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Pain management and complications in children undergoing surgical treatment for childhood cancers: A systematic literature review

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Abstract

Objectives: This study aimed to examine in detail the scientific research articles on children undergoing surgical treatment for childhood cancers.

Materials and methods: In this systematic literature review, scientific research articles on children who received surgical treatment for childhood cancers between January 1, 2014, and August 1, 2024, were scanned using international databases. A total of 1,490 articles were reached in the databases, and eight articles that met the inclusion criteria were examined in detail.

Results: When the designs of the studies were examined, one was quasi-experimental, and seven were descriptive studies. All studies were retrospective. When the samples of the studies were analyzed, it was determined that five (62.5%) had a sample size >50. Two (25%) studies were conducted with pediatric patients with pancreatic tumors. The study topics were short- and long-term complications, postoperative pain management, postoperative anxiety, depression, and quality of life, and comparison of different surgical methods.

Conclusion: There is a limited number of studies on surgical interventions in children with solid tumors. It is recommended to conduct experimental studies with a large sample size in this vulnerable population.

Keywords: Complications, hildhood cancer, pain, systematic review.

Cancer is a general term for a group of diseases that can affect any part of the body, characterized by abnormal and uncontrolled proliferation of cells and invasion into surrounding tissues, causing destruction.[1] Childhood cancers are a heterogeneous group of malignancies with different etiological factors, pathophysiological characteristics, clinical presentation, treatment and care processes, and risk of acute/chronic side effects compared to adult cancers.[2] Childhood cancers are rarer than adult cancers and account for approximately 2% of all cancers. In 2024, it is estimated that 9,620 children (0 to 14 years) and 5,290 adolescents (15 to 19 years) in the USA will be diagnosed with cancer, and a total of 1,590 will experience cancer-related mortality.[3] National and international data demonstrate that the most common malignancy of childhood is leukemia. The second most common cancer types in the world are nervous system tumors (astrocytoma, medulloblastoma, ependymoma, and atypical teratoid/rhabdoid tumors), and the third most common is lymph node cancers (Hodgkin and non-Hodgkin lymphoma).[4] This is followed by neuroblastomas, renal tumors (Wilms tumor, rhabdoid kidney tumor, and renal sarcomas/carcinomas), and rhabdomyosarcomas.[5] Osteosarcoma, Ewing sarcoma, melanoma, retinoblastoma, and hepatoblastoma are rarer.

Treatment of childhood cancers includes chemotherapy, radiotherapy, and surgery for tumor

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excision. Before the development of chemotherapy protocols and the introduction of ionizing radiation, surgery was the mainstay of treatment in this disease. Diagnosis (biopsy and staging) and tumor excision can be performed in different types of cancer with different surgical treatments.[6] Monitoring children in the perioperative period is one of the primary nursing care responsibilities in these cases.[7] Providing monitoring, ensuring and maintaining airway access, maintaining nutrition and fluid-electrolyte balance, providing pain management, monitoring the incision area, wound care, dressing to prevent infections, discharge education, maintenance of home care, ensuring the adaptation of the child and family, and improving their quality of life are important initiatives of nursing care.[8]

This study aimed to draw the framework of the literature, reveal the current situation, and reveal the missing areas in the literature by analyzing the scientific research articles on children undergoing surgical treatment for childhood cancers. The secondary aim of the study was to examine pain management and complication management in the postoperative period in children undergoing surgical treatment for childhood cancers.

MATERIALS AND METHODS

Literature search and selection criteria

In this systematic literature review, research articles published in English in the Medline/PubMed, Scopus, Web of Science, EBSCO, and Google Scholar databases between January 1, 2014, and August 1, 2024, with accessible full texts, were scanned. The Boolean indicators were as follows: ((pediatric) OR (child)) OR (children)) OR (baby)) OR (neonatal)) OR (infant)) OR (childhood)) OR (newborn)) OR (adolescent)) OR (teenager)) OR (teenage)) OR (young adult)) AND (oncology)) OR (oncological)) OR (cancer)) OR (tumor)) OR (tumor)) OR (neoplasm)) OR (neoplastic)) AND (pediatric surgery)) OR (child surgery)) OR (surgery)) AND (nursing). The reference lists of retrieved studies and relevant reviews were manually searched.

