Scientific Research Publishing

Open Journal of Pediatrics, 2023, 13, 594-603
https://www.scirp.org/journal/ojped
ISSN Online: 2160-8776
ISSN Print: 2160-8741

Evaluation of Glomerular Filtration Rate and Urinary Abnormalities in Children with Cancer before Chemotherapy

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How to cite this paper: Diop, M.M., Barry, A., Kolié, O.O., Camara, E., Diallo, M.L., Bangoura, K., Doukouré, M.A., Beimy, P.N., Diallo, D., Kouyate, M. and Kaba, M.L. (2023) Evaluation of Glomerular Filtration Rate and Urinary Abnormalities in Children with Cancer before Chemotherapy. *Open Journal of Pediatrics*, **13**, 594-603.
https://doi.org/10.4236/ojped.2023.134066

Received: June 19, 2023
Accepted: July 25, 2023
Published: July 28, 2023

Abstract

Introduction: Glomerular filtration is an important elimination pathway for many types of chemotherapy. Accurate estimation of glomerular filtration is essential in the management of children with cancer. **Methodology:** This was a prospective cross-sectional study of the descriptive type extending over a period of 6 months from July 01 to December 31, 2021 on all children with cancer followed in the pediatric hemato-oncology unit of the HND with a renal, blood and urinary assessment associated with the GFR calculated by the SCHWARTZ formula during the study period. **Results:** During the study period, we registered 41 new cases of cancer in the pediatric oncology unit. The age group of 0 - 5 years was the most represented, *i.e.* 65.85% and the average age was 5.6 ± 4 years. The most cited clinical signs were fever ie 56.10% followed by abdominal pain 34.15% and anemia 26.83%. The most represented diagnosis was Burkitt's Lymphoma, *i.e.* 26.83% followed by Retinoblastoma 24.39%. Mean serum creatinine was 70.65 ± 68.93 µmol/L. In our series, patients whose normal glomerular filtration rate were more represented, *i.e.* 70.73% and 29.27% had an abnormal GFR with an average of 87.28 ± 70 mL/min/1.73m^2. Proteinuria and leukocyturia were observed in 31.71% and 19.51% respectively. Glycosuria and hematuria with common frequencies of 2.44% of patients. **Conclusion:** The prevention of renal toxicity of anticancer drugs always involves the precise evaluation of renal function using the Schwartz formula in children.

Keywords

GFR, Child, Cancer, Chemotherapy

1. Introduction

Glomerular filtration is an important elimination pathway for many types of chemotherapy. Accurate estimate of filtration Glomerular at the bedside is essential in the care of children with cancer [1].

Improved prognosis and life expectancy for children with cancer has led to a growing interest in the prevention of long-term side effects.

Pediatrics with cancer has led to a growing interest in the prevention of long-term side effects. Identifying patients with reduced kidney function is important to prevent toxicity [2].

Impaired kidney function can lead to long-term problems with water-electrolyte balance, blood pressure regulation, growth, and drug elimination [2].

A number of factors potentiate renal failure in cancer patients. The most clinically significant are extracellular volume depletion due to vomiting, diarrhea, urinary tract obstruction, and fluid and electrolyte disturbances that may be present in these patients [3]. Elucidating the role of renal function in cancer patients is important for developing therapeutic strategies and determining prognosis [3].

Worldwide, the annual number of new cases of childhood cancer exceeds 200,000 and more than 80% of them come from developing countries [4]. The incidence of childhood cancer in most populations of the world ranges from 75 to 150 per million children per year [4].

In China, the incidence of malignant tumors in children is increasing every year, making it an important public health problem and increasing the need for prevention and treatment [5].

In Kenya, it is estimated that the annual incidence of childhood cancers at Kenyatta National Hospital (KNH) is 125 cases per year [4].

An accurate assessment of the glomerular filtration rate (GFR) during oncological treatment is essential and allows defining therapeutic strategies, planning prophylactic management of contrast examinations, making decisions on the eligibility of cisplatin and adjusting medication prescriptions, especially chemotherapy agents [6].

In Guinea, we do not have a study on this subject.

Thus, the fact that the route of elimination of most anticancer products and other molecules is renal, the difficulties related to the care and the absence of study carried out on the subject are among other reasons for the choice of the theme.

To carry out this work, we have set ourselves the following objectives:

- **Main objective**:

To assess glomerular filtration rate and urinary abnormalities in children with

cancer before chemotherapy.

- **Specific objectives**:

1) To determine the frequency of renal damage in children with cancer before chemotherapy;

2) Describe the socio-demographic characteristics of these children;

3) Describe the clinical manifestations and urinary abnormalities of children with cancer before chemotherapy;

4) Estimate the GFR using the SCHWARTZ formula.

