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Pediatric Cancer Types, Diagnosis, and Treatment

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Abstract **Review Article**

The current study's objective was to conduct a review study on pediatric malignancies from several angles, including kinds, diagnosis, and treatment. In order to accomplish this, the primary data sources, including Google, GoogleScholar, Sciencedirect, PubMed, and others, were examined. The findings of this study demonstrated that, despite being uncommon, childhood malignancies are lethal once they manifest. His study's findings also demonstrated the presence of therapy choices and diagnostic technologies that increase survival rates to above 80% of cases. Hence, pediatric cancer affects youngsters under the age of 18. Each form of pediatric cancer has a unique set of symptoms and available therapies. Juvenile cancer can be challenging to diagnose and is typically detected by physical examinations, blood tests, imaging scans, and biopsies. Pediatric cancer treatment is determined by the type, stage, age, and condition of the child. The prognosis for pediatric cancer has significantly improved thanks to recent developments in diagnosis and treatment.

Keywords: Pediatric cancer, diagnosis, types, malignancy, treatment.

1. INTRODUCTION

The present study investigated the literature for various aspects of pediatric cancers. Several sections will be discussed to cover in detail the different perspectives of pediatric cancers.

2. Overview of Pediatric Cancer

Cancer that manifests itself in childhood is referred to simply as pediatric cancer. About eighty percent of children who are diagnosed with cancer can be successfully treated due to the advancements in medical technology and improved standards of patient care (Ceasar *et al.*, 2022). On the other hand, only about ten percent of children who are diagnosed with cancer and who live in high-income countries where appropriate medical treatments and care are offered are able to receive those services (paho.org, 2023).

Cancer is the leading cause of death by disease in children in the United States who have moved past the newborn stage and are now older than infants. Despite the fact that cancer in children and teenagers is extremely rare, it is the leading cause of death by disease in this age group. In the United States of America in the year 2021, it is expected that 15,590 children and adolescents between the ages of 0 and 19 will be diagnosed with cancer, and that 1,780 of those individuals will pass away as a direct result of the ailment (Siegel *et al.*, 2021). It is projected that 10,500 cases of cancer will be diagnosed in children ages 0 to 14 years old in the year 2021, and of those children, 1,190 will pass away as a result of their illness (Siegel *et al.*, 2021). Cancer will be diagnosed in roughly 5,090 adolescents between the ages of 15 and 19, and around 590 of those adolescents will pass away as a direct result of the disease (Siegel *et al.*, 2021).

There is a sizable gap in survival rates between different racial and ethnic groups in the United States when it comes to the incidence of the most common types of childhood cancer. For example, between the years of 2013 and 2017, the incidence of leukemia in children under the age of 14 years old who were Hispanic was nearly twice as high as the incidence in children who were Black (Islami *et al.*, 2021). Between the years of 2014 and 2018, the rate at which brain and other tumors of the central nervous system were diagnosed in White children was noticeably higher than the rate at which these diagnoses were made in children of any other race or ethnicity (Marcotte *et al.*, 2021).

As of January 1, 2018, the most recent date for which data are available, there were approximately 483,000 cancer survivors living in the United States

who were diagnosed as children or adolescents between the ages of 0 and 19 years old (Howlader *et al.,* 2021). The number of people who have beat their cancer will continue to increase as a result of several factors, including the improvement in overall survival rates and the slight uptick in the incidence of childhood cancer that has been observed over the course of the past few decades.

Pediatric cancer is a group of diseases that occur in children and young adults under the age of 18. It is a significant health concern, with cancer being the leading cause of death among children in the United States. In this article, we will discuss the various types of pediatric cancer, their diagnosis, and treatment options.

3. Types of Pediatric Cancer

There are several types of pediatric cancer, including leukemia, lymphoma, brain and central nervous system (CNS) tumors, sarcomas, and others (cancer.org, 2023).

3.1 Leukemia

Leukemia is the most common type of childhood cancer, accounting for approximately 30% of all pediatric cancer cases. Leukemia is a type of cancer that affects the blood and bone marrow, and it is characterized by an abnormal increase in the number of white blood cells in the body (An *et al.,* 2017).

Up to 30 percent of all cancers diagnosed in children and young adults are cases of leukemia. Leukemia accounts for the majority of these cases. Because of this, it is the type of cancer that occurs in children at an alarmingly high rate. The treatment of acute lymphoblastic leukemia (ALL) has seen significant advancements over the past four decades, resulting in survival rates that are getting close to 90% in the most recent studies. These advancements have led to an increase in the number of patients who are able to beat the disease. When compared to other types of acute lymphoblastic leukemia (ALL), myeloid leukemia and certain subgroups of acute lymphoblastic leukemia, including infant ALL, adolescent/young adult ALL, and relapsed ALL, have seen less progress in treatment. Recent developments have included the recognition of subgroups that are defined molecularly, which has paved the way for approaches in precision medicine (Madhusoodhan *et al.,* 2016).

