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Role of computed tomography in post-chemotherapy evaluation of neuroblastoma in children

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ABSTRACT

Background: Neuroblastoma is the most common type of cancer that accounts for 15% of all mortality in children. Imaging diagnosis takes an essential role in the detection, diagnosis, follow of tumors, and so does Computer tomography. This study determines the value of Computer tomographic in the evaluation of neuroblastoma in children after chemotherapy. *Methods:* 49 pediatric patients were diagnosed neuroblastoma at the Children Hospital 2 Ho Chi Minh City from February 2015 to January 2017. The patients were treated with chemotherapy. The study was designed with prospective analysis. *Tools and means of study*: CT images were taken by the "CT Light Speed" machine with eight probe ranges of GE incorporation, USA. *Results*: 49 cases of neuroblastoma, of which 22 had follow-up by Computer tomographic after chemotherapy. The rate of under-five children is 89.9%. Boys are more likely than girls with a rate of 1.33/1. Tumor at stage III, IV accounted for 71.5%. Histopathology is characterized by non-differentiated disease (87%). Computer tomography has been shown to play an important role in evaluating tumor size, crossing the middle line, blood vessels, pushing organs, invading neighboring neurons before and after chemotherapy. *Conclusion:* Computed tomographic study is useful to evaluate the neuroblastoma after chemotherapy.

Keywords: Computer tomographic, Wilms' tumor, children

1. INTRODUCTION

Neuroblastoma is the most common cancer, ranking third among children with malignant leukemia and brain tumors (Thach, 2009). Neuroblastomas have diverse histopathological and clinical characteristics, which may be asymptomatic until severe clinical manifestations due to an invasion of other organs of the tumor. Neuroblastoma accounts for 15% of childhood cancer deaths (Lan, 2007). Evaluation of neuroblastoma before and after chemotherapy is important in the selection of appropriate treatment. There are many methods of monitoring neuroblastoma, such as ultrasound, X-ray, magnetic resonance imaging, computer tomography. In particular, computer tomographic X-ray is an increasingly popular method, widely used, providing much-needed information, contributing to the orientation of appropriate treatment regimens and prognosis of the disease. In the world, there are many studies on the role of computer tomographic in evaluating the results of the treatment of neuroblastoma. However, in our country, no work has been published. We conduct this study to determine the results of neuroblastoma chemotherapy in children with computer tomography.

2. MATERIALS AND METHODS

Children under 15 years of age, diagnosed with neuroblastoma in Children's Hospital 2 from February 2015 to January 2017. Be treated with chemicals according to the uniform regimen. During the study time, we selected 49 neuroblastomas, of which 22 cases had CT scans followed by chemotherapy. Computer tomographic image was taken with an 8-row transducer "CT Light Speed" of GE, USA. The procedure of scanning for kidney tumors in children: Survey field: Chest and abdomen, extending from the neck area to the bottom of the pubic bone, assessing the entire tumor as well as investigating suspected metastatic lesions, in both pelvic and chest region, according to the number are pre-set. Evaluation: Computer tomographic images are recreated axial planes Arial, Coronal, Sagittal. All tumors were analyzed: tumor size, crossing midline, pushing blood vessels, covering blood vessels, pushing organs, invading neighboring structures. Evaluate, compare before, and after chemotherapy. The data was processed using SPSS 20.0 program. Using T-pair test to compare quantitative values before and after treatment, Mc Nemar test to compare ratios (qualitative variables) before and after chemotherapy.

3. RESULTS

Forty-nine neuroblastomas, twenty-two had CT scans after follow-up chemotherapy. The average age in the study group was 34.8 months, the smallest age was 01 month (08 days old), and the largest was 159 months (13 years old). The sample is mainly in children under 05 year's old, accounting for 89.8%. Males accounted for a higher proportion (57.1%) than females (42.9%) in the study group. Male / female ratio = 1.33/1 (Table 1). Neuroblastoma is mainly differentiated form with 43 cases, accounting for 83.7%, differentiated neuroblastoma has 03 cases, accounting for 6.2 %, ganglioneuroblastoma had 03 cases, accounting for 6.2% and no undifferentiated neuroblastoma was recorded (Table 2).