For the realization of this study, the following plan will be adopted.

2. Methods

This was a prospective cross-sectional study of the descriptive type extending over a period of 6 months from July 01 to December 31, 2021. Our study population consisted all children with cancer followed in the pediatric hematology-oncology unit of the National Donka Hospital who received a kidney, blood and urine test during the study period. We included in our study all children with cancer aged 0 to 15 years before chemotherapy who had a serum creatine assay and a urine test using associated reactive strips or GFR calculated by the SCHWARTZ formula.

3. Results

See Figure 1 and Tables 1-7.

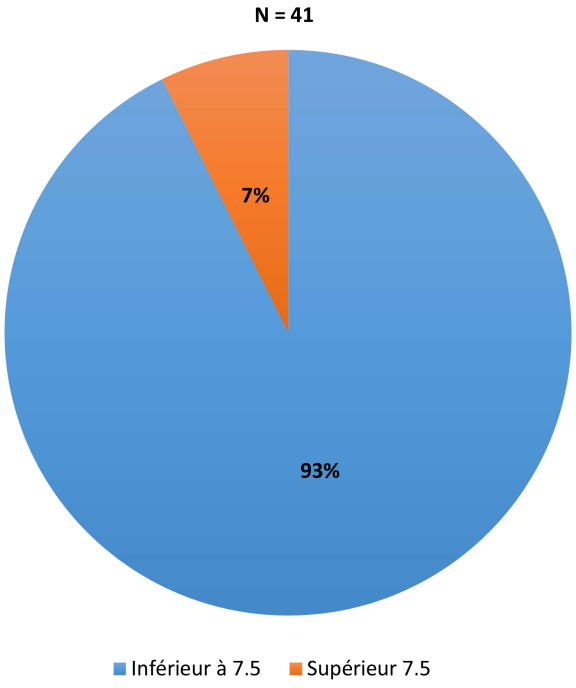

Figure 1. Distribution according to urea of 41 cancer patients in the hematology-oncology unit of Donka National Hospital. Mean urea = 5.78 ± 3.88 mmol/L; Extreme 1.7 and 52 mmol/L.

Table 1. Frequency of the reasons for consultation of 41 cancer patients in the hemato-oncology unit of the Donka national hospital.

Reasons for consultation	Number	Percentage
Fever	23	56.10
Anemia	11	26.83
Abdominal pain	14	34.15
Others*	10	24.39
Abdominal mass	9	21.95
exophthalmos	8	19.51
Abdominal distention	8	19.51
weight loss	6	14.63
Physical asthenia	6	14.63
Headache	5	12.20
Diarrhea	4	9.76
Anorexia	4	9.76
Facial puffiness	2	4.88
Vomiting	2	4.88
IOM	2	4.88
Lymphadenopathy	2	4.88
Maxillofacial swelling	1	2.44

Others*: Epistaxis, leucocoria, Pain in the lower limbs, Swelling (latero-cervical, of the lower third of the latero-external face of the left thigh, of the left shoulder, supra-umbilical), Osteoarticular pain, Buphthalmos.

Table 2. Distribution according to serum creatinine in µmol/L of the 41 cancer patients in the hematology-oncology unit of Donka National Hospital.

CREAT IN µmol/L	Number	Percentage
From 20 to 40	8	19.51
From 40 to 60	5	12.20
From 60 to 80	17	41.46
From 80 to 100	8	19.51
More than 100	3	7.32
TOTAL	**41**	**100**

Mean serum creatinine = 70.65 ± 68.93 µmol/L Extreme 27 and 191.91.

Table 3. Distribution according to age and serum creatinine of 41 cancer patients in the hematology-oncology unit of Donka National Hospital.

	CREAT IN MICROMOL/L					
Age (year)	**20 - 40 µmol/L**	**40 - 60 µmol/L**	**60 - 80 µmol/L**	**80 - 100 µmol/L**	**≥100 µmol/L**	**Total**
0 - 5	6 (75%)	4 (80%)	10 (58.8%)	6 (75%)	1 (33.3%)	**27**

Continued

6 - 10	2 (25%)	0	3 (17.6%)	2 (25%)	0	**7**
11 to 15	0	1 (20%)	4 (23.5%)	0	2 (66.6%)	**7**
TOTAL	**8**	**5**	**17**	**8**	**3**	**41**

$X^2 = 10.4$, $P = 0.23$.

Table 4. Distribution according to age and glomerular filtration rate (GFR) of 41 cancer patients in the hematology-oncology unit of Donka National Hospital.

