



## Different types of cancer in children and their treatments in a Mexican pediatric hospital

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### RESUMEN

Estudios recientes muestran un incremento de los distintos tipos de cáncer en niños, lo cual es importante conocer, así como sus respectivos tratamientos quimioterapéuticos. El objetivo de este estudio fue conocer los diferentes tipos de cáncer, así como sus tratamientos farmacológicos en un hospital pediátrico de tercer nivel de México.

**Métodos.** Se hizo un estudio retrospectivo con la revisión los expedientes de 415 pacientes atendidos en el Servicio de Oncología del Instituto Nacional de Pediatría entre enero de 2005 y diciembre de 2007.

**Resultados.** Se encontraron 108 diferentes tipos de enfermedades oncológicas, de las cuales 60 tipos ocurrieron en niños y 48 en niñas. En niños, las principales enfermedades fueron leucemia aguda linfoblástica (LAL) en 30 % de casos, linfoma de Hodgkin con 9% y retinoblastoma con 7%; en niñas fueron LAL con 30%, sarcoma de Ewing con 12%, y retinoblastoma con 8%. 47.6% de quimioterapias administradas fueron para niños y 52.4% para niñas. Los fármacos que más se administraron en ambos grupos fueron etopósido, metotrexate, vincristina, ciclofosfamida y citarabina. El perfil de enfermedades oncológicas fue muy parecido al que se describe en la literatura aunque los tratamientos empleados fueron variables.

**Conclusiones.** El mayor número de padecimientos oncológicos se ve en niños, siendo LAL el más común en ambos grupos. Predominó un nivel socioeconómico bajo en 80% de los pacientes atendidos; siendo este un hecho importante ya que las familias muchas veces no pueden comprar los medicamentos para cumplir con los tratamientos.

**Palabras clave:** Cáncer, quimioterapia, farmacia hospitalaria, farmacología, medicamentos.

### ABSTRACT

Recent studies have shown that different types of cancer in children are increasing. This requires to have adequate knowledge of the most common types of cancer and their chemotherapeutic based treatments.

**Purpose.** To conduct a retrospective study with focused on the knowledge of different types of cancer in pediatric population and the chemotherapies used for their treatment in a third level pediatric hospital in Mexico.

**Methods.** 415 clinical files of patients seen in the Oncology Service of the National Institute of Pediatrics (Instituto Nacional de Pediatría), of Mexico city, from January 2005 to December 2007 were reviewed.

**Results.** One hundred and eight types of cancer were found, of which 60 were in boys and 48 were in girls. The predominant types of cancer in boys were lymphoblastic acute leukemia, LAL (30%), Hodgkin's lymphoma (9%), retinoblastoma (7%), and neuroblastoma (6%), while in girls, they were LAL with 30%, Ewing's sarcoma with 12%, and retinoblastoma with 8%. 47.6% of chemotherapies given were for boys and 52.3 for girls. For both sexes, the drugs most frequently used were etoposide, metotrexate, vincristin, cyclophosphamide and citarabin. These findings are similar to those reported in the literature; although treatments were variable.

**Conclusion.** Oncological conditions are more common in boys than in girls with LAL being the most frequent in both sexes. The socioeconomic status of the patients was mainly of limited resources and this represented about 80% of the total. This is important since in many cases the families of the patients could not afford the drugs for adequate and complete treatment. This must be taken into consideration by physicians in the care and treatment of these patients.

**Key words:** Cancer, chemotherapy, drugs, pharmacology.

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Cancer is defined as a proliferation disorder of cells with the capacity of invading other tissues and of sending metastasis to distant cells, which eventually is fatal.<sup>1</sup> This condition is one of the main public health problems. Despite the advances in research and treatment, over six million people in the world die of cancer every year.<sup>2</sup> Not taking early strategies of prevention, could result in a large number of new cases in the future and a severe deficiency of resources and infrastructure for their treatment, due to the elevated costs of cancer fighting therapies and the indispensable need for an integral treatment, which neither patients, nor their families, nor institutions of sanitary attention can afford in the majority of the cases.