Data extraction procedure

As observed in Figure 1, a total of 1,490 results were displayed, and all of them had accessible full texts. All articles accessed from the databases were independently reviewed by the researchers. With the removal of duplicate studies (n=40), 1,450 articles were analyzed. Of those reviewed, 1,192

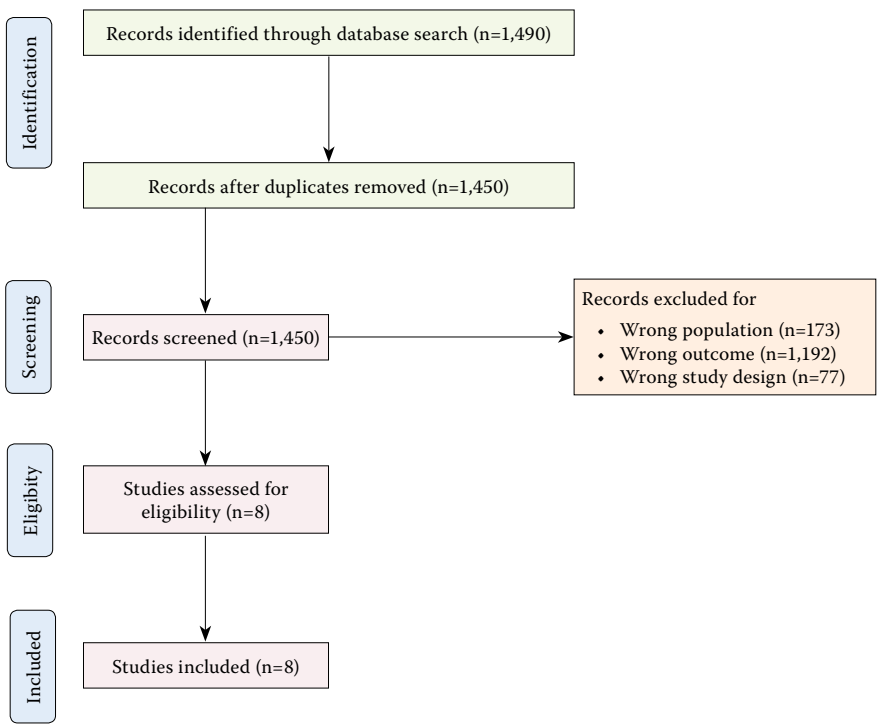

Figure 1. Selection scheme of studies included in the review.

articles were excluded because their subject matter was not suitable, 173 articles were excluded because their sample was not suitable, and 77 articles were excluded because they were not research articles. The eight articles that met the criteria were included in the sample of the study (Figure 1). The data were independently and blindly extracted by two researchers. The inclusion criteria were as follows: *(i)* conducted in the field of pediatrics; *(ii)* carried out with children between the ages of 0-18 or their parents; *(iii)* included patients who underwent surgical operations for childhood cancers.

Statistical analysis

In this study, descriptive analyses were performed with IBM SPSS version 22.0 software (IBM Corp., Armonk, NY, USA). Descriptive data of the included studies were determined by number, percentage and frequency analysis. The Rayyan-Intelligent Systematic Review software (Cambridge, Version 1.5.2) was used to extract and evaluate the data.

RESULTS

Descriptive characteristics of the studies included in the study, such as type, sample, and characteristics, are given in Table 1. The detailed data of the studies (name, year, purpose, type, sample, data collection tools, and results) are given in Table 2. Seven (87.5%) of the analyzed studies were descriptive and one (12.5%) was quasi-experimental. When the samples of the studies were analyzed, it was determined that five (62.5%) had a sample size >50 (Table 1).

TABLE 1
Descriptive characteristics of included studies

	n	%
Study type		
Descriptive	7	87.5
Quasi-experimental	1	12.5
Sample		
≤50	3	37.5
>50	5	62.5
Cancer type		
Cerebellar tumor	1	12.5
Pancreatic tumor	2	25.0
Ovarian tumor	1	12.5
Nephroblastoma	1	12.5
Abdominal tumor	1	12.5
Other	2	25.0

Of the studies reviewed, one was conducted with children with cerebellar tumors,[5] two with pancreatic tumors,[9,10] one with ovarian tumors,[11] one with nephroblastoma,[12] and one with abdominal solid tumors.[13] Two studies did not focus on a single cancer type but were conducted with all children with solid tumors in a pediatric cancer center (Table 1).[14,15]