3.2 Brain and CNS Tumors

Brain and CNS tumors account for approximately 20-25% of all pediatric cancer cases. These tumors can be benign or malignant and can occur in various parts of the brain and spinal cord (Heath *et al.,* 2012; Thorbinson *et al.,* 2021).

These tumors encompass a wide variety of subgroups that differ clinically, pathologically, and physiologically (Thorbinson *et al.,* 2021). Because of this, they are capable of posing major problems when it comes to conducting research and clinical trials. As a result, worldwide collaboration is required in order to meet these challenges. Around six out of every one hundred thousand children in industrialized cultures are diagnosed with one of these cancers (Ostrom *et al.,* 2021). The percentage of patients who are cured of some types of pediatric brain tumors, most notably medulloblastoma, has increased during the past few decades (Packer *et al.,* 2006). This is primarily as a result of developments in multiparametric neuroimaging, neurosurgical methods, radiation therapy, multiagent chemotherapy, and improvements in supportive care. These developments have all contributed to an increase in overall survival rates. Yet, any advances in survival chances are frequently counterbalanced by a therapy-induced toxicity load for the patient. This burden has far-reaching ramifications not only for the child, but also for their family and for society as a whole. In addition, the prognosis for the vast majority of brain tumors has not altered in more than three decades, despite the breakthroughs that have been made in medical science (Thorbinson *et al.,* 2021).

Brain and other central nervous system (CNS) tumors, both malignant and nonmalignant, represent a complex constellation of over 100 histologically different subtypes with varying descriptive epidemiology, clinical characteristics, therapies, and prognosis (Miller *et al.,* 2021). The fact that each of these subtypes can be generated by a different mutation is what contributes to the diversity that we see today. Even though primary malignant brain and other CNS tumors are uncommon in the United States, they account for a disproportionate burden of cancer mortality due to their high fatality rate; only one-third of individuals survive at least 5 years after diagnosis. This accounts for a disproportionate share of the cancer mortality burden. This accounts for a disproportionate share of the burden caused by cancer deaths (Siegel *et al.,* 2021). In recent years, there has been a major movement in the classification and reporting of these malignancies. This change has taken place in line with improvements in molecular knowledge as well as breakthroughs in detection and diagnosis. In spite of the fact that the majority of the etiology is a mystery, these shifts have taken place rather rapidly (Miller *et al.,* 2021).

3. 3 Sarcomas

Sarcomas are a rare type of cancer that affects the bones, muscles, and connective tissues in the body. Sarcomas account for approximately 10% of all pediatric cancer cases (Mur *et al.,* 2020). Cancer of the head and neck is a relatively common occurrence across the globe, with an annual incidence of 650,000 cases and a mortality rate of 330,000 deaths per year (Ferrari *et al.,* 2015). On the other hand, this particular pathology is extremely rare among the population of

children and adolescents. As a result of this, there is a paucity of evidence to support the development of clinical practice guidelines that could assist medical professionals in the treatment of these diseases. Despite this, there is a growing body of evidence that suggests the incidence of head and neck cancers in children has been on the rise over the course of the course of the last few decades (Andrassy *et al.,* 2001; Simon *et al.,* 2012).

Even more so, certain subsets of head and neck cancers, specifically sarcomas, are significantly less common than other types of head and neck cancers. This is especially true for older patients. Sarcomas account for approximately one percent of all cancers that can develop in the head and neck, and approximately five percent of all sarcomas can be discovered in the head and neck (Papaspyrou *et al.,* 2003). It is difficult to conduct in-depth research on these neoplasms due to the fact that these lesions account for approximately 1,000 to 1,500 cases per year in the United States and consist of a wide variety of histologic subtypes. However, there are higher reported rates of local recurrence and lower overall survival rates associated with these sarcomas compared to their counterparts that do not involve the head and neck. In general, the natural history of these sarcomas is comparable to that of their counterparts that do not involve the head and neck (Rodríguez-Vargas *et al.,* 2022).

Rhabdomyosarcoma (RMS), the most common histological subtype of childhood sarcoma, is responsible for approximately 4.5% of all pediatric malignancies and has an incidence rate of 4.5 cases for every 1,000,000 children (Gross *et al.,* 1988). There is a bimodal distribution for the age at which symptoms first appear, with the first peak happening between the ages of 2 and 6 years and the second peak happening between the ages of 10 and 18 years (DeGroot *et al.,* 1980).

