effectiveness of intraperitoneal drug delivery, it has some advantages and disadvantages.

1.2. Advantages of Pressurized Intraperitoneal Aerosol Chemotherapy Procedure

Direct Effect: The PIPAC method acts directly on cancers located in the peritoneum. Rather than acting systemically like other cancer treatments, it works by directly targeting cancer cells (Case et al.,

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2022; Mohammad et al., 2022; Nadiradze et al., 2019).

High Efficacy: The aerosolized chemotherapy medication may affect directly on the cells in the peritoneum with the help of pressure and make smaller the tumors (Case et al., 2022; Mohammad et al., 2022; Nadiradze et al., 2019).

Fewer Side Effects: The PIPAC method causes fewer side effects than other cancer treatments and the patient's quality of life is more easily maintained after treatment.

Repeatable: The PIPAC can be applied again in case the tumor grows again, as like the others have cancer treatment methods.

Suitability for Untreatable Patients: The PIPAC can be applied palliatively in patients for whom other cancer treatment methods are insufficient (Case et al., 2022; Mohammad et al., 2022; Nadiradze et al., 2019).

1.3. Disadvantages of Pressurized Intraperitoneal Aerosol Chemotherapy Procedure

High Cost: The PIPAC is more expensive than other cancer treatments. Therefore, it is economically disadvantageous for some patients.

Side Effects: The PIPAC may cause side effects such as fatigue, nausea, vomiting, diarrhea, hair loss.

Surgical and Drug Risks: Since the PIPAC is a procedure, it may cause medication toxicity and undesirable conditions such as bleeding and organ damage.

Limited Applicability: PIPAC is only used to treat cancers that are located in the peritoneum, making it unsuitable for treating other types of cancer.

Knowledge and Experience: PIPAC requires a team with the knowledge and experience to perform the procedure and specialized equipments. (Khosrawipour et al., 2016; Mohammad et al., 2022; Nadiradze et al., 2019).

The PIPAC method is effective in treating cancers that affect the lining of the abdomen (peritoneum), usually cancers of the gastrointestinal tract. These cancers include stomach cancer, pancreatic cancer, ovarian cancer, colon cancer and rectal cancer (Alyami et al., 2021; Mimouni et al., 2021; Mohammad et al., 2022).

1.4. Pressurized Intraperitoneal Aerosol Chemotherapy Complications and Management

In addition to the benefits of the PIPAC procedure for patients, there are also many risks of postoperative complications. In the postoperative period, the PIPAC procedure contributes to a lot of complications. The most common complications of surgical procedures are abdominal pain, bleeding, deep venous thrombosis, intestinal obstruction, ascites, surgical site infections, and chemotherapy medication's side effects. Also, the side effects of chemotherapy medications are well known. In particular, allergy, loss of taste, nausea, and vomiting may occur because of the effect of drugs on the stomach and intestines, while irritation in the intestines may lead to diarrhea. For this reason, it is important that patients receive supportive therapies and adjust their diet to manage complications after the PIPAC procedure. Nurses should closely monitor surgical procedure complications in patients, take

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appropriate precautions to manage them, and make efforts to improve patient comfort (Bakkers et al., 2023; Hu et al., 2023).

After the PIPAC procedure, patients are expected to have mild abdominal pain for a few days. The pain usually occurs within the first 24 hours and lasts between 1-3 days (Tidadini et al., 2024; Tidadini et al., 2022). The most basic method for the treatment of abdominal pain is analgesic medication. Abdominal pain complications can be controlled when the three-step analgesic treatment specified by World Health Organization (WHO) is performed. Analgesics should be administered at regular intervals before the onset of pain. Analgesics should be administered in sufficient doses to provide adequate analgesia with minimal side effects. Side effects should be explained to the patient and treated appropriately. At present, the management of postoperative acute and chronic pain is mainly achieved through thoracic epidural anesthesia combined with opioids (Wang & Li, 2020).

