

Research Paper

# Management of pediatric peritonsillar and deep neck infections- cross- sectional retrospective analysis



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## KEYWORDS

Deep neck infection;  
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Microbiology;  
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**Abstract** *Objective:* Deep neck infections (DNI) are responsible for significant morbidity in children and healthcare expenditures. Few studies exist specifically addressing the clinical and epidemiologic characterization and management of DNI's in the pediatric population. Our goal was to analyse the demographic characteristics, clinical presentation, diagnostic and therapeutic approaches of peritonsillar and DNI in pediatric patients.

*Methods:* The medical records of patients, aged up to 18 years, admitted for peritonsillar and DNI at our department, from 2011 to 2016, were retrospectively reviewed and compared with the literature available. Ninety-eight patients were enrolled.

*Results:* The mean age was higher in patients with peritonsillar abscess and lower in patients with retropharyngeal and parapharyngeal infections. Admissions have significantly increased from 2011. There was a seasonal variation for DNI incidence, with a peak incidence in Summer and Spring. All patients included were treated as inpatient and received empirical intravenous antibiotic therapy and steroids regardless of drainage procedures. Incision and drainage was performed in 72 patients. The hospital length of stay was higher among patients with retropharyngeal abscess and in the group with complications. Only 2 patients developed complications during hospital stay. The most common microbiological pattern was monomicrobial and the most commonly isolated pathogens were *Streptococcus Pyogenes*, *Streptococcus Mitis* and anaerobic bacteria.

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**Conclusions:** Surgical incision and drainage followed by intravenous antibiotic and steroids proved to be successful with low morbidity related to surgical approach. However, in selected cases, medical therapy may be an alternative to surgical management in uncomplicated infections.

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## Introduction

Deep neck infections (DNI) are a significant clinical entity in the pediatric population, commonly affecting the retropharyngeal, parapharyngeal and peritonsillar spaces.

These infections represent a major source of morbidity and healthcare expenditures in children.<sup>1</sup>

Life threatening complications can develop rapidly and include airway obstruction, dissemination of infection and development of mediastinitis, jugular vein thrombosis, cranial nerve dysfunction, cervical osteomyelitis, meningitis and death.<sup>1</sup>

Early diagnosis, based on clinical evaluation and radiological imaging, followed by prompt and appropriate treatment is crucial.

Few studies exist specifically addressing the clinical epidemiologic characterization and management of DNI's in the pediatric population. Recent reports suggest an increase in the incidence of pediatric retropharyngeal abscess, without concurrent increase in the incidence of combined DNI, peritonsillar or parapharyngeal abscesses.<sup>2</sup>

The aim of this study was to perform a descriptive study of the management of peritonsillar and DNI in our institution namely to analyse demographic characteristics, clinical presentation, diagnostic and therapeutic approaches in pediatric patients. The findings were compared to those in the literature available.

## Material and methods

The medical records of patients, aged up to 18 years, admitted for DNI at our department, from January 2011 to August 2016, were retrospectively reviewed and compared with the literature available. The study was approved by the Ethical Committee of our Hospital.

DNI are defined as an infection in the potential spaces and fascial planes of the neck.

Although peritonsillar infections are not truly DNI, we have decided to include them in our review because of its high incidence and sometimes coexistence with other DNI.

Therefore, we have studied peritonsillar, parapharyngeal and retropharyngeal abscesses or cellulitis. Peritonsillar abscess/cellulitis is localized in the space surrounding the palatine tonsils, limited externally by the superior pharyngeal constrictor muscle. The parapharyngeal abscess/cellulitis is localized medially to the space surrounded by the pharynx, the carotid sheath posteriorly, and the muscles of styloid process laterally. Retropharyngeal abscess/cellulitis is localized in the space

posterior to the pharynx, bounded by the buccopharyngeal fascia anteriorly, the prevertebral fascia posteriorly, and the carotid sheaths laterally. Patients with other subtypes of DNI were excluded.

The data collected is summarized in [Table 1](#).

Statistical analysis was performed with the IBM SPSS Statistics program, 22nd version.

Continuous variables are presented as mean  $\pm$  standard deviation and categorical variables as frequencies and percentages.

Correlation between continuous variables was tested using Pearson or Spearman correlation tests. Associations were tested for categorical variables using Chi-square or Fisher's exact tests.

