Febrile Neutropenic Episodes in Children with Lymphoma and Malignant Solid Tumors

Lenfoma ve Solid Malin Tümör Tanılı Çocuklarda Gelişen Febril Nötropenik Ataklar

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Abstract

Objective: To analyze febrile neutropenic episodes (FNEs) of children with lymphoma and malignant solid tumors (MSTs).

Methods: Medical records of children with cancer who had FNEs between July 01, 2005-August 01, 2007 were analyzed. Neutropenia was defined as an absolute neutrophil count (ANC) of <500 cells/mm^3 or a count of <1000 cells/ mm^3, with a predicted decrease to <500 cells/ mm^3 within 24-48 h. Fever was defined as a single axillary temperature ≥38.5°C, or ≥38°C for 1 h, or ≥38°C in two consecutive measurements with at least 4h interval.

Results: Seventy-three febrile neutropenic episodes in 33 children were analyzed. The median age of diagnosis was 6 years (5 months-18years), M:F ratio was 2. The diagnosis was lymphoma in 24%, malignant solid tumors (MSTs) in 76%, and 77% of FNEs occurred in patients with MSTs. Patients received prophylactic G-CSF before 78% of the episodes. Clinical and microbiological documentation was available in 55% and 16% of FNEs, respectively. Isolated microorganisms were mostly (85%) gram (-) bacteria. Empirical treatment was monotherapy in 22%, duotherapy in 48%, three antibiotics in 22%, more than three antibiotics in 8%. As empirical therapy, 39 patients received cephalosporins, 34 patients received carbapenems. Antibiotic modification was required in 22%. Overall, glycopeptides, antifungal and antiviral agents were used in 35%, 20% and 5% of FNEs, respectively. Fever was controlled within a median of 48h (1-18 days). Parenteral antibiotics were switched to oral cefixime before 7th day of the treatment in 42% of FNEs. Parenteral antibiotherapy duration was >10days in 14% of FNEs. Shock developed in 5 FNEs.

Conclusion: Twenty-two percent of FNEs were treated with monotherapy, and in 42% of episodes, parenteral antibiotics were used for less than one

Özet

Amaç: Lenfoma ve malin solid tümör (MST) tanılı çocuklarda gelişen febril nötropenik atakların (FNA) değerlendirilmesi.

Yöntemler: 01 Haziran 2005-01 Ağustos 2007 tarihleri arasında onkolojik tedavi uygulanan, FNA gelişen çocukların dosyaları incelendi. Nötropeni, mutlak nötrofil sayısının <500 hücre/mm^3 olması veya <1000 hücre/mm^3 olup 24-48 saat içinde <500 hücre/mm^3' e düşmesinin beklenmesi; ateş, aksiller ölçüm ile bir kez ≥38.5°C veya 1 saat süreyle ≥38°C veya en az 4 saat arayla ardışık iki kez ≥38°C ölçülmesi olarak tanımlandı.

Bulgular: Otuzüç hastada gelişen 73 febril nötropenik atak (FNA) değerlendirildi. Ortanca tanı yaşı 6 y (5ay-18y), E:K oranı 2 idi. Onkolojik tanıların %24'ü lenfoma, %76'sı maliyn solid tümörler (MST) olup, FNA'ların %77'si MST hastalarında gelişmişti. Atakların %78'inden önce hastalar proflaktik G-CSF kullanmışlardı. Febril nötropenik atakların %55'i klinik, %16'sı mikrobiyolojik olarak dökümante edilmişti. İzole edilen mikroorganizmalar %85 oranında Gram (-) bakterilerdi. Empirik tedavide %22 tek, %48 iki, %22 üç, %8'inde üçün üzerinde sayıda antibiyotik uygulanmıştı. Empirik tedavide FNA'ların 39'unda sefalosporinler, 34'ünde karbapenemler verilmişti. Antibiyotik modifikasyonu FNA'ların %22'sinde gerekmişti. Glikopeptidler %35, antifungaller %20, antiviraller %5 oranlarında FNA'larda uygulanmıştı. Ateş kontrolü ortanca 48 saatte (1-18 gün) sağlanmıştı. Febril nötropenik atakların %42'sinde 7 günden önce parenteral antibiyotik tedavisi kesilip, ağızdan sefiksim tedavisine geçilmişti. Parenteral antibiyotik tedavisinin süresi FNA'ların %14'ünde 10 günden uzun süreliydi. Beş FNA' da şok gelişmişti.