Table 1 Age distribution in groups

Age group	Number of cases	Rate (%)
0 - 2	18	36.7
>2 - 5	26	53.1
>5	5	10.2
Gender		
Male	28	57.1
Female	21	42.9

Table 2 Histopathological results

Histopathological results (n=49)	Số ca	Tỉ lệ (%)
Undifferentiated neuroblastoma	0	0
Poorly differentiated neuroblastoma	43	87.6
Neuroblastoma is differentiating	03	6.2
Ganglioneuroblastoma	03	6.2
Total	49	100

After chemotherapy, the size of the tumor decreased significantly compared to before chemotherapy (4.52 ± 1.60 cm compared to 7.38 ± 2.11, p <0.01) (Table 3 and Figure 1). The percentage of tumor crossing the midline after chemotherapy decreased significantly compared to before chemotherapy (9.1% compared to 77.3%, p <0.01) (Table 4).

Table Error! No text of specified style in document. Compare tumor size before and after chemotherapy

Time	Number of track cases	Tumor size (X±SD)	p
Before chemotherapy	22	7.38 ± 2.11 (cm)	<0.01
After chemotherapy	22	4.52 ± 1.60 (cm)	

Table 4 The rate of passing the middle line before and after chemotherapy

Passing the middle line	Before chemotherapy		After chemotherapy	
	n	%	n	%
Yes	17	77.3	2	9.1
No	5	22.7	20	90.9
p	p<0.01			

The rate of tumor pushing blood vessels after chemotherapy significantly decreased compared to before chemotherapy (13.7% compared with 77.3%, p <0.01) (Table 5).The rate of tumor covering blood vessels after chemotherapy was significantly reduced compared to before chemotherapy (66.7% compared with 86.4%, p <0.01) (Table 6).

Table 5 Rate of vascular suppression before and after chemotherapy

Vascular suppression	Before chemotherapy		After chemotherapy	
	n	%	n	%
Yes	17	77.3	3	13.7
No	5	22.7	19	86.3
p	p<0.01			

Table 6 Rate of vascular wrap before and after treatment

Vascular wrap	Before chemotherapy		After chemotherapy	
	n	%	n	%
Yes	19	86.4	14	66.7
No	3	13.6	8	33.3
p	p<0.01			

The rate of tumor pushing organs after chemotherapy decreased significantly compared to before chemotherapy (14.3% compared with 54.6%, p <0.01) (Table 7). The rate of the invasive adjacent structure after chemotherapy has no significant decrease compared to before chemotherapy (p> 0.05) (Table 8).

Table 7 Rate of organ repulsion before and after treatment

Organ repulsion	Before chemotherapy		After chemotherapy	
	n	%	n	%
Yes	12	54.6	3	14.3
No	10	45.4	19	85.7
p	p<0.01			

Table 8 Rate of adjacent structural invasion before and after treatment

Adjacent structural invasion	Before chemotherapy		After chemotherapy	
	n	%	n	%
Yes	5	22.7	4	19.1
No	17	77.3	18	80.9
p	p>0.05			