Comparison between groups was tested, using independent *t*-tests or ANOVA and Mann–Whitney or Kruskal Wallis tests for continuous variables. Post-hoc tests were made using multiple pairwise comparisons with the Bonferroni correction for Kruskal Wallis. For significant findings, the effect size is also reported.

Regression analysis was performed to identify significant predictors of the occurrence of complications after admission and the hospital length of stay.

Significance is settled for  $P < 0.05$ . Descriptive statistics are presented as mean  $\pm$  standard deviation.

## Results

### Demographic characterization

There were 98 patients presenting with peritonsillar and DNI during the study period. Of these, 45 (45.9%) were male and 53 (54.1%) were female (M/F ratio = 0.8). The mean age of patients was (12.07  $\pm$  4.75) years (maximum 18 years; minimum 2 years).

Patients were more often hospitalized in Summer (30.6%) and Spring (28.5%), followed by Winter (23.5%) and lastly Autumn (17.3%). The three months of the year with higher admissions rates were July (17.3%), followed by June (11.2%) and May (11.2%). Although the year of 2016 was analysed only until August, there has been a sustained increase in the hospital admissions due to peritonsillar and DNI in the pediatric age, since 2011 until 2015.

### Location

The most common infection was the peritonsillar abscess ( $n = 71$ ; 72.4%) and peritonsillar cellulitis ( $n = 15$ ; 15.3%), with only 7 patients (7.1%) admitted for parapharyngeal

**Table 1** Data collected for each patient admitted for peritonsillar and DNI, from 2011 to 2016.

Age at the admission (years)
Gender
Hospital length of stay (HLS) (days)
Hospital length of stay superior to 5 days (HLS>5 d), (days)
Seasonal distribution (winter, spring, summer, autumn)
Month at the admission
Year at the admission
Type of DNI (peritonsillar, parapharyngeal, retropharyngeal abscess/cellulitis)
Side of Dni (left, right, bilateral)
Etiology of the abscess/cellulitis
Symptoms at presentation
Time since the beginning of symptoms until admission (days)
Tonsillar Hypertrophy (Friedman Grading Scale) at the admission
History of previous DNI
Site and side of previous DNI
History of recurrent tonsillitis
Comorbidities
Pre- hospital antibiotherapy treatment
Performance of a computed tomography (CT) scan at the admission
Dimension of the abscess in CT scan (mm) (greater axis)
Performance of incision and drainage
Performance of drainage in the operative room
Laboratorial measurements at admission (leucocyte count, neutrophil count, C reactive protein)
Microbiology analysis of DNI
Antibiotherapy during hospital stay
Transfer to the hospital of local residency
Occurrence of complications during hospital stay
Need for surgical reintervention
Need for antibiotherapy adjustment during hospital stay
Need for performance of a CT scan during hospital stay, after admission

DNI: deep neck infection.

abscess and 4 patients (4.1%) admitted for retropharyngeal abscess (Table 2). There were no cases of parapharyngeal or retropharyngeal cellulitis during the period of study. There has been only 4 cases of bilateral infection.

Although, the mean age was higher in patients with peritonsillar abscess ( $12.43 \pm 4.91$ ) years and lower in patients with retropharyngeal abscess ( $6.00 \pm 2.83$ ) years, these differences were not statistically significant (Table 2).

The mean global hospital length of stay (HLS) was ( $4.41 \pm 1.65$ ) days. The patients with retropharyngeal abscess presented the highest HLS ( $5.25 \pm 1.71$ ) days, followed by peritonsillar ( $4.43 \pm 1.22$ ) days and parapharyngeal abscesses ( $4.20 \pm 0.84$ ) days. Peritonsillar cellulitis presented the lowest length of stay ( $3.80 \pm 2.51$ ) days (Table 2).

Fifteen patients (17.6%) presented a HLS longer than 5 days (>5 d), being peritonsillar and retropharyngeal abscesses the most common causes (Table 2).

### Clinical presentation

The most common symptoms at presentation were odynophagia (97.3%), fever (58.9%) followed by dysphagia (53.4%). Trismus was present in 24.7% of the patients and otalgia in 11.0%. Only 3 patients (4.1%) described dyspnea and 7 patients (7.61%) presented neck pain. Noteworthy is

the occurrence of neck pain more commonly in patients with retropharyngeal ( $n = 3$ ) and parapharyngeal ( $n = 2$ ) abscesses. ( $\chi^2(5) = 45.72, P < 0.001$ ). The average time since the beginning of symptoms until admission was ( $4.8 \pm 3.5$ ) days. Twelve patients had history of previous infection. These affected only the peritonsillar region and all, except one, were ipsilateral in relation to the actual episode.