Sonuç: Febril nötropenik atakların %22'si tek antibiyotikle tedavi edildi ve %42'sinde parenteral antibiyotikler bir haftadan kısa süreli kullanıldı. Hastaların

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week. The majority of patients were hospitalized for less then 10 days. Neither fever control time, nor antibiotic modification rate was different in the cephalosporin and carbapenem groups.
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Key words: Febrile neutropenia, cancer, childhood

çoğunluğu 10 günden kısa süre hastanede yatırılarak tedavi edildi. Gerek ateşin kontrol edilme zamanı, gerekse antibiyotik modifikasyon oranı sefalosporin ve karbapenem grupları arasında farklı bulunmadı.
(Çocuk Enf Derg 2010; 4: 1-8)
Anahtar kelimeler: Febril nötropeni, kanser, çocukluk çağı

Introduction

Myelosupression due to the primary oncologic disease and intensive chemotherapy causes risks for serious bacterial, viral, fungal infections and infection-related death. Neuropenic fever is one of the oncologic emergencies that requires prompt diagnosis and therapeutic interventions., Prompt administration of the empirical antibiotic therapy reduces morbidity and mortality in febrile neutropenic episodes (FNEs). Several factors, including depth and duration of neutropenia, affect the frequency and severity of FNEs (1,2). Especially an absolute neutrophil count (ANC) lower than 1000 cell/ mm^3 and longer than 7 days duration of neutropenia are related with FNEs (1-3). Although the site of infection is defined less frequently due to the lower counts of neutrophils, fever frequently arises related to the inflammatory cytokines (1). Therefore, fever is the most frequent sign of septicemia in febrile neutropenic patients (3-5). Infection related mortality was reduced to 0.4-1 % with management of FNEs in children as a potential medical emergency (6). In this study we analysed FNEs of children with cancer in our center, from July 01, 2005 till August 01, 2007.

Materials and Methods

Medical records of children with lymphoma and malignant solid tumors (MSTs) who were admitted with FNE to our center from July 01, 2005 till August 01, 2007 were analysed retrospectively. Records of age, gender, oncologic diagnosis, stage and risk group of disease were evaluated in patients with FNE. Prophylactic G-CSF administration, diagnostic criterias for FNEs and the time of FNEs were evaluated. Neutropenia was defined as an absolute neutrophil count (ANC) of <500 cells/mm^3, or a count of <1000 cells/ mm^3 with a predicted decrease to < 500 cells/ mm^3, as suggested by IDSA (1,5). Fever was defined as a single oral temperature ≥38.5°C or ≥38°C for 1 h by the Infectious Diseases Society of America (IDSA) (5). Although oral fever measurement was suggested by the IDSA, we used axillary measurements. Fever was defined as a single axillary temperature ≥38.5°C, or ≥38°C for 1 h, or ≥38°C in two consecutive measurements with at least 4h interval (6). Initial evaluation records including physical examination findings, laboratory and radiologic evaluations were analysed for all FNEs. Occult infection sites were noted and c*linically documented infection* was considered for the existence of an infectious focus by physical examination. Records of complete blood count (CBC), peripheral blood smear, urinalysis, cultures of blood (peripheral and catheter), urine, stool, and/or other lesions were evaluated. Microbiologically documented infections, and defined pathogens were noted. Administered antimicrobial treatments were analysed. The reports of radiological investigations (chest X-ray and thoracic CT, abdominopelvic USG) which had been performed during FNE were also assessed.

Statistical analysis: The SPSS 11.0 program was used for data analysis. Patient characteristics were summarized using descriptive statistics. Comparison between groups was made by Fisher's chi-square-exact test and Mann-Whitney U test, P values of <0.05 were considered significant.

Results

Seventy-three consecutive FNEs were evaluated in 33 children with cancer, between July 01, 2005 - August 01, 2007. The median age of patients was 6 years (5months-18 y), M:F ratio was 2:1 (Table 1). The diagnoses of patients were lymphomas in 24% (n: 8), MSTs in 76% (n: 25). Fifty-six (77%) of FNEs occurred in children with MSTs (Table 1, 2). The median and mean time of FNE after chemotherapy course were 8 days (1-23 days). Patients were receiving prophylactic G-CSF before 78% of the episodes. The median and mean duration of prophylactic G-CSF administration were 5 days (1-10 days).