DISCUSSION

Data were retrospectively collected in all studies, and one study was quasi-experimental. Retrospective studies, by their nature, allow researchers to examine the subject as it occurs in routine clinical care. Such designed studies often provide larger study populations and longer observation periods, enabling the study of specific populations.[16] When the durations of the studies were analyzed, it was observed that they were mostly long-term studies. These retrospective studies were conducted with data obtained from the databases of the health institutions where they were conducted or from the national databases of the country where the research was conducted. In the studies included, it was stated that descriptive data were obtained by analyzing the electronic medical records of the patients. It was observed that electronic medical records were frequently used in the studies. Electronic medical records, with the information stored in databases, provide detailed information about the causes of diseases, the treatment methods, new cases, and disease groups. In addition, it provides benefits such as storing patient information for a long time, analyzing data from different angles, determining future risks, calculating cost expenditures, and clinical decision making.[17] Similarly, in the studies included in the sample of this study, electronic medical records were used to collect data on the descriptive characteristics of children, length of stay in the hospital/intensive care unit, cost of care, morbidity/mortality rate, determination of short- and long-term complications after surgical operations, determination of conditions such as pain and sleep disturbance experienced by patients after the operation, development of infection, hemorrhage, and organ failure in the postoperative

TABLE 2
Details of included studies

Name of the study/year	Aim	Type of study/number of samples	Data collection tools	Results
Epidemiology and short-term surgical outcomes of children presenting with cerebellar tumors/2018[5]	To describe the epidemiology and short-term surgical outcomes of pediatric patients with cerebellar tumor excision.	A descriptive, national retrospective electronic hospital record study of children aged 1-18 years (n=461) who underwent cerebellar tumor excision compared with all other children.	Data were collected by analysing electronic hospital records (length of hospital stay, discharge time, cost of care, mortality rate, mechanical ventilation, tracheotomy support rate, etc.) Healthcare Cost and Utilization Project (HCUP)	Excision of cerebellar tumors in children has been reported to significantly increase morbidity. In this US cohort, it was emphasised that maintenance of air clearance, treatment of hydrocephalus and long-term care were necessary.
Outcome after surgery for solid pseudopapillary pancreatic tumors in children: Report from the TREP project-Italian Rare Tumors Study Group/2018[9]	To evaluate postop short and long term complications and follow-up of children diagnosed with solid pseudopapillary pancreatic (SPP) tumor and excision.	This descriptive, retrospective electronic record study was conducted with 43 children aged 7-18 years with a diagnosis of SPP tumor.	Data were collected by reviewing electronic records TREP.	It has been reported that complete excision is the main treatment in these children with SPP tumors. Long-term follow-up and care were recommended for the detection of relapse and evaluation of residual pancreatic function.
Minimally Invasive Surgery in Pediatric Surgical Oncology: Practice Evolution at a Contemporary Single-Center Institution and a Guideline Proposal for a Randomized Controlled Study/2019[10]	To evaluate minimally invasive surgery (MIS) practice and care in a pediatric cancer centre between 2000 and 2014.	This descriptive, retrospective electronic hospital record study was conducted with 252 children with different solid tumors.	Data were collected by analysing electronic hospital records. MIS applications and complications for cancer diagnosis, tumor resection or treatment of cancer-related complications were evaluated.	It was reported that complications such as bleeding, infection, bowel injury, etc. occurred after MIS procedures, albeit at a lower rate compared to open surgical procedures. The authors emphasised that MIS can be used in the treatment of solid tumors in children in recent years.
Operative management of pediatric ovarian tumors and the challenge of fertility-preservation: Results from the United Kingdom CCLG Surgeons Cancer Group Nationwide Study/2020[11]	To determine the probability of total oophorectomy or conventional open surgery in children with ovarian tumors.	This descriptive retrospective electronic hospital record study was conducted in 310 girls aged <16 years with ovarian tumors.	Data were collected by analysing electronic hospital records (family history, type and time of operation, histology results, relapse status, etc.).	It was stated that ovarian sparing surgery and minimally invasive surgery were not performed effectively enough. The need for national standardisation to reduce unnecessary oophorectomy rates was emphasised.
Long-term outcome of pancreatic function following oncological surgery in children: Institutional experience and review of the literature/2021[12]	To examine endocrine and exocrine pancreatic function and growth after oncological pancreatic surgery in the pediatric population	This descriptive, retrospective study was conducted in 16 children aged <18 years with pancreatic tumors.	Exocrine insufficiency (steatorrhoea assessment), Endocrine insufficiency (development of DM, impaired glucose tolerance, hypo/hyperglycaemia) Body mass index assessment, Development of fat-soluble vitamin (A, D, E, K) deficiency	The importance of long-term follow-up for the recognition and treatment of exocrine and endocrine pancreatic insufficiency that may occur in the postoperative period is emphasised.