During PIPAC, bleeding due to tumors may occur around the trocars. Postoperative bleeding within 30 days has been reported, with an incidence of 1.7% to 8.3%. The patient should be monitored for bleeding complications, trocar site control, hemogram values, and melena (Lundbech et al., 2020).

In the management of deep vein thrombosis (DVT) complications after the PIPAC procedure, the risk of DVT should first be identified. Applications such as anticoagulant prophylaxis and compression stockings can be used as recommended in ERAS (Enhanced Recovery After Surgery) protocols (Li et al., 2019).

Intestinal obstructions and ascites resulting from peritoneal cancer have significant negative effects on the patient's quality of life. Urinary tract injuries or unrecognized intestinal damage throughout the procedure, may cause ascites development after the procedure (Račkauskas et al., 2021). Peritoneal dialysis may be preferred if necessary, in the treatment of ascites during the PIPAC procedure. Tumors originating from the gastrointestinal tract can directly lead to intestinal tract obstruction. The gas and chemotherapy medications used in the PIPAC may cause diarrhea or constipation in patients (Balmer et al., 2022). For intestinal obstruction, standing up of the patient and active and passive movement in bed are effective in preventing intestinal obstruction. (Ellebæk et al., 2020; Nadiradze et al., 2019).

The incidence of surgical site infection after PIPAC varies between 11% and 46%. These patients are also at high risk for postoperative abdominal infections and septic complications. Aggressive screening protocols and high intra- and postoperative alertness are recommended to minimize and quickly identify all possible infectious complications after PIPAC (Vallicelli et al., 2021).

Patients at risk of a chemotherapy allergy are identified. Allergy symptom findings—more serious reactions such as urticaria, itching, hypertension, general restlessness, shortness of breath, cyanosis, bronchospasm, chest pain, back pain, hypotension, and tremor—are evaluated. If a reaction occurs, the infusion is stopped. Oxygen is administered to maintain saturation at 90% or higher. Medications are administered to help resolve the reaction (Siebert et al., 2019).

Loss of taste is an extensive side effect throughout standard chemotherapy treatments, typically when chemotherapy medications are given systemically. Loss of taste is associated with neural and sensory

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changes caused by the damage caused by chemotherapy affecting cells. Patients who experience loss of taste can apply for supportive therapies to decrease this side effect. Changes in patients' sense of taste after PIPAC procedure should be evaluated with objective and subjective tools. Regulating patients' diets, avoiding foods that cause unpleasant taste sensations, and choosing foods rich in nutrients can help reduce taste loss complications. Interventions such as eating small and frequent meals, consuming preferred foods, consuming fresh vegetables and fruits, chewing sugar-free or flavored gum or using mints, and brushing teeth can be applied. In cases of taste changes, the patient and their family should be educated to reduce or eliminate the severity of the taste change (Bakkers et al., 2023).

Nausea and vomiting may occur due to cancer, but they may also occur due to treatment, metastases, metabolic diseases, or other medications. The chemotherapy medications given throughout the PIPAC procedure affect the stomach and intestines and can forward signals to the brain, triggering nausea and vomiting (Rouche et al., 2020). Nausea and vomiting can negatively influence patients' quality of life and decrease treatment compliance. Hence, it is important to prevent or relieve these side effects by administering antiemetic medication and appropriate supportive therapies before and after the PIPAC procedure. The form, occurrence, and severity of nausea and vomiting are defined. External factors that cause nausea and vomiting are evaluated, and solutions are developed for them. The patient's meal intake, fluid intake, content of meals, number, frequency, and characteristics of meals are evaluated. Proper oral hygiene is ensured (Bakkers et al., 2023; Deng et al., 2022; Weibel et al., 2020).