Empirical treatment

Empirical treatment was monotherapy in 22%, duotherapy in 48%, and three antibiotics in 22%, more than three antibiotics in 8% of FNEs (Table 3). As empirical therapy, 39 patients received cephalosporins

including cephepim and cephaperazon-sulbactam, 34 patients received carbapenems including meropenem and imipenem-cilastatin.

Neutropenia and Fever

Fever criteria were a single axillary temperature ≥38.5°C in 39 (53%) of FNEs, ≥38°C in two consecutive measurements with at least 4h in 22 (30%) of FNEs, ≥38°C for 1 h in 12 (17%) of FNEs. The median and mean ANC were 180 cell/mm^3 and 357cell/mm^3 (0-5580cell/mm^3), respectively. Fever (40°C) occurred in one patient with the diagnosis of ataxia-telangiectasia (AT) and non-Hodgkin lymphoma (NHL), when he had 5580cell/mm^3 of ANC (the upper range of ANC). We considered that he had FNE, because he had primary immunodeficiency, and his ANC decreased below 1000cell/mm^3 in a few days. The median duration of fever was 48 hours (24h-18 day). Fever control time did not differ between patients with lymphomas and MSTs and also between cephalosporin and carbapenem groups (p>0.05).

Clinical infection site

Clinical infection site was documented in 40 (55%) FNEs (Table 4). Positive findings by physical examination were as follows: oral mucositis in 21, diarrhea in 12, positive lung auscultation findings in 10, upper respiratory tract infection (URTI) in two, otitis media in one, anal fissure in two, diarrhea and encopresis-related perianal ulceration and infection in one, infected decubitis ulceration in one, paronychia in two, catheter pouch infection in two, pyoderma gangrenosum-like necrotic skin lesions in one, herpes labialis in one and zona zoster infection-like vesicular suprapubic skin lesions in one FNE.

Microbiologic documentation

Twelve (16%) FNEs were documented microbiologically, and 85% were Gram negative bacteria. Bacterial documentation was made by blood cultures in 9, by urine culture in one, and by skin lesions in two. Respiratory syncitial virus (RSV) was detected in one patient.

Blood cultures were positive in 12% (9/73) of FNEs, and 5 of them were in the cephalosporin group. The results of the antibiotic sensitivity tests were summarized in Table 5. Peripheral blood cultures (PBCs) were taken in all FNEs with the median number of two (1-5). Patients had central venous catheters in 47 (64%) of FNEs, 43 of them were port catheters. The median number of central venous catheter blood cultures (CVCBCs) were one (1-5) in 47 FNEs. Documented microorganisms were *Klebsiella pneumonia* (n:1), *Pseudomonas aeruginosa* (n:2) by PBCs; *Klebsiella pneumonia* (n:1), diphtheroid bacil (n:1), *Acinetobacter baumannii (n:1)* by CVCBCs*; Pseudomonas aeruginosa (n:1), Aprobacterium radiobacter (n:1),* coagulase negative *staphylococcus (n:1)* by both PBCs and CVCBCs. Removal of the port catheter was required in one patient because of catheter pouch infection and isolation of *Aprobacterium radiobacter* which is one of the nonfermentative gram negative bacilli in the *Pseudomonas* group. One Hickman catheter was removed because of the existence of hyperemia in the Hickman line insertion site, and no microorganism was isolated by blood cultures in this patient. The *coagulase negative staphylococcus* isolation in six blood cultures were considered to be contamination.

Klebsiella pneumonia were isolated by culture of skin lesions in one patient with diarrhea and encopresis related perianal infected ulceration. Urinalysis was performed in all FNEs and positive findings were detected in 6 (8%) of them. Pyuria was detected in 5, and microscopic hematuria was detected in one urinalysis. Urine culture was taken in 54 FNEs, and *Proteus mirabilis* was isolated in only one urine culture. Throat culture was taken in two FNEs and both of them had normal results. Diarrhea was present in 12 FNEs and stool examination was performed in all of these FNEs. Stool culture was taken in 10 of them, and no pathogenic microorganism was isolated in these cultures.