3.4 Pediatric Neuroblastoma

A neuroblastoma can originate in the adrenal medulla or in any other part of the body that ordinarily contains sympathetic tissue. Both of these sites are possible starting points for the disease. It is possible for it to present with a wide variety of symptoms because of the primary tumor, the metastatic disease, or unusual signs and symptoms like opsoclonus-myoclonus or severe diarrhea. This is because it is possible for it to cause all of these things. It is still one of the most discouraging and difficult tumors in children to treat and cure, despite the fact that this neoplasm responds favorably to a number of different therapeutic modalities (Blanca and Allen, 1985).

3.5 Wilms' Tumor

A condition known as bilateral Wilms tumor may be present in up to 13 percent of patients who have been diagnosed with Wilms tumor (BWT) (Coppes *et al.,* 1999; Ehrlich *et al.,* 2017). In addition, there is a population of children who are at an increased risk for synchronous and metachronous tumors because they have genetic disorders or tumor-specific features, such as Beckwith-Wiedemann Syndrome or multi-centric tumors. Children with Beckwith- Wiedemann Syndrome make up what is known as the Beckwith-Wiedemann Syndrome Population (Coppes *et al.,* 1999). One of the challenges that must be conquered in order to treat BWT is the fact that, prior to 2009, there had been no specific study that was dedicated to the treatment of children who have BWT. This is one of the obstacles that must be overcome in order to treat BWT. The most recent COG AREN0534 study, which concentrated on bilateral Wilms tumors and unilateral high-risk tumors, has made a significant contribution to our increased comprehension of BWT (Aldrink *et al.,* 2019).

3.6 Retinoblastoma

It is extremely unusual for infants to develop cancer of the retina, but when it does take place, it is referred to as retinoblastoma. This particular form of cancer arises when both copies of the RB1 gene in a susceptible retinal cell, almost certainly a cone photoreceptor precursor, mutate at the same time. The loss of tumor-suppressor functions of the retinoblastoma protein, pRB, which occurs during the progression of a tumor, results in uncontrolled cell division and recurrent changes to the genomic makeup of the cells that are affected. Cone precursors have biochemical and molecular characteristics that may make them more susceptible to the effects of RB1 loss, which in turn facilitates the development of tumors. Despite the fact that pRB is expressed in virtually all tissues, this does not prevent cone precursors from being more likely to develop tumors. Every single year, the diagnosis of retinoblastoma is made in somewhere in the neighborhood of 8,000 children all over the world. Patients have a survival rate of more than 95% in countries with high incomes, but it is less than 30% worldwide. On the other hand, the outcomes are getting better as a consequence of increased awareness for earlier diagnosis, new guidelines, and the sharing of expert knowledge. Intravitreal and intra- arterial chemotherapy are two relatively new treatment options that have recently emerged as potentially successful treatment options for the preservation of eyes. The many different classifications of eye involvement that are currently in use will be phased out as a result of ongoing international collaborations, which will lead to the creation of standardized definitions as a final product. These definitions will be utilized in the process of evaluating potential treatment options with regard to their applicability, level of effectiveness, and degree of risk. It is imperative that people who have survived heritable retinoblastoma receive follow-up care for the rest of their lives. This is because survivors of this form of cancer are at risk for developing second cancers. Patients who have germline mutations in the RB1 gene

are at a higher risk of developing retinoblastoma and other cancers. Determining the molecular effects of RB1 loss in different tissues could lead to the discovery of novel approaches for the treatment and prevention of retinoblastoma and other cancers (Dimaras *et al.,* 2015).

The global incidence of retinoblastoma, which is estimated to be between 1 in 16,000 and 18,000 live births, was multiplied by the number of infants expected to survive (which is the birth rate minus the infant mortality rate) (Broaddus *et al.,* 2009; Kivela *et al.,* 2009).