TABLE 2
Continued

Name of the study/year	Aim	Type of study/number of samples	Data collection tools	Results
Effect of Orem's Self-Care Theory Combined with Active Pain Assessment on Pain, Stress and Psychological State of Children with Nephroblastoma Surgery/2022[13]	To examine the effect of Orem's Self-Care Theory (OSCT) based nursing care on postoperative pain, stress, psychological state and sleep in children who underwent nephroblastoma surgery.	This retrospective, quasi-experimental study was conducted with 150 children aged 6-10 years with nephroblastoma. Two groups were compared, the children who received OSCT-based care and the control group.	Houston Pain Inventory Pittsburgh Sleep Quality Index Four-tier Functional Activity Score	It has been reported that OSCT-based nursing care can reduce pain, improve stress response, psychological state and sleep quality in children undergoing nephroblastoma surgery.
Early postoperative complications in pediatric abdominal solid tumor surgery according to Clavian-Dindo classification/ 2022[14]	To determine the incidence and treatment of short-term complications after abdominal solid tumor surgery	This descriptive, retrospective study was conducted in 393 pediatric patients aged 2-9 years with abdominal tumors. Early postoperative complications were graded according to the Clavian-Dindo classification.	Data were collected by analysing electronic hospital records (obstruction, hemorrhage, infection, organ failure, development of thromboembolic condition, etc.).	It has been reported that there are various complications in the short term after abdominal tumor surgery in children, and these complications are frequently associated with prolonged hospitalization and the need for medical/surgical intervention. It was stated that the number of surgical operations, organ of origin and tumor type affected the risk of complications.
Interdisciplinary surgical approach enables complete tumor resection with preservation of neurological function in specific conditions of pediatric solid malignancies/2023[15]	To analyse descriptive data of children with tumors involving neurovascular structures	This descriptive, retrospective study was conducted in 25 children aged 2-16 years with tumors involving neurovascular structures.	Data were collected by examining electronic hospital records (operation time, operation age, intensive care and hospitalization time, follow-up period, etc.).	It has been emphasised that interdisciplinary approaches in radical tumor resections are supportive in preserving neurological functions.

US: United States; TREP: Italian Rare Tumours in Pediatric Age Project; CCLG: Children's Cancer and Leukaemia Group; DM: Diabetes mellitus.

period. Healthcare Cost and Utilization Project and Italian Pediatric Rare Tumor Registry are the international databases mentioned.

Postoperative pain management

Postoperative pain management is important in oncology patients undergoing surgical operation. Although it differs according to age periods, pain management in the pediatric population requires special nursing interventions. Physiological (heart rate, respiratory rate, blood pressure, and oxygen saturation), biological (serum cortisol) and behavioral (crying, facial expression, and body posture) parameters are used in the evaluation of pain.[18] The most commonly used pain assessment scales in the pediatric population are the Premature Infant Pain Profile, Neonatal Infant Pain Scale, Neonatal Infant Acute Pain Assessment Scale, FLACC (Faces, Legs, Activity, Cry, Consolability) scale, Wong Baker Pain Scale, Visual Analog Scale, and numeric pain rating scale.[19] Different from these scales, Houston Pain Inventory was used in Tang et al.'s[12] study conducted with children diagnosed with nephroblastoma aged 6 to 10 years.