### Previous clinical history

According to the records, 35.2% of patients had history of recurrent tonsillitis. Only 8 patients presented with comorbidities in the medical records, namely asthma ( $n = 3$ ), epilepsy ( $n = 1$ ), Charcot–Marie–Tooth disease ( $n = 1$ ), inflammatory bowel syndrome ( $n = 1$ ), cardiac valvulopathy ( $n = 1$ ) and chromosomopathy ( $n = 1$ ). No other comorbidities were seen in this sample.

### Previous treatment

More than a half of patients were under antibiotic therapy previously to admission, mainly Amoxicillin-clavulanate (AC) (39.2%) and penicillin (27.4%).

**Table 2** Clinical characterization of peritonsillar and DNI in pediatric patients admitted, according to infection subtype, from 2011 to 2016.

Type of infection	Patients, No. (%) (n = 98)	Side (n = 98)	Age (n = 98, Mean ± SD)	HLS (n = 83, Mean ± SD) <sup>a</sup>	HLS>5 d (n = 83) <sup>a</sup>	Antibiotics during hospitalization (n = 83) <sup>a</sup>
Peritonsillar Abscess	71 (72.4)	Left-42 Right-27 Bilateral-2	12.43 ± 4.91	4.43 ± 1.22	9	AC + Clindamycin- 61 Clarithromycin + Clindamycin- 1 AC- 4 Ceftriaxone + Clindamycin- 4 Ceftriaxone + Metronidazole- 1 AC + Clindamycin- 4 Ceftriaxone + Clindamycin- 2 Ceftriaxone- 1
Parapharyngeal Abscess	7 (7.1)	Left-2 Right-5 Bilateral-0	10.80 ± 5.02	4.20 ± 0.84	1	AC + Clindamycin- 4 Ceftriaxone + Clindamycin- 2 Ceftriaxone- 1
Retropharyngeal Abscess	4 (4.1)	Left-2 Right-1 Bilateral-1	6.00 ± 2.83	5.25 ± 1.71	3	AC + Clindamycin- 2 Ceftriaxone + Clindamycin- 1 Clindamycin- 1
Peritonsillar cellulitis	15 (15.3)	Left-8 Right-6 Bilateral-1	10.43 ± 4.47	3.80 ± 2.51	1	AC + Clindamycin- 14 AC- 1
Retropharyngeal cellulitis	1 (1.0)	Right			1	AC + Clindamycin
P- value		>0.05	>0.05	<0.05	<0.05	

DNI: deep neck infection; HLS: hospital length of stay; AC: Amoxicillin-clavulanate.

<sup>a</sup> 15 patients transferred to the hospital of local residency were excluded.

## Diagnosis and treatment

The data of leucocyte count was available in 72 patients. The reference range of leucocyte count was (4.0–11.0)  $\times 10^9$  cells/L. The leucocyte count was abnormal ( $>11.0 \times 10^9$  cells/L) in 56 (76.7%) patients with a mean value of  $(15.3 \pm 4.3) \times 10^9$  cells/L. There were no cases of leukopenia. C-reactive protein (CRP) was measured and positive ( $>2.9$  mg/L) in 52 patients (mean  $(72.0 \pm 48.2)$  mg/L).

Computed tomography (CT) scan with contrast enhancement was performed in 34 patients (34.7%) at the admission. CT was performed at admission in case of need of confirmation of diagnosis after negative trans-oral puncture/drainage or in case of need to drainage in the operative room. The mean size of the abscess in the CT scan, considering the greater axis, was  $(19.47 \pm 8.45)$  mm.

Excluding the cases of peritonsillar cellulitis, incision and drainage was performed in 72 patients (86.7%). Incision and drainage procedures were performed under local anesthesia, via trans-oral whenever possible. In 20 patients drainage was performed in the operative room under general anesthesia, mainly due to lack of collaboration from the child and also in case of need of external approach (in 2 cases of parapharyngeal abscess).