Table 1. Characteristics of patients with FNE

Characteristics	
Number of patients	33
Gender	
Female	33% (n:11)
Male	77% (n:22)
M / F ratio	2
Median age (ranges)	6 y (5 months-18 y)
Oncologic diagnosis	
Lymphoma	24% (n:8)
Malignant solid tumors	76% (n:25)
Total number of FNEs	73
Mean and median number of episodes per patient (ranges)	2 (1-8)
Number of FNEs	
in children with lymphoma	%23 (n:17)
in children with malignant solid tumors	%77 (n:56)

FNE: Febrile neutropenic episode

Table 2. Distribution of diagnosis, stage and risk groups of disease, and FNEs

Diagnosis, stage and risk groups	Number of patients	Number of FNEs	Total number of patients	Total number of FNEs
NHL[1]				
Stage 2 Anaplastic large cell, HRG	1	7		
Stage 3 Anaplastic large cell, HRG	1	1		
Stage 3 T cell, HRG	1	1		
Stage 3 pre-T cell, HRG	1	1		
Stage 3 B cell + AT, HRG	1	3		
Stage 4 pre-B cell, HRG	1	2		
Relapsed pre-T cell, HRG	1	1		
HL[2] Stage 4, nodular sclerosing type, HRG	1	1	1	1
NB[3]			6	13
Stage 1, LRG	1	1		
Stage 3, IRG favourable histology	1	2		
Stage 4, IRG unfavourable histology	1	3		
Stage 3, HRG	2	5		
Stage 4, HRG	1	2		
13				
RMS[4],			6	16
Stage 3, IRS clinical group 3	6	16		
Ewing sarcoma/PNET			5	13
Nonmetastatic, HRG	3	4		
Bone marrow metastatic, HRG	1	8		
with pulmonary metastasis, HRG	1	1		
Osteosarcoma			3	6
Nonmetastatic	3	6		
HB[5]				
PRETEXT I, SRG	1	2		
PRETEXT IV , HRG	1	3		
RB[6]				
Reese-Elsworth Stage 5b, nonmetastatic	2	2	2	2
MPSKT + NF-1, with pulmonary metastasis, HRG	1	1	1	1
Total	33	73	33	73

FNE: Febrile neutropenic episode, NHL: Non-Hodgkin's lymphoma, HL: Hodgkin's lymphoma, AT: Ataxia-telangiectasia, NBL: Neuroblastoma, RMS: Rhabdomyosarcoma, PNET: Primitive neuroectodermal tumor, HB: Hepatoblastoma, RB: Retinoblastoma, MPSKT: Malignant peripheral nevre sheet tumor, NF-1: Neurofibromatosis type 1 LRG: Low risk group, IRG: Intermediate risk group, HRG: High risk group, SRG: Standard risk group
[1]Murphy staging system and BFM risk grouping were used for children with NHL
[2]Ann Arbor staging system was used for children with HL
[3]TPOG NBL 2003 protocol staging and risk grouping were used for children with NB
[4]IRS pretreatment TNM staging system and IRS clinical grouping were used for children with RMS
[5]SIOPEL Pretreatment extention of disease (PRETEXT) staging and risk grouping were used for children with HB
[6]Reese-Elsworth intraocular tumor staging system was used for children with RB

Radiologic examinations

Chest X-ray was carried out in 36 (49%) FNEs and lung auscultation findings were present in 10 (14%) of them. Pneumonic infiltration was detected in 5 FNEs. Thorax CT was performed in 7 FNEs, pneumonic infiltrations (n:3) and pleural effusion (n:1) were detected. Although isolation of fungus or virus could not be done in any patients, fungal (n:2) and viral (n:1) pulmonary infections were considered in 3 FNEs by both chest X-ray and thorax CT.

Table 3. Antibiotic treatments in FNEs

Antibiotics	**Number of FNEs (%)**
I. Monotherapy	**16** (22)
Cephalosporins	11
- (Cefepim)	(9)
- (Cefoperazon sulbactam)	(2)
Carbapenem	5
- Meropenem	(3)
- Imipenem-cilastatin	(2)
II. Duotherapy	**35** (48)
Cefepim, amikacin	20
Cefoperazon sulbactam, amikacin	1
Meropenem, amikacin	9
Imipenem-cilastatin, amikacin	5
III. Three antibiotics	**16*** (22)
Cefepim, amikacin, glycopeptide	6
Cefoperazon sulbactam, amikacin, glycopeptide	1
Meropenem, amikacin, glycopeptide	4
Imipenem-cilastatin, amikacin, glycopeptide	5
IV. ≥ **Four antibiotics**	**6** (8)
Cefepim, amikacin, glycopeptide, and other antibiotics**	1
Meropenem, amikacin, glycopeptide, and other antibiotics**	2
Imipenem-cilastatin, amikacin, glycopeptide, and other antibiotics**	3
Total	73 (100)