In Mexico, cancer in children has increased. In 1971 it was in the thirteenth place as the cause of death. It was in the second place in 2000 in the population between 1 to 14 years. Based on statistical data of National Institute of Pediatrics of Mexico City, cancer was also in second place as the cause of mortality in the year 2005 and in the first place in morbidity. Cancer is the fourth cause of death in infants in Mexico.<sup>3</sup> In some countries, cancer is the second cause of death in children, just under the accidents.<sup>4</sup>

Timely detection of cancer in children is difficult due to the fact that it usually begins with uncertain signs resembling trivial sicknesses. For this reason, parents are advised to have their children undergo periodic medical check-ups and to watch for any persistent and uncommon symptoms.

In the Pediatric Hospital of the National Medical Center, Mexico city, 500 cases of tumors were registered every year, out of which fewer than half were malignant.<sup>5</sup>

In view of this, the National Health Program proposes different initiatives to encourage a healthier lifestyle and to promote early detection and pertinent preventive measures for specific risks among the exposed population.<sup>6</sup>

Cancer is the second cause of death in the general population in Mexico. It has increased 68% from 1953 to 1998. In the past decade, malignant tumor rates in Mexican adults (30 years old and above) increased 63.5% in females and 35.3% in males.<sup>7</sup> Official statistics report a prevalence of 80% survival of these patients.<sup>8</sup> On the other hand cancer is the main cause of death in children under 15 years of age.<sup>9</sup>

Chemotherapy is a useful tool for the treatment of cancer and for prevention of complications. The drugs used

eliminate cancerous cells in a specific stage of their cycle. Combined chemotherapy of these drugs, offer a better and less toxic treatment.<sup>10</sup> Cancer is a silent enemy which affect humans of any age and in both sexes. A delayed diagnosis results in severe consequences for the patients.<sup>11</sup> The purpose of this study is to evaluate the frequency of different cancer types and chemotherapies prescribed in a pediatric hospital of Mexico City.

## METHODS

A retrospective study was conducted from January 2005 to December 2007, where 415 clinical files of patients were studied. Patients seen at the Institute come from different states of Mexico. The information obtained was classified based on economic status, sex and chemotherapeutic drugs administered. The inclusion were not based on any specific criteria except that the patients must have had oncology related disease, and received pharmacologic treatment in the period of time established.

## RESULTS

A total of 273 patients had cancer, of which there were over 108 types. In boys (Table 1), the following 60 types were diagnosed: lymphoblast acute leukemia (LAL) (21.13%), Hodgkin's lymphoma (6.34%), retinoblastoma (4.93%), neuroblastoma (4.23%) and osteosarcoma (4.23%). For girls, the study showed 48 types of cancer: LAL (22.90%), Edwing's sarcoma (9.16%), retinoblastoma (6.11%), Wilm's tumor (6.11%) and a few with other types (Table 1).

The number of chemotherapies administered was 3607 in boys and 3968 in girls (Table 2). The drugs mostly used in boys were: etoposide (577 times), followed by metotrexate (575), vincristin (483), cyclophosphamide (312) and citarabin with 277 doses. In girls, the most commonly used drugs were: etoposide (608), vincristin (558), metotrexate (548), cyclophosphamide (483), and citarabin with 289 doses. The study showed that in boys, a smaller number of chemotherapies (47.62%) were administered in comparison with girls in whose case the amount was (52.38%). Socioeconomic studies of the patients showed that 80% of the patients' families had limited financial means or were affiliated to public health insurance.