All patients included in this study were treated as inpatient and received empirical intravenous antibiotic therapy regardless of the use of drainage procedures. Our department presents a specific protocol for treatment of peritonsillar abscess, initiated in 2012, which consists of a 5-day intravenous treatment with AC ( $90 \text{ mg kg}^{-1} \cdot \text{day}^{-1}$ )

plus clindamycin ( $20\text{--}25 \text{ mg kg}^{-1} \cdot \text{day}^{-1}$ ), associated with corticosteroids. Globally, over 84% of the patients were treated with AC plus clindamycin, regardless the site of DNI.

Samples of pus was collected for microbiological analysis in 26 patients. Around 60% of the cultures were monomicrobial. The most commonly isolated pathogens were *Streptococcus Pyogenes* (the most common in monomicrobial infections), *Streptococcus Mitis*, *Streptococcus constellatus* and also anaerobic bacteria. Anaerobic bacteria most frequently occurred in a polymicrobial pattern. Other pathogens isolated are listed in [Table 3](#).

## Complications

Only 2 patients developed complications during hospital stay. A 4-year-old boy, admitted for a peritonsillar abscess for conservative treatment, developed dyspnea with stridor in the first day in the ward and a quinsy tonsillectomy had to be performed. One patient was readmitted due to persistence of a peritonsillar abscess; It was the case of a 11-year-old boy, submitted to incision and drainage of the abscess, followed by 4 days inpatient treatment with AC plus clindamycin with clinical improvement. He was readmitted 6 days after, due to worsening of the symptoms and completed a 5-day-treatment with ceftriaxone plus metronidazole, with complete resolution. Antibiotic therapy adjustment during hospital stay was also required in another 4-year-old male patient with a retropharyngeal abscess, previously treated with oral AC before admission. After surgical drainage in the operative room we underwent

**Table 3** Laboratorial and culture analysis of pediatric patients admitted for peritonsillar and DNI, from 2011 to 2016.

Characteristics	Number
<b>Laboratorial measurements at admission (Mean <math>\pm</math> SD)</b>	
Leucocyte count ( $\times 10^9$ cells/L) ( $n = 72$ )	15.3 $\pm$ 4.3
Neutrophil count ( $\times 10^9$ cells/L) ( $n = 72$ )	11.6 $\pm$ 4.4
C reactive protein (mg/dL) ( $n = 52$ )	72.0 $\pm$ 48.2
<b>Microbiology analysis (<math>n = 26</math>, No. (%))</b>	
Monomicrobial infections	15 (61.5)
Polymicrobial infections	11 (38.5)
<b>Microbiology analysis (<math>n = 26</math>)</b>	
Streptococcus pyogenes	7
Streptococcus mitis	7
Streptococcus constellatus	4
Staphylococcus aureus	3
Streptococcus anginosus	3
Streptococcus gordonii	2
Streptococcus intermedius	2
Streptococcus spp	1
Aerococcus spp	1
Streptococcus Parasanguinis	1
<b>Anaerobic bacteria</b>	
Fusobacterium	3
Prevotella melaninogenica	3
Peptostreptococcus asaccharolyticus	3
Veillonella	2
Clostridium clostridioforme	1

DNI: deep neck infection.

a 7-empirical day treatment with ceftriaxone plus clindamycin with complete clinical resolution. There were no patients requiring further surgical reintervention.

### Association studies and comparison between groups

#### Hospital length of stay (HLS)

There were statistical significant differences in the HLS between the different types of infections ( $F(4,90) = 3.542$ ;  $P = 0.010$ ;  $\eta^2 = 0.136$ ). As previously stated, patients with retropharyngeal abscess presented the highest HLS (5.25  $\pm$  1.71), followed by peritonsillar (4.43  $\pm$  1.22) and parapharyngeal abscesses (4.20  $\pm$  0.84). See Table 2.

Also, there was a statistical significant association between the subtype of infection and HLS > 5 days ( $\chi(8) = 41.710$ ,  $P < 0.001$ ). As previously stated patients with peritonsillar and retropharyngeal abscesses most frequently had HLS > 5 days.

Patients which displayed complications had longer HLS (7.00  $\pm$  2.64) days compared with patients without complications (3.96  $\pm$  1.73) days. ( $t(93) = -2.949$ ;  $P = 0.004$ ;  $g = 3.91$ ).