* Among 16 FNEs treated by three antibiotics, teicoplanin was used in 15 FNEs and vancomycin was used in one FNE.
** Metronidazole, clarithromycin, and/or TMP-SMX were given in addition to treatment by three antibiotics in 6 FNEs.

Table 4. Clinical infection sites in patients with FNEs

Clinical infection sites	**Number of FNEs**
oral mucositis	12
positive lung auscultation findings	6
diarrhea	5
oral mucositis and diarrhea	3
upper respiratory tract infection	2
oral mucositis, diarrhea and catheter pouch infection	1
oral mucositis, diarrhea and otitis media	1
oral mucositis, diarrhea and positive lung auscultation findings	1
oral mucositis, diarrhea and encopresis related perianal infected ulceration and positive lung auscultation findings	1
oral mucositis and anal fissure	1
oral mucositis and paronichia	1
infected decubitis ulceration and positive lung auscultation findings	1
pyoderma gangrenosum – like necrotic skin lesions and positive lung auscultation findings	1
Herpes labialis and anal fissure	1
paronychia	1
catheter pouch infection	1
zona zoster infection like vesicular suprapubic skin lesions	1
Total	40

FNE: Febrile neutropenic episode

Table 5. The results of the antibiotic sensitivity tests

	Klebsiella Pneumoniae (in PBC)	*Pseudomonas Aeroginosa* (in PBC)	*Pseudomonas Aeroginosa* (in PBC)	*Klebsiella Pneumoniae* (in CVCBC)	*Acinetobacter baumani* (in CVCBC)	*Pseudomonas Aeroginosa* (in both PBC and CVCBC)	Coagulase negative staphylococcus (in both PBC and CVCBC)	*Aprobacterium radiobacter*** (in both PBC and CVCBC)
Ampicillin	R	-	-	R	-	-	-	
Penicillin	-	-	-	-	-	-	R	
Cefoperazon sulbactam	S	S	S	S	S	S	-	
Ceftazidime	S	S	-	S	S	-	-	
Cefotaxime	S	-	-	S	-	-	-	
TMP-SMX	R	-	-	S	-	-	-	
Gentamicin	S	S	S	S	S	S	R	
Amikacin	S	S	S	S	S	S	-	
Ciprofloxacine	S	S	S	S	S	S	S	
Carbapenem	S	S	S	S	S	S	-	
Piperacilin-Tazobactam	-	S	S	-	-	S	-	
Cefepim	-	-	S	-	-	S	-	
Oxacillin	-	-	-	-	-	-	R	
Eritromycin	-	-	-	-	-	-	R	
Gylcopeptide	-	-	-	-	-	-	S	
Clindamycin	-	-	-	-	-	-	R	

* Antibiogram was not done for *diphtheroid bacilli* isolated from CVCBC and for Klebsiella pneumonia isolated from culture of skin lesions
** PBC: Peripheral blood culture, CVCBC: Central venous catheter blood culture, *** Antibiotic sensitivity test results could not be found retrospectively

Glycopeptide, antifungal, antiviral treatments

Overall, glycopeptides, antifungal and antiviral agents were used in 35%, 20%, and 5% of FNEs, respectively. Antifungal agents were given in 15 (20%) FNEs. Fluconazole was given in 7 FNEs because of clinical esophagitis (n:2) and grade 4 oral mucositis with candidal plaques (n:5). Amphotericin B administration was required in 8 FNEs because of the acute-progressive respiratory distress (ARDS) and pneumonia that was radiologicaly considered as a fungal infection (n:2), and because fever control could not be achieved at the 5th day of empirical antibiotherapy (n:6). Antiviral agents were given in 4 (5%) FNEs. Two patients received acyclovir because one of them had Herpes labialis and the other had suprapubic vesicular lesions. One patient required ribavirin treatment because viral pneumonia was considered by radiologic evaluations and RSV was detected in tracheal aspiration material. Gancyclovir therapy was administered to another patient with AT and NHL because the fever control could not achieved at the 17th day of follow up.