**Table 1.** Types of cancer diagnosis in pediatric patients (continuous in the following page)

<i>Boys</i>		<i>Girls</i>		
<i>Diagnostics</i>	<i>Cases</i>	<i>Diagnostics</i>	<i>Cases</i>	
1	Severe aplastic anemia	1	Metastatic coriocarcinoma	1
2	Cervical adenopathy	1	Ovarian coriocarcinoma	1
3	Colon adenocarcinoma	1	Esthesioneuroblastoma	1
4	Oncogenic cardiopathy	2	Ganglioneuroblastoma	1
5	Craniofaringeoma	1	Hepatosplenomegaly	1
6	Suprarenal ganglioneuroblastoma	1	Hepatoblastoma	2
7	Germinoma	2	Hemangioma of the tongue	1
8	Eosinophilic granuloma	1	Hepatocarcinoma	1
9	Glioblastoma	1	Histiocytosis	1
10	Hepatoblastoma	3	Lymphoblastic acute leukemia	30
11	Histiocytosis	3	Granulocytic acute leukemia	1
12	Langerhan's cell histiocytosis	3	Lymphoblastic lymphoma	1
13	Acute leukemia	2	Lymphangiomalipoblastoma	1
14	Lymphoblastic acute leukemia	30	Burkitt's lymphoma	3
15	Megakaryocytic acute leukemia	1	Hodgkin's lymphoma	5
16	Submaxilar lymphadenopathy	1	Diffuse colon lymphoma	1
17	Burkitt's lymphoma	2	Bone lymphoblastic lymphoma	1
18	Hodgkin's lymphoma	9	Medulloblastoma	2
19	Diffuse large B cell lymphoma	1	Neuroblastoma	4
20	Lymphoma	1	Right retro-orbital neuroblastoma	1
21	Lymphoblastic lymphoma	1	Right femur osteosarcoma	1
22	Arteriovenous malformation	2	Osteosarcoma linfanoplasty	1
23	Medulloblastoma	4	Maxillary osteosarcoma	1
24	Classic medulloblastoma	1	Osteoblastic osteosarcoma	5
25	Neuroblastoma	6	Knee osteosarcoma	1
26	Osteoblastic osteoblastoma	1	Osteosarcoma	5
27	Androblastic osteosarcoma	1	Cyst bone aneurysm	1
28	Anaplastic osteosarcoma	1	Rhabdomyosarcoma	5
29	Osteoblastic osteosarcoma	5	Alveolar rhabdomyosarcoma	1
30	Osteosarcoma	6	Embryo rhabdomyosarcoma	2
31	Astrocytoma	1	Retinoblastoma	8
32	Pancreatoblastoma	1	Ewing's sarcoma	12
33	Panhipopituitarism	1	Cerebral pseudocyst	1
34	Pinealoblastoma	1	Immature teratoma	1
35	Poliploidy	1	Cystic teratoma	1
36	Iliac bone cyst	1	Astrocytoma tumor	1
37	Rhabdomyosarcoma	4	Central parietal right tumor	1
38	Alveolar rhabdomyosarcoma	2	Endodermic sinus tumor	1

**Table 1.** Types of cancer diagnosis in pediatric patients (continued)

Boys		Cases	Girls	
Diagnosics			Diagnosics	Cases
39	Bilateral retinoblastoma	3	Neuroblastic ganglion tumor	1
40	Retinoblastoma	7	Germinal ovary tumor	1
41	Orbit retinoblastoma	1	Germinal mixed tumor	3
42	Ewing's sarcoma	2	Frontoparietal tumor	1
43	Axial Ewing's sarcoma	1	Neuroectodermic tumor	1
44	Synovial sarcoma	1	Ovarian tumor	1
45	Granulocytic sarcoma	1	Mixed ovarian germinal tumor	1
46	Myeloid sarcoma	1	Polycystic tumor	2
47	Hemophagocytic syndrome	1	Wilms tumor	8
48	Malignant schualuma	1	Submandibular tumor	1
49	Endodermic sinus tumor	1	Total	131
50	Endodermic sinus testicular tumor	1		
51	Mediastinal tumor	1		
52	Wilms' tumor	4		
53	Fibrous tumor	2		
54	Germinal tumor	1		
55	Neuroectodermic mesenteric tumor	1		
56	Bone tumor	1		
57	Left testicular tumor	1		
58	Right testicular tumor	1		
59	Neuroectodermic tumor	1		
60	Retro-orbital tumor	1		
	Total	142		

## DISCUSSION

Survival rate of children with cancer has significantly improved in the last 20 years. In the U.S.A., these children have an 80% chance of being cured.<sup>12</sup> This is true for Mexico, but only when children are treated in third level hospitals. However, a large number of patients are not seen in specialized institutions, thence a high mortality rate for them.<sup>3</sup>

Recent studies have shown that the incidence of cancer in both adults and children are constantly increasing. This suggests a probable prolonged exposure to cancer factors such as: ionic radiation and hydrocarbons, active and passive smoking, alcohol consumption, electromagnetic fields, drug ingestion during pregnancy, chemotherapy agents, insecticides, and organic solvents;<sup>13</sup> by-products

of substances produced by waste incineration, pulp and paper bleaching, wood preservation, metallurgy, petroleum refinement, ethylenedychloride (PVC products) synthesis, and manufacture of other chemicals. Most individuals are exposed daily to low-dose of these through ingestion and inhalation.<sup>14</sup>