There were no differences of HLS between groups which displayed comorbidities or had history of previous recurrent tonsillitis or history of previous peritonsillar or DNI ( $P > 0.05$ , Table 4). There were no differences in the HLS between patients submitted to drainage of abscess and

the patients submitted to medical treatment alone ( $P > 0.05$ ). However, the existence of a treatment protocol for peritonsillar abscess might be a source of bias for the evaluation of HLS. The HLS has fair-moderate positive correlation with the dimension of the abscess in the CT scan at the admission ( $r = 0.52$ ,  $P = 0.32$ ). Also, there is a significant association between the presence of neck pain at the admission and a HLS > 5 d ( $\chi(2) = 11.28$ ,  $P = 0.004$ ).

#### Site of infection

A association was found between the site of infection and the presence of neck pain at presentation ( $\chi(5) = 45.72$ ,  $P < 0.001$ ). Seven patients (8.1%) described neck pain at the admission, 3 presented retropharyngeal abscess, 2 presented a parapharyngeal abscess and 2 presented a retropharyngeal cellulitis.

The site of infection was associated to the performance of a CT scan at the admission and during hospital stay ( $\chi(5) = 15.15$ ,  $P = 0.010$ ). In fact, 83.3% ( $n = 5$ ) of patients with parapharyngeal abscess underwent CT scan at the admission, followed by 75% ( $n = 3$ ) of patients with retropharyngeal abscess, 29.6% with peritonsillar abscess ( $n = 21$ ) and 20% with peritonsillar cellulitis ( $n = 3$ ).

#### Dimension of the abscess in the CT at the admission

Concerning the dimension of the abscess in the CT at the admission, there was a statistical significant difference between the patients who had history of recurrent tonsillitis and those who had not ( $t(16) = -2.035$ ;  $P < 0.05$ ). In fact, the group with recurrent tonsillitis presented larger abscesses in the CT scan (Table 5).

**Table 4** Comparison of the HLS among groups, in days, from 2011 to 2016 ( $n = 98$ , unless stated otherwise).

Characteristics	Number	<i>P</i> value
<b>Comorbidities</b>		$p > 0.05$
Yes	4.05 $\pm$ 1.87	
No	4.00 $\pm$ 1.16	
<b>History of previous recurrent tonsillitis</b>		$p > 0.05$
Yes	3.97 $\pm$ 1.47	
No	4.22 $\pm$ 2.03	
<b>Occurrence of complications</b>		$p < 0.05$
(n = 83) <sup>a</sup>		
Yes	7.00 $\pm$ 2.64	
No	3.96 $\pm$ 1.73	
<b>Drainage of the abscess at the admission</b> (n = 83) <sup>b</sup>		$p > 0.05$
Yes	4.13 $\pm$ 1.54	
No	3.83 $\pm$ 2.51	
<b>History of previous DNI</b>		$p > 0.05$
Yes	4.01 $\pm$ 1.80	
No	4.25 $\pm$ 2.14	

DNI: deep neck infection.

<sup>a</sup> 15 patients transferred to the hospital of local residency were excluded.

<sup>b</sup> Patients with peritonsillar cellulitis were excluded.

**Table 5** Comparison of the Dimension of the abscess in the CT scan at the admission among groups.

History of previous recurrent tonsillitis	Dimension of the abscess in the CT scan (greater axis) (mm)	<i>P</i> value
Yes (n = 10)	22.80 ± 7.30	<0.05
No (n = 8)	15.30 ± 8.30	
<b>Drainage of the abscess at the admission</b>		>0.05
Yes (n = 14)	21.39 ± 8.52	>0.05
No (n = 4)	12.75 ± 3.69	
<b>History of previous DNI</b>		>0.05
Yes (n = 3)	14.67 ± 5.51	>0.05
No (n = 15)	20.43 ± 8.75	

There was no difference between patients with and without personal history of DNI considering the dimension of the abscess in the CT scan at the admission (Table 5).

Furthermore, the group submitted to drainage of abscess at the admission presented greater dimensions of the abscess in the CT performed before in the admission, although the difference was not statistically significant ( $P > 0.05$ , Table 5).

#### Age

Age difference between infection subtypes was not statistically significant. ( $P > 0.05$ ).

As expected, age of the patient at presentation was statistically significantly lower in the group patients submitted to drainage of the abscess in the operative room ( $6.86 \pm 3.75$ )years versus ( $13.46 \pm 4.00$ )years,  $Z(U) = 197.5$ ;  $P < 0.001$ ).