	GFR IN ML/MIN/173M2		
Age	**GFR < 60 mL/min/1.73m²**	**GFR ≥ 60 mL/min/1.73m²**	**Total**
From 0 to 5 years old	12 (44.4%)	15 (55.5%)	**27**
From 6 to 10 years old	0	7 (100%)	**7**
From 11 to 15 years old	0	7 (100%)	**7**
TOTAL	**12**	**29**	**41**

$X^2 = 8.79$; $P = 0.01$.

Table 5. Distribution according to the stages of the renal disease of the 41 cancer patients in the hematology-oncology unit of the Donka national hospital.

Stadiums	Number	Percentage
IR with normal or high GFR	14	34.15
IR with slightly decreased GFR	15	36.59
Moderate IR	11	26.83
Severe IR	1	2.44
IR Terminal	00	0
TOTAL	**41**	**100**

Table 6. Distribution according to histological type of 41 cancer patients in the hematology-oncology unit of Donka National Hospital.

TYPE HISTOLOGY	Number	Percentage
Lymphoma (NHL and LH)	13	31.71
Retinoblastoma	10	24.39
Leukemia	8	19.51
Nephroblastoma	5	12.20
Soft tissue sarcoma	2	4.88
Carcinoma	1	2.44
Osteosarcoma	1	2.44
Hepatoblastoma	1	2.44
TOTAL	**41**	**100**

Table 7. Distribution according to the result of the urinary dipstick of the 41 cancer patients in the hematology-oncology unit of the Donka national hospital.

DRANK	Number	Percentage
Proteinuria	13	31.71
Leukocyturia	8	19.51
Glycosuria	1	2.44
Hematuria	1	2.44

4. Discussion

We carried out a prospective, cross-sectional study of the descriptive type extending over a period of 6 months from July 1 to December 31, 2021.

During our study period, we recorded 53 cases of cancer in the pediatric hematology-oncology unit, 41 of which (77.35%) underwent a renal assessment against 12 (22.64%) who did not. made. These results are different from those found by Barry A *et al.* [7] in their study in the same unit in 2020 in which the average annual frequency of cancer was 70 cases over a period of one year. This could be explained on the one hand by the ignorance of cancer in children by the population and on the other hand, this result shows an increase in the incidence of cancer in the pediatric hematology-oncology unit of the HND.

In our study, most of our patients had a normal GFR 29 (70.73%) against those who had an abnormal GFR 12 patients, *i.e.* a frequency of 29.27%, the average GFR was 87.28 ± 70 mL/min/1.73m^2 and extremes 25.02 and 197.8. The abnormal GFR could be due to the fact that on the one hand the undernutrition and on the other hand the cancer itself which would be the cause of degradation of the renal function.

We found a male predominance of 60.98% and a sex ratio of 1.56. These results are comparable to those found by *Diallo B* [8] in Mali in 2013 in his doctoral thesis in medicine on the epidemiological and anatomopathological study of childhood cancers where he had found a male predominance of 58.6% with an en sex ratio of 1.4 and those of Jankowski M *et al.* [9].

In our series, the age group from 0 to 5 years was the most dominant 27 cases or 65.85% with an average age of 5.6 years. This average age is lower than that found by Coulibaly B [10] in his doctoral thesis in medicine in Mali on the epidemiological and anatomo-clinical study of childhood cancers in 2011, which was 6.5 years. Jankowski M *et al.* [9] found 40.69% of children in the age group between 0 - 5 years: this age group would be the preferred age for the onset of pediatric cancers.

More than 2/3 (70.73%) of our patients did not come from Conakry these results are contrary to those of Narcisse Gateu [11] in his 2020 MD thesis on retinoblastoma found that 52.4% of patients came from Conakry. This could be explained by the fact that it is the only pediatric hematology-oncology unit of reference for the management of these children with cancer.

The most found reasons for consultations were very diverse however dominated by fever followed by abdominal pain and anemia with respectively: 56.10%; 34.15% and 28.83%. The association of other signs represented 24.39%. These reasons for consultation vary according to the location and the nature of the tumour.

Among the 41 patients studied, 18 cases or 43.90% of our patients saw their symptoms evolve over at least 3 months. Depending on the consultation period; the delay in consultation of patients in the pediatric hematology-oncology unit could be explained by the fact that the signs of childhood cancers are easily confused with the signs of other childhood illnesses and therefore the children pass into several health structures not specialized in the management of childhood cancers and also often the parents try traditional treatments, out of ignorance of the parents or lack of financial means and of certain service providers before finally being referred to the service.

More than half of our respondents had an ATCD of malaria 24 (58.54%); in addition 12 (29.27%) had no elucidated ATCD. This could be explained on the one hand by the fact that our country is an endemic area for malaria and on the other hand children are the most vulnerable to this disease.

According to the body mass index (BMI), malnourished children were much more represented at 87.80%. This high frequency could be explained by the delay in consultation and the disease itself.