Treatment modifications and success

Antibiotic modification was required in 22% of FNEs. The median duration of the parenteral antibiotic administration was 8 days (3-21days). Parenteral antibiotics were switched to oral cefixime before the 7th day of treatment in 42% of FNEs. Parenteral antibiotherapy duration was >10days in 14% of FNEs. Neither antibiotic modification rate nor the duration of parenteral antibiotic therapy were found different between the cephalosporin and carbapenem groups (p>0.05).

Hypotension and shock developed in 5 (7%) of FNEs during the first 24 hours. Acute, progressive respiratory distress that reuired mechanical ventilation was seen in 3 FNEs, and despite administration of wide spectrum antimicrobial therapy, two patients died with sepsis and multiple organ failure. The diagnoses of the dead patients were non-Hodgkin lymphoma (in the carbapenem group), and neuroblastoma (in the cefalosporin group).

Discussion

In our center leukemias are treated by different department. Herein we analysed FNEs of patients with

lymphomas and MSTs, and the majority of our patients had MSTs. All patients received systemic chemotherapy. Febrile neutropenia developed despite the high rate (78%) of prophylactic G-CSF administration before the episodes. In our previous report, 59% of FNEs were seen in patients with MSTs (7). In this study, 77% of FNEs were seen in MSTs, and 71% of these FNEs were seen in high risk group patients (Table 2).

When we compared the empirical treatment rates with results of our previous report, increase in rates of monotherapy (22% vs 15.8%) and decrease in rates of duotherapy (48% vs 58%) were seen (7). As empirical therapy, 39 (53%) patients received cephalosporins, 34 (47%) patients received carbapenems. The fever control time, antibiotic modification rate, and the duration of parenteral antibiotic therapy were not significantly different between these two groups. These results showed that cephalosporin and carbapenem therapies were equally effective in FNEs. The rate of antibiotic modification requirement was 25% in monotherapy, 26% in duotherapy and 14% in more than three drugs regimens.

Clinical infection site was documented in 40 (55%) FNEs and the most common findings were oral mucositis in 21, diarrhea in 12, and positive lung auscultation findings in 10 FNEs. Although diarrhea was seen in 12 FNEs, it was thought to be related to the high dose methotrexate therapy.

We routinely take chest X-rays in patients with positive lung auscultation findings. Chest X-rays were carried out in 49% FNEs, although only 10 (14%) of them had lung auscultation findings. Pneumonic infiltration was detected in 5 FNEs. We considered that pneumonic infiltration could not be seen in the other 5 patients with lung auscultation findings due to neutropenia. Thorax CT was performed in selected patients.

The rate of positive blood culture was 12% and was consistent with the bacteremia rate in other studies (8-10). Previously, gram negative bacteria were identified in 51% of positive bacterial cultures in our center (7). In this study 85% of microorganisms isolated by blood cultures were gram negative bacterias (predominantly *Pseudomonas*). These documented microorganisms reflected the microbiologic pathogen profile of our center. Although the incidence of gram negative bacteremia was high, aminoglycoside treatment was given for <7days in 42% of FNEs who received aminoglycosides, because of the renal toxicity risk. Our pediatric hematology department also overviewed 239 FNEs in 82 pediatric leukemia cases (11). They reported that the microbiologic documentation rate was 31.4% and 61.8% of these were gram negative microorganisms; the mean antibiotic administration time was 12.7 days and fever resolved after a mean of 5.3days (11).

In our management, when fever control was achieved for 72 hours, we decide to switch antibiotic therapy to oral cefixime in order to reduce hospitalization. Parenteral antibiotherapy duration was >10days in 14% of FNEs. Parenteral antibiotics were switched to oral cefixime before the 7th day of treatment in 42% of FNEs.

Conclusion

We treated 22% of patients with monotherapy. In 42% of episodes, parenteral antibiotics were used for less than one week. The majority of patients were hospitalized for less than 10 days. Fever control time, and antibiotic modification rate did not differ different between the cephalosporin and carbapenem groups. Empirical therapy with cephalosporin and carbapenem for FNEs are equally effective and safe in pediatric patients with lymphomas and MSTs. Continuation of antibiotic therapy with oral cefixime could be considered for children with FNEs.

Conflict of Interest

No conflict of interest is declared by the author.

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