No other associations between age and other variables were seen.

#### Time since the beginning of symptoms until admission

The time since the beginning of symptoms until admission was statistically significantly higher in the group under antibiotic therapy at admission ( $5.48 \pm 3.8$  versus  $3.83 \pm 3.00$ ,  $Z(U) = 566.00$ ;  $P = 0.013$ ). No other significant differences between groups were established.

#### Regression studies

For the purpose of this study, no significant regression models were obtained where type of infection, age, gender, time since the beginning of symptoms until admission, dimension of the abscess in CT scan, performance of incision and drainage were predictive variables for the occurrence of complications after admission or the hospital length of stay.

#### Discussion

Initial diagnosis of peritonsillar and DNI in the pediatric population is particularly challenging due to the subtleness of clinical presentation, the frequent unreliable collaboration associated with the difficulty in self expression of symptoms in this age group. Moreover, the differential diagnosis is often difficult due to the overlap in the clinical presentation with other clinical entities such as tonsillitis,

viral pharyngitis and lymphadenitis very frequent in the pediatric population.

We have studied the management of 98 pediatric patients with peritonsillar and DNI at our institution, specifically in the peritonsillar, parapharyngeal and retropharyngeal location over a 5 year-period. Few studies exist specifically addressing the incidence of peritonsillar and DNI in the pediatric population. A decreased incidence has been previously observed due to improvements in antibiotics, improvement of oral hygiene and better access to healthcare system.<sup>3</sup> However, recent reports have documented an increased incidence of these infections.<sup>4,5</sup> Recently, Novis et al.<sup>2</sup> reported that the combined incidence of pediatric DNI from 2000 to 2009 remained stable but demonstrated a significant increase in the incidence of retropharyngeal abscess.

Our study revealed a sustained increase in the hospital admissions due to peritonsillar and DNI in the pediatric age, from 2011 to 2015. Other studies have reported an annual increase of incidence of DNI infections over a 11-year period. Our results might be explained by the fact that since 2012 a specific protocol for treatment of peritonsillar abscess has been instituted leading to greater admissions of these cases. Also, the antibiotic resistance is a major concern. In fact, more than a half of patients admitted were already under antibiotic treatment and many had fulfilled more than one antibiotic without improvement.

In our study, there was a seasonal variation for infection's incidence, with a peak incidence in Summer and Spring, unlike other studies that reported a predominance of the infections in winter.<sup>5</sup> In the study of Mazur et al,<sup>6</sup> Summer was also the season with most cases of peritonsillar cases.

In our series, the most common infection subtype was the peritonsillar abscess. These results questions the theory of peritonsillar abscess being a direct complication of acute tonsillitis or upper respiratory tract infection given that the incidence of the latter seems to be higher in colder months. A fact that might justify the disparity of seasonal incidence of these infections in literature is the variability of climate of each season around different parts of the world.<sup>7</sup>

Previous reports addressing pediatric peritonsillar and DNI are conflicting regarding sex predilection. These discrepancies might be attributed to the limited number of pediatric peritonsillar and DNI cases compared with adult cases. In this study, there was a non significant male predominance (M/F ratio = 0.8), which has been reported in other studies as well.<sup>5,8-10</sup>

Age varied among the different types of infection, although this difference was not statistically different. Still, the mean age was higher in patients with peritonsillar abscess and lower in patients with retropharyngeal and parapharyngeal infections. Other studies have reported a similar age dependent incidence of different types of DNI in pediatric patients.<sup>10,11</sup> It has been postulated that peritonsillar and DNI in older children and in adults might result from direct spread of infection from an adjacent structure including dental infection, pharyngitis, and sialoadenitis.<sup>10</sup> The predisposition of young children to present retropharyngeal and parapharyngeal infections might be explained by higher incidence of respiratory infections in this age group as well as to the prominent paramedian chain of lymph nodes in the retropharyngeal space that tend to involute after 5 years of age.<sup>10-12</sup>

There is no established goldstandard treatment of peritonsillar and DNI regarding indications of surgical intervention, empirical choice and duration of antibiotic therapy. In our hospital, incision and drainage of the abscess associated to intravenous antibiotics and corticosteroids is the treatment of choice and was performed whenever possible with few exceptions. In our series, the cases in which incision and drainage was not performed was due to the reduced dimension of the purulent collection (usually peri-centimetric abscesses) combined with good clinical response to medical therapy.