According to serum creatinine, the range of 60 to 80 µmol/L was the most represented 17 (41.46%) followed by the range of 20 to 40 µmol/L and 80 to 100 µmol/L with the same frequency of 8 (19.51%). Mean serum creatinine was 70.65 ± 68.93 µmol/L and extremes were 27 and 191.91.

In our study, 6 (75%) of our patients who had a serum creatinine in the range of 20 to 40 µmol/L were aged 0 to 5 years, followed by 2 (25%) aged 6 to 10 years; 4 (80%) of patients who had serum creatinine in the range of 40 to 60 µmol/L were 0 to 5 years old followed by 1 (20%) were 11 to 15 years old. Patients with serum creatinine in the range of 60 to 80 µmol/L 10 (58.8%) were aged 0 to 5 years followed by 4 (23.5%) aged 11 to 15 years, 3 (17.6%) aged 6 to 10 years. Of the patients whose serum creatinine was in the range of 80 to 100 µmol/L, 6 (75%) were aged 0 to 5 years followed by 2 (25%) aged 6 to 10 years; and the patients who had serum creatinine over 100 µmol/L 2 (66.6%) were aged 11 to 15 years, followed by 1 (33.3%) aged 0 to 5 years. This variation in serum creatinine values could be explained on the one hand by the variation in age, on the other hand by the fact that the production of serum creatinine is modified by various factors such as: nutritional status, variation in muscle mass and hepatocellular insufficiency. From the association of age and serum creatinine, it emerged that there is no statistically significant relationship between age and serum creatinine ($P = 0.23$).

In our study, patients who had urea (≤) less than or equal to 7.5 mmol/L were much more represented 38 (92.68%) against those who had urea (>) greater than 7.5 mmol/L 3 (7.32%). The average urea was 5.78 ± 3.88 mmol/L and extremes

1.7 and 52 mmol/L.

During our study, according to the Schwartz formula, we found that in patients aged 0 to 5 years, 15 patients, *i.e.* a frequency of 55.5%, had a normal GFR against 12 patients, *i.e.* a frequency of 44.4% had an abnormal GFR. From the association of age and GFR it emerged that there is a statistically significant relationship between the two (2) (P = 0.01).

In our study we found that patients who had a slightly reduced GFR were more represented 15 patients, *i.e.* a frequency of 36.59% against those who had a normal or increased GFR of 14 (34.15%) and a moderately reduced GFR (moderate IR) 11 patients, *i.e.* a frequency of 26.83%.

On histology, lymphomas were the most frequent followed by retinoblastoma and leukemia with respectively 31.71% (including 26.83% of NHL and 4.87% of LH), 24.39% and 19.51% on the other hand. Coulibaly B [10] had respectively found retinoblastoma at 31.2% followed by lymphoma at 28.8% and nephroblastoma which comes in 3rd position with 18.4%.

Burkitt's lymphoma was the most represented type of cancer followed by Retinoblastoma with respectively 26.83% and 24.39%, nephroblastoma meanwhile came in 3rd position with 12.20% of cases. These results are comparable to those found by Barry A *et al.* [7]: on the other hand, Améabor K *et al.* [12] in their study in Togo in 2011 on solid childhood cancers found 51.5% cases of Burkitt's lymphoma and 9.3% of Hodgkin's disease. The analysis of the urinary dipstick in search of a urinary anomaly concerned all the patients, proteinuria was present in 13 patients with a frequency of 31.71%, leucocyturia in 8 patients or 19.51% glycosuria and hematuria with common frequencies of 2.44%.

Among the 41 patients, 80.49% performed the abdominopelvic ultrasound. Among them, 28 or 84.85% had a normal size kidney and 5 or 15.15% had an abnormal size kidney. The non-performance of ultrasound by some patients could be explained by the fact that paraclinical examinations in cases of cancer are directed by the site of the initial attack. The 5 (15.15%) who had an abnormally sized kidney are those who developed a nephroblastoma. It can be concluded that the other 28 did not develop renal metastasis [13].

We found 39.02% death. On the other hand, Traore S [14] found 34.3%, this result is lower than ours.

5. Conclusions

Kidney damage in children with cancer remains significant in our study one third (1/3) of our patients.

The age group from 0 to 5 years was the most affected with a male predominance. Fever, abdominal pain and anemia were the most common clinical signs. The prevention of renal toxicity of anticancer drugs always involves the precise evaluation of renal function using the Schwartz formula in children.

An analytical study of children with cancer before chemotherapy and children undergoing chemotherapy could have a better view of the impact of cancer on kidney disease.

Conflicts of Interest

The authors declare that there is no conflict of interest.

Contribution of the Authors

All the authors contributed significantly to the research as well as to the development of this scientific article.

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