TABLE 3
The degrees of Clavien-Dindo classification[14]

Grade	Definition
1	Any deviation from normal postoperative course. Antiemetics, antipyretics, analgesics, physiotherapy;
2	Altered postoperative course. Blood transfusions, total parenteral nutrition, antibiotics;
3	Complications requiring interventional management either with: a. Regional/local anesthesia b. General anesthesia
4	Life-threatening complications requiring intensive care unit admission a. Single organ dysfunction b. Multi-organ dysfunction
5	Patient demise

This scale consists of 33 items in five subdimensions examining the effects of pain on physical-emotional and daily life, pain experience.[12]

Postoperative complication management

Complications that occur in the postoperative period can be classified as short- or long-term according to the time of onset. Complications occurring before the 30th postoperative day are considered short-term complications, and those occurring after 30 days are considered long-term complications.[9] In the literature, although it varies according to the operation area, hemorrhage in the excision area, surgical site infection, and thromboembolic events are considered short-term complications; organ failure and secondary tumors are considered long-term complications. The three studies that constitute the sample of this study[9,10,13] focus on short- and long-term complications after the operation. In Crocoli et al.'s[9] study, postoperative short-term complications included pancreatic fistula, chylous fistula, and hemorrhage, while pancreatic duct stenosis, tumor recurrence, and associated secondary tumors were reported as long-term complications. Similarly, Bolasco et al.[10] examined long-term endocrine (development of diabetes mellitus, impaired glucose tolerance, and hypo/hyperglycemia) and exocrine (steatorrhea) complications after pancreatic resection.

Classification of postoperative complications according to their severity is also crucial in providing appropriate care. The Clavien-Dindo classification (CDC), first developed by Clavien et al.[20] in 1992 to define complications after cholecystectomy, was updated in 2004 by Dindo et al.[21] based on complication management and developed to define and grade postoperative events. The most important feature of the CDC system is that the severity of a complication is graded according to the type of therapy needed to treat the complication.[22] The degrees of this classification can be explained as in the Table 3.[13] While this classification is frequently used after operations performed on adult patients, it has limited use in pediatric surgery.[23] In the two studies constituting the sample of this study, postoperative complications were classified according to CDC. According to Crocoli et al.'s[9] study, 35 of 43 patients had no complications, while three children developed Grade 2b complications, and five children developed Grade 2 complications. In the study by User et al.[13] it was reported that Grade 2 complications developed in 23 children, Grade 3b complications in nine children, Grade 4a complications in five children, and Grade 5 complications due to thromboembolism developed in one child. Similarly, in a study conducted by Madadi-Sanjani et al.[24] with children diagnosed with cancer aged between 1 and 18 years and evaluating 78 postoperative complications according to the CDC, 7.9% of the children in the sample were classified as 3a and 30.8% as 3b.

In addition to the burden of oncological disease in pediatric patients, the fact that a surgical intervention will be performed causes the child to experience more fear and anxiety and to be affected more psychologically and physiologically. It is of vital importance to plan and implement nursing interventions by considering the age and developmental status of children in reducing fear

and anxiety of operation in children.[25] In Tang et al.'s[12] study, it was stated that nursing care based on Orem's self-care theory can not only alleviate and reduce the physiological pain of children but also effectively alleviate the anxiety and depression of children after surgery and improve their sleep quality. Similarly, in Mechtel and Stoeckle's study, it was stated that art-based coping mechanisms provide psychosocial benefits to children diagnosed with cancer who are scheduled to undergo surgical intervention and can be considered a coping mechanism in situations such as fear and anxiety.[25]

The limitation of this systematic review was that six databases were used to search the studies. In addition, only the articles whose full texts were available and written only in English were included in the review. The fact that the studies were mostly descriptive, the number of samples varied, and the clinics in which the studies were conducted had different characteristics from each other may also be among the limitations. The fact that the interventions used in the study were methodologically different from each other was also considered a limitation.

In conclusion, this study focused on the examination of scientific studies conducted with pediatric patients who underwent surgical operation due to cancer diagnosis. It was observed that there were few studies that met the inclusion criteria, and the sample consisted of children with cancer. Furthermore, the number of studies that focused specifically on nursing care was very limited. These results suggest that pediatric nurses should focus more on the care of children with solid tumors and increase research in this field. Studies to improve nursing care in this population are a critical factor affecting the recovery process of patients, and it is thought that research in this field can provide more information and strategies to improve the quality of life of children. This study aims to raise awareness among pediatric nurses and provide guidance on this important issue. It is recommended that more comprehensive and experimental studies with larger samples focusing on preoperative and postoperative nursing care in this vulnerable population of pediatric patients should be conducted on a national and international scale.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Idea/concept, design, data collection and/or processing, analysis and/or interpretation, literature review: S.A.S.; Control/supervision, critical review: F.Y.; Writing the article: S.A.S., F.Y.

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