Diarrhea may rarely happen after PIPAC. In patients who experience diarrhea after PIPAC, supportive treatments can be used to reduce this side effect. Nurses provide individualized care to patients by taking measures to relieve diarrhea complications, such as encouraging restriction of high fibre consumption, monitoring fluid intake and administering antidiarrheal medications as per surgeon advice (Bakkers et al., 2023; Jansen-Winkeln et al., 2023; Teixeira et al., 2017).

1.5. The Role of the Operating Room Nurse in the Pressurized Intraperitoneal Aerosol Chemotherapy Procedure and Nursing Care

Pressurized intraperitoneal aerosol chemotherapy is a surgical procedure performed under sterile conditions in the operating room (OR). The patient becomes undefended to many complications. The OR nurse is involved in preventing the patient from complications and in the successful implementation of the procedure (Chellam Singh & Arulappan, 2023; Dunn et al., 2019). The roles of the OR nurse throughout the PIPAC procedure are as follows:

Patient Preparation and Operating Room: The OR nurse performs preoperative preparations for the patient prior to the PIPAC procedure. These preparations include sterilization of the OR and surgical instruments and proper cleaning of the patient's operating area (Dunn et al., 2019).

Ensuring the Organization of the Team and Equipment: The PIPAC procedure is generally performed with the accession of a multidisciplinary team. The OR nurse ensures the coordination and communication of this team and organizes the preparedness of the medical equipment to be used throughout the procedure (Chellam Singh & Arulappan, 2023; Dunn et al., 2019).

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Identity Verification: Identity verification is a preventative procedure to ensure patient safety in all patient-related procedures and to avoid errors caused by patient confusion. Information such as the personal identification number and/or the patient's name, surname, and date of birth is used throughout the identity confirmation stage. This information is checked by processes such as patient ID (identification) wristbands or electronic authentication systems to verify that the patient is the correct person (Chellam Singh & Arulappan, 2023).

Time-out Process: It is a safety process made with the accession of all in the surgical team. All details about the PIPAC procedure are reviewed and verified. The time-out process provides a final control mechanism to ensure that the entire team has a common understanding of the procedure and to prevent errors (Papadakis et al., 2019; Robella et al., 2022).

Patient Positioning and Monitoring: The OR nurse is responsible for positioning the patient supine for the PIPAC procedure. It is the responsibility of the OR nurse to protect the patient from any pressure damage. The OR nurse regularly monitors the patient's vital signs (Valle et al., 2015).

Infection Control: The PIPAC procedure utilizes two balloon trocars. The OR nurse uses sterile techniques to minimize the risk of infection and maintains aseptic technique in the operating field (Valle et al., 2015; Yurttas et al., 2018).

Maintaining Fluid and Electrolyte Balance: Throughout the PIPAC procedure, changes in the patient's fluids and electrolyte values may consist as chemotherapy drugs are aerosolized inside the abdominal cavity. Consequently, it is important to carefully monitor the patient's fluid and electrolyte balance (Ryu & Koo, 2021).

Maintaining Body Temperature: The temperature of chemotherapy drugs used throughout the PIPAC procedure is 42-43 °C. The temperature of the human body can be affected by the temperature of the drug used. For this reason, the body temperature should be maintained by checking it regularly. The temperature of the OR should be between 22.3-22.6°C (Ben Aziz et al., 2023; Yurttas et al., 2018).

Drug Administration: The PIPAC procedure includes the management of aerosolized chemotherapy drugs inside the abdominal cavity. The OR nurse takes part in the management of the chemotherapy drug (Ben Aziz et al., 2023).

Safety of Instrument Counting: Since many different materials are used in the PIPAC procedure, counting the materials after the procedure is important for patient safety (Bhatt et al., 2016; Clerc et al., 2021).

Personal Safety: Throughout the PIPAC procedure, the use of suitable personnel protective equipment for medical personal is momentous to provide personal safety by decreasing the risk of exposure to aerosolized chemotherapy drugs. The OR nurse should supervise the use of protective equipment for herself/himself and the surgical team (Bhatt et al., 2016; Clerc et al., 2021; Robella et al., 2022).