The fact that HLS did not differ between patients submitted to surgical and patients submitted to medical treatment alone might be explained by medical treatment being indicated in patients without complications or with smaller abscesses. Furthermore, the existence of a treatment protocol mandating a 5-day treatment for peritonsillar abscess is indeed a source of bias for the evaluation of HLS. Particularly, the treatment of peritonsillar abscess is particularly controversial. Many advocate that surgical incision and drainage should be reserved only for patients with airway compromise, poor response to antibiotherapy, immunocompromised and patients with complications. Wang Y *et al* concluded that the management of peritonsillar abscess with needle aspiration alone was associated with higher degree of recurrence in the pediatric population.<sup>13</sup>

Outpatient management of peritonsillar abscesses involving needle aspiration and oral antibiotics is advocated by many physicians.<sup>13–15</sup> Although, considering the potential life-threatening complications of these infections, hospitalization is a common procedure.<sup>13</sup> Empirical antibiotic therapy should cover the most common isolated pathogens, induce little or no resistance and achieve sufficient concentration in the infected site, have a good safety record, cause minimal toxicity and have maximum stability. Duration of treatment should be individualized, depending on the clinical response. Also, combination of steroids to intravenous antibiotics is currently considered.

In our study, the most common microbiological pattern was monomicrobial and the most commonly isolated pathogens were *Streptococcus pyogenes* and *Streptococcus mitis*. Also anaerobic bacteria were very frequent, including *Prevotella*, *Fusobacterium* and *Peptostreptococcus* spp, occurring typically in a polymicrobial pattern. Our results are consistent with other studies which also report the monomicrobial pattern.<sup>12</sup> However, other pathogens have also been reported as more frequent for pediatric peritonsillar and DNI, like *Staphylococcus aureus* and *Streptococcus viridans*.<sup>8,12,17,18</sup>

The present results may be explained by the use of high dose of empirical antibiotics before admission and surgical drainage. As previously mentioned, more than a half of our patients underwent antibiotic therapy before admission, mainly amoxicillin-clavulanate and penicillin. Furthermore, an improper sample collection may have affected the results of microbiological tests of this study. In fact, it is has become widely accepted that bacteriology of peritonsillar and DNI has changed. Nowadays mixed infection with both aerobic and anaerobic bacteria has become the rule and drug resistance is the greater contributor.<sup>13,15,16</sup>

Considering our microbiological findings we consider our empirical antibiotherapy AC plus clindamycin, associated with corticosteroids to be a good choice. It guarantees an adequate gram positive and anaerobic bacteria coverage. Furthermore, we had a low complication rate, no need for surgical re-intervention and only 2 patients required antibiotic therapy adjustment. However, considering the broad spectrum of AC and the increasing resistance to clindamycin, AC could be used initially in monotherapy and later adjusted if needed according to the microbiological examinations and antibiograms if necessary.

In our study, CT scan was performed in 34.7% of patients. We consider this imaging study of value in differentiating cellulitis versus abscesses, in delineating the anatomical extent and detecting complications of DNI so that correct and timely treatment can be implemented, being particularly important for planning the surgical management. Although, CT scan is not innocuous, and the risk of x-ray exposure of the child must always be weighted by the benefit to the patient.

Limitations of this study include its retrospective study design, small sample size due to the relatively low prevalence of peritonsillar and DNI and the fact that it reflects the experience of single medical center. Furthermore, empirical antimicrobial coverage may have affected the microbiological findings. Further studies including multicenter and prospective studies should be helpful to overcome these limitations.

## Conclusions

Admissions due to peritonsillar and DNI in the pediatric age have significantly increased from 2011. Prompt recognition and initiation of therapy is important to avoid serious complications. Surgical incision and drainage followed by intravenous antibiotic and steroids proved to be successful with low morbidity related to surgical approach. However, in selected cases, medical therapy may be an alternative to surgical management in uncomplicated infections.

Future research is crucial to determine appropriate guidelines to select the best therapeutic approach considering clinical, radiologic and laboratorial findings.

## Conflicts of interest

All authors declare that they have read and understood the policy on declaration of interests of this magazine and have no competing interests. This study was presented as an oral communication at "67 Congreso Nacional de la Sociedad Española de Otorrinolaringología y Cirugía de Cabeza y Cuello", in Sevilla, October of 2016.

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