Other pathologies which young patients with cancer could suffer are the metabolic syndrome (MS), a complication induced by chemotherapy;<sup>15</sup> obesity, which is a serious problem in Mexican children,<sup>16</sup> and chemotherapy-induced hematopoietic toxicity, which is a multifactorial challenge that hinders treatment of an oncology patient.<sup>17</sup>

In the present study, the two most common diagnoses in pediatric patients in both sexes, were LAL and retinoblastoma. Other studies report that patients with LAL

**Table 2.** Amount of chemotherapy pediatric patients administered from January 2005 to December 2007

		Boys				Girls			
		2005	2006	2007	Total	2005	2006	2007	Total
1	Folinic acid	44	16	15	75	51	3	2	56
2	Actinomycin	12	86	16	114	24	107	17	148
3	Adriablastine	36	68	75	179	48	79	76	203
4	Amifostin		8	11	19	14	1	9	24
5	Bleomicin	3		11	14		2	3	5
6	Carboplatin	26	50	13	89	18	14	12	44
7	Cetuximab		1		1				
8	Ciclophosphamide	47	166	99	312	77	325	81	483
9	Cisplatin	25	15	49	89	80	28	24	132
10	Arabinoside-C	53	128	96	277	44	180	65	289
11	Dacarbazine	3		11	14		2	2	4
12	Daunorubicin	7	18	19	44	2	9	1	12
13	Etoposide	96	277	204	577	144	314	150	608
14	Iphosphamide	56	129	51	236	117	90	41	248
15	L-Asparaginase	30	78	101	209	34	161	44	239
16	Mannitol	11	5	2	18	38	3	7	48
17	Mesna	64	21	28	113	170	79	26	275
18	Metotrexate	96	210	269	575	73	331	144	548
19	Mercaptopurine			9	9				
20	Oxaliplatin			3	3			1	1
21	Topotecan		1		1	2	25		27
22	Vinblastine	7	116	33	156	1	2	8	11
23	Vincristine	96	213	174	483	79	348	131	558
24	Teniposide					5			5
	Total	712	1606	1289	3607	1021	2103	844	3968

have shown neutropenia and fever after undergoing chemotherapy. The incidence and range of infections in them is mainly caused by the decrease of granulocytes.<sup>18</sup>

Acute leukemias are the most frequent cancers in infants. Acute lymphoblastic leukemia accounts for 80% of the cases. The peak incidence of which occurs in children between 2 and 5 years of age.<sup>19</sup> In the last few years, the increased percentage of prolonged survival rate and cure is in the range of 60% to 80% according to various international groups.<sup>20</sup> With the advent of intensive chemotherapy and the increase of support treatment such as blood transfusion and antimicrobials 70 to 75% children can benefit.<sup>21</sup>

Oncological drugs offer different results, which could change the prognosis of patients throughout their

treatment. They are used independently or combined to treat several types of cancers and oncology diseases.<sup>22</sup> Likewise, adverse effects of oncology drugs on organs and tissues particularly on gonads, due to severe or to mild damages with negative consequences on fertility, for instance, disruption of germinal stem cells must be considered.<sup>23</sup>

An important point to consider is the high cost of medications for oncology therapy, the only known alternative treatment for cancer. Pediatric patients often require numerous chemotherapy drugs depending on their individual situation. Therefore, it is important to enlarge the subsidies for government hospitals in order to provide quality attention to all cancer patients.

Studies on pediatric cancer, suggest that young patients must remain hospitalized for a short period of time when receiving chemotherapy treatment, in order to achieve the best possible outcome.<sup>11</sup> Chemotherapy at home is acceptable, but it is restricted by low economical resources. On the other hand, special surgery such as laparoscopy is required, in order to facilitate quick recovery of patients.

This study is intended to be useful for improving statistics in cancer in pediatric population and oncological therapies. Medical services should monitor this field and strive to give the best treatment and care to the pediatric population.<sup>24</sup>

## CONCLUSION

Cancer is more prevalent in boys than in girls. LAL is the most frequent malignancy in both sexes. The socioeconomic status of patients was mainly of limited resources, representing about 80% of the total. This point is important for the simple reason that very often, the families of the patients could not afford the drugs for adequate and complete treatment of their sick child and this ought to be taken into consideration by physicians in the care and the treatment of these patients.

The proposed drugs are the ones in use in clinical pediatric sectors for the treatment of cancer; however, their action, their side effects or their administration are different. Treatment should be chosen based on the sickness, the patient, and the criterion of the physician, always focusing on causing the least possible adverse effects.

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