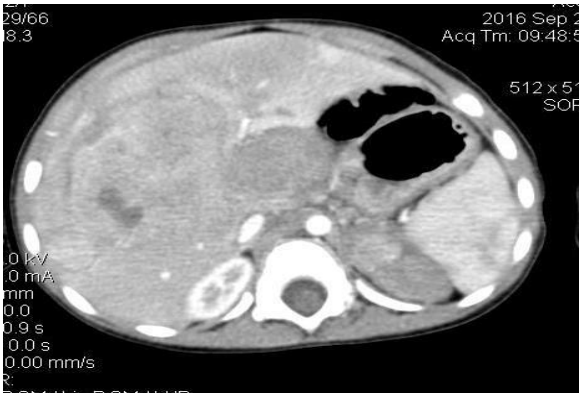

Figure 1 Post-treatment CT image of neuroblastoma

4. DISCUSSION

The average age in our study group is 34 months old, the youngest is 14 days old, and the largest is 13 years old. The average age in our study is equivalent to that of some other studies, compared with that of author Hoang Ngoc Thach at the National Hospital of Pediatrics in 2009, which was 33 months (Thach, 2009) and the author Phung Tuyet Lan is 42 months (Lan, 2007). Compared to the 2016 American Cancer Society's 2016 Children's Cancer Group Study and Kembhavi 2015 (Kembhavi et al., 2015), our average age is higher, the average age of these studies is 22 months. We recorded the highest age group affected is under 01 years old, and the majority are children under 05 years old, accounting for 90%. This result is similar to the studies of other authors. According to Hoang Ngoc Thach, the percentage of children under five years old is 86.4% (Thach, 2009), and according to the author, Kembhavi is 90% (Kembhavi et al., 2015). Results of the study on 49 children with retroperitoneal neuroblastoma, we found that the incidence in men and women was 1.33/1. Research by S. J. Cotterill has the ratio of 1.18/1(Cotterill et al., 2000), Phung Tuyet Lan is 1.62/1, Hoang Ngoc Thach is 1.08/1 (Thach, 2009). In most studies, the percentage of males is always higher than females, but the rates may vary and vary. Due to our small sample size, which is limited to patients treated at Children's Hospital 2, statistical studies on large sample sizes are needed to identify this difference accurately. According to INPC 1999, neuroblastoma is divided into three groups, which are undifferentiated neuroblastoma, poorly differentiated neuroblastoma; neuroblastoma is differentiating. Our research results show that the tumor is mainly differentiated in the group of neuroblastoma with 43 cases, accounting for 87.6%, higher than the results of the author Le Nguyen Phuong Thao and author Fake Joshi. In this study, we did not note any case of being undifferentiated while this rate in Le Nguyen Phuong Thao was 15.3%. (Thao et al., 2010) and Joshi are 2.1% (Joshi et al., 1992). We also have not noticed a correlation between histopathological groups with the severity of the disease. Many genetic changes of neuroblastoma have been recorded, and have been clinically identified in which amplification of the N-myc gene is one of the most

significant changes in chromosome structure. The most important prognosis Amplification of the N-myc gene has a poor prognostic significance for patients. Although recorded in the records, most cases sent N-myc tissue, but the result only recorded 08 cases, including 02 cases with amplified N-myc gene (similar detection rate). with author Vu Dinh Quang (Quang et al., 2016) and Huang M 2013 (Huang and Weiss, 2013). This may be due to the high cost of testing and the difficulty of testing at another health unit, so it is possible that testing for the N-myc gene has not been fully performed. Therefore, more research with larger sample sizes is needed to determine further the role of the N-myc gene in the prognosis of neuroblastoma. Most neuroblastomas are often detected late, with a metastasis rate of up to 60% at the time of diagnosis equivalent to stage III, IV or IVS (Lan, 2007). Therefore, the rate of neuroblastoma crossing the midline is often higher than the number of tumors that do not cross the middle line. The vascular wrap is a very characteristic sign of neuroblastoma that is less common in other tumors. This is a marker that helps differentiate neuroblastoma from other tumors such as wilms' tumor (Kembhavi et al., 2015; Cotterill et al., 2000). Hugosson's vascular wrap rate is 57.1% and author Richard E is 55%. When neuroblastoma exceeds the surgical indication, the tumor cannot be completely removed, the patient will undergo a biopsy, a tumor will be removed and chemotherapy will be performed. After chemotherapy, the tumor will be reassessed on computer tomographic. Depending on the results of the next computer tomographic patients will be assigned to undergo surgery or continue treatment by other methods. In our study, 22 patients underwent computer tomographic after chemotherapy. As a result, characteristics of the computer tomographic vary greatly. The size u gets smaller the signs of crossing the middle line, covering blood vessels, pushing the organs all decreased after chemotherapy. This difference is statistically significant with $p < 0.01$. If the tumor is still surrounded by blood chemotherapy, the number of surrounding blood vessels is also greatly reduced, especially there are no tumors still covering large blood vessels such as the abdominal aorta, the inferior vena cava. All 22 cases in this study were surgically removed after the chemotherapy. Thus, in addition to the value of helping diagnose tumors, orientation for initial treatment, computer tomographic also has the value of monitoring the treatment response of neuroblastoma after chemotherapy, thereby helping to orient for the next treatment.

5. CONCLUSION

The rate in children under 05 years old is 89.9%. Boys are more likely than girls to be 1.33/1. Stage III and IV tumors account for 71.5%. The histopathology is mainly poorly differentiated neuroblastoma 87.6%. CT scans are valuable for evaluation, monitoring of tumor size, crossing the midline, pushing blood vessels, covering blood vessels, pushing organs, invading adjacent structures of neuroblastoma before and after chemotherapy treatment.

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Conflicts of Interest:
The authors declare no conflict of interest.

Informed consent
Informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this manuscript.

Ethical approval for study protocol
The study was approved by the Medical Ethics Committee of Children Hospital 2 (ethical approval code: 37-CH2).

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