Reporting: Progressively records the patient's vital signs, doses of drugs administered, and other information during the procedure (Bhatt et al., 2016; Clerc et al., 2021).

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The OR nurse plays a vital role in the perioperative care of the patient during the PIPAC procedure.

In the PIPAC procedure, patients' actual health conditions and medical history are exactly appraised in the preoperative period. An individualized diagnosis is made by questioning factors like the patient's gender, age, medical history, allergies, chronic diseases, medications, and surgical background. In this instance, it is important to communicate effectively with the patient and take time to answer the patient's questions. Moreover, a computed tomography (CT) scan is performed before the procedure to determine the scope and spread of the disease and to plan abdominal accession. Since the chemotherapy drug will be administered as an aerosol, the OR must have an advanced ventilation system. OR nurse is responsible for preparing the OR and organizing the team and equipment for PIPAC procedure (Solanki et al., 2019; Shree et al., 2020).

During the perioperative period, the PIPAC procedure includes patient identity verification, positioning, protection from infection, medication management, maintaining body temperature, and maintaining fluid and electrolyte balance. Throughout the procedure, the nurse is liable for performing the time-out process, the safety of counting the materials used throughout the procedure, the safety of the personnel, and the declaring of nursing interventions planned and performed throughout the procedure (Girardot-Miglierina et al., 2021; van Stein et al., 2022; Wahidi et al., 2022; Wajekar et al., 2022).

Throughout the PIPAC procedure, the nurse carefully monitors the patient's common situation, vital signs, and medication management and takes necessary supportive measures (Hübner et al., 2020; Sgarbura et al., 2022; Solanki et al., 2019; Wahidi et al., 2022).

Nurses also provide support to reduce patients' fear and anxiety throughout the procedure by meeting their physical and emotional needs. Moreover, informing patients and their families about PIPAC and providing reliable and accurate information regarding the procedure is an important role of the nurse within the context of an educational role (Ben Aziz et al., 2023; Girardot-Miglierina et al., 2021). This process can be summarized as preparing the patient for surgery, educating the patient, planning the necessary medical tests, and providing physical and psychological support (Hübner et al., 2020; Sgarbura et al., 2022; Solanki et al., 2019; Wahidi et al., 2022).

2. Conclusion

In conclusion, compared to intravenous chemotherapy treatment, treatment with the PIPAC method, in which the chemotherapy drug is given by pressure into the abdomen, is more effective. Since chemotherapy drugs are applied directly to the abdominal area during the PIPAC procedure, a lot of complications are observed. The most common complications include abdominal pain, bleeding, deep vein thrombosis, intestinal obstruction, ascites, and side effects of chemotherapy drugs. Due to the effects of chemotherapy drugs on the stomach and intestines, side effects such as allergies, loss of taste, nausea, vomiting, intestinal irritation, and diarrhea can occur. Controlling and managing the complications that occur is important for the patient's quality of life and continuity of life. Nurses must be prepared for all complications that may be encountered. Various methods are used to manage the complications encountered during the PIPAC procedure. The PIPAC is a surgical procedure

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performed in the OR under sterile conditions and anesthesia. The patient becomes vulnerable to many complications. Nurses are responsible for protecting the patient from complications and ensuring the successful implementation of the procedure. The PIPAC treatment is a complicated procedure that requires individualized nursing care that can positively influence patient results. Nursing care during the period of perioperative involves verifying patient identity, ensuring proper positioning, protecting against infection, maintaining body temperature, and balancing fluids and electrolytes. Throughout the procedure, the nurse is responsible for conducting the timeout process, ensuring the safety of materials and personnel, and documenting the nursing interventions planned and carried out during the procedure. Enhancing nurses' knowledge of PIPAC and adherence to established guidelines contribute to more successful outcomes in patient care.

Authors Contributions

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Conflict of Interest

The authors declare that there is no conflict of interest.

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