4. Diagnosis of Pediatric Cancer

The symptoms are frequently vague or difficult to pin down; they may point to a more common alternative diagnosis, and they are quite dissimilar to the symptoms that are associated with malignant conditions in adults. The symptoms may point to a more common alternative diagnosis; they may also point to a more common alternative diagnosis. When signs or symptoms do not go away or when multiple symptoms point toward a possible diagnosis of malignancy, it is the responsibility of the skilled office practitioner to consider the possibility of cancer as a diagnosis. Given the dramatic increase in the overall survival rate that has taken place over the course of the last few decades, the significance of making an early diagnosis cannot be overstated. It is not uncommon for the diagnosis to be put off for a considerable amount of time, especially in the case of brain tumors and certain lymphomas (Hodgkin disease). It is imperative that a child be referred to a pediatric cancer center for further evaluation whenever one observes symptoms in a child that raise concerns about the presence of cancer. In this situation, the symptoms in question raise concerns about the presence of cancer. In addition to being able to carry out additional evaluations and management procedures for children who have cancer, these centers are also able to offer support services to both the patients and their families. It is possible that additional imaging will be performed during this evaluation; however, the collection of tissue samples for histologic examination will almost always take place. In order to accomplish this, a suitable biopsy of either the tumor or the bone marrow will need to be performed, preferably before the treatment itself is started. Direct tumor biopsies can be performed more easily with imaging-guided biopsies, such as those performed with ultrasound, computed tomography, or magnetic resonance imaging. These biopsies also spare patients the need for additional surgical procedures. In an ideal world, this is the kind of situation that should be handled by a knowledgeable team that includes a hematologist/oncologist, surgeon, radiologist, and pathologist. It is essential for the patient to be referred to a specialist as soon as possible by a practitioner who is attentive (Raab and Gartner, 2009). The diagnosis of pediatric cancer often involves a combination of physical exams, blood tests, imaging studies, and biopsies. The initial symptoms of pediatric cancer can be vague and nonspecific, which can make diagnosis challenging (cancer center, 2023).

Blood tests can detect abnormal levels of certain substances in the blood, which can be a sign of cancer. Imaging studies, such as X-rays, CT scans, and MRIs, can help identify tumors or other abnormalities in the body. Biopsies involve taking a sample of tissue from the affected area and examining it under a microscope to look for cancer cells (cancer.gov, 2023).

5. Treatment of Pediatric Cancer

Significant progress has been made in the treatment of children who have been diagnosed with cancer since the first clinical trials of chemotherapy for leukemia were carried out in the 1940s and 1950s. These trials took place in the United States. It is estimated that more than 80 percent of children who have been diagnosed with cancer can be cured of the disease today (Adamson, 2015; Siegel *et al.,* 2020). These improvements in prognosis can be attributed, in large part, to cooperative multicenter clinical trials that have been carried out by organizations such as the Pediatric Oncology Group, the Children's Cancer Group, the National Wilms Tumor Study Group, the Intergroup Rhabdomyosarcoma Study Group, and, more recently, the Children's Oncology Group (COG) and the Pediatric Brain Tumor Consortium in the United States, as well as their international counterparts. These organizations are the ones that have been in charge of carrying out these tests. Prior to the year 2000, increases in survival were primarily the result of increased therapy intensity, particularly for high-risk subgroups of patients, as well as advancements in supportive care. However, these factors are no longer the primary contributors to increases in survival. However, over the course of the past few years, the rate of improvement in the survival rate of children who have cancer has slowed down. Previously, there was significant progress being made in this area. Additionally, as targeted small molecules and immunotherapeutic agents have become more readily available, the emphasis in clinical trials for pediatric cancer has increasingly shifted toward the incorporation of these agents, either in conjunction with or in place of cytotoxic chemotherapy. This shift in emphasis reflects an increase in the prevalence of pediatric cancer (Regenold *et al.,* 2023).

The treatment of pediatric cancer depends on several factors, including the type and stage of cancer, the age of the child, and the child's overall health. Treatment options include surgery, chemotherapy, radiation therapy, immunotherapy, and targeted therapy (Minard-Colin *et al.,* 2020).

Surgery involves removing the tumor or affected tissue from the body (Moreno *et al.,* 2013). Chemotherapy involves using drugs to kill cancer cells

in the body (Cheung *et al.*, 2014), while radiation therapy uses high-energy radiation to destroy cancer cells (Oeffinger *et al.*, 2006). Immunotherapy involves using the body's immune system to fight cancer, and targeted therapy uses drugs to target specific molecules that are involved in cancer growth (Winter *et al.*, 2018).

In some cases, a combination of these treatments may be used to achieve the best possible outcome (Bertaina *et al.*, 2017). The goal of treatment is to cure the cancer, but it can also be used to manage symptoms and improve quality of life (Hunger and Mullighan, 2015).

6. CONCLUSION

Cancer in children and young adults who are under the age of 18 is a significant public health problem that affects a wide range of ages. There are a number of subtypes of cancer that can affect children, and each one presents its own set of symptoms and potential treatments. The process of diagnosing childhood cancer can be difficult, but it typically involves a mix of physical exams, blood tests, imaging investigations, and biopsies. The treatment of pediatric cancer is contingent upon a number of elements, such as the nature and stage of the disease, the age of the kid, and their general state of health. In recent years, there has been a dramatic improvement in the prognosis for pediatric cancer due to advancements in both the detection and treatment of the disease.

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