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Predictive factors for abscessing tonsillitis: a retrospective analysis

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Abstract. – OBJECTIVE: In clinical practice, identifying abscesses in tonsillar infections is crucial for early therapeutic management. Diagnosis of a peritonsillar abscess is usually based on clinical symptoms. Complementary examination procedures, such as laboratory parameters and imaging, are available for confirmation.

PATIENTS AND METHODS: A retrospective analysis was carried out of data for 752 patients who presented with acute tonsillar infection and were hospitalized between January 2012 and February 2021. The data analyses involved evaluating the patient's clinical symptoms, inflammatory parameters, and previous medical history in relation to the predictive power of these factors for the presence of an abscess.

RESULTS: Predictor analysis for the presence of an abscess showed significant values for trismus (OR 2.392; 95% CI, 1.305 to 4.383; *p*=0.005) and palatal arch protrusion (OR 29.679; 95% CI, 17.460 to 50.447; *p*=0.000). The inflammatory parameter C-reactive protein and the leukocyte count were not statistically significant as predictors.

CONCLUSIONS: The presence of a tonsillar abscess can be diagnosed from the clinical presentation alone if the findings are clear. Further diagnostic procedures are indicated in case of inconclusive findings, and ultrasound should be the primary noninvasive method. Computed tomography is only required in selected cases. Inflammatory parameters can be assessed in order to monitor therapy, but do not predict the presence of an abscess. However, if defined action sequences are being considered, tonsillar abscesses can be differentiated at an early point.

Key Words:
Tonsillitis, Predictive factors, Clinical symptoms, Abscessing tonsillitis.

Introduction

Acute tonsillitis (AT) is defined as a painful inflammation confined to the palatine tonsils[1,2]. AT is one of the 20 most common diagnoses in hospitalized children between 0 and 15 years of age in Germany[1]. A considerably declining incidence of AT with increasing age is seen, with a rate of 41% in patients older than 20 years[1].

AT is predominantly caused by viral pathogens (70-95%, e.g., adenoviruses, Epstein-Barr virus, influenza viruses, coronaviruses) and less frequently by bacterial pathogens (in particular *Streptococcus pyogenes, Haemophilus influenzae, Nocardia*, *Corynebacteria*, *Neisseria*)[3]. Plaut-Vincent angina is a specific form involving a symbiosis of *Fusobacterium nucleatum* and *Borrelia vincentii*[4]. If the inflammatory reaction spreads into the surrounding tissue, the condition is referred to as peritonsillar cellulitis (PTC). Abscess formation in the tonsils is a severe clinical condition. Peritonsillar abscess (PTA) formation is defined as a purulent fluid collection in the area between the palatine tonsil capsule and the superior pharyngeal constrictor muscle[5]. While PTA has traditionally been characterized as an intensification of acute tonsillitis, the prevailing hypothesis now posits an abscess within Weber's glands at the tonsil's upper pole as the disease's origin[6]. Intratonsillar abscess (ITA) is defined as abscess formation confined to the tonsillar parenchyma. The incidence of ITA in patients with PTA is approximately 7%[7]. The peak incidence of abscessing inflammation in the tonsillar fossa is observed in adolescents, with 14-40 per 10,000 patients under 18 years of age being affected[8].

The diagnosis of AT can be made clinically by assessing typical symptoms such as sore throat and dysphagia[1]. Laboratory diagnosis often reveals elevated inflammatory parameters such as the leukocyte count and C-reactive protein (CRP). Imaging methods such as ultrasonography (US) and computed tomography (CT) can indi-

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cate the presence of an abscess. US or CT may be beneficial if there are atypical or absent clinical symptoms, to allow treatment to be started at an early stage[9,10]. With adequate treatment, the symptoms usually regress after 48 hours, especially in adolescents and adults[1].

Incorrect diagnosis and subsequent delays in therapy may lead to complications. These include extension of the infection into the deep tissues of the neck, abscess rupture with aspiration of purulent fluid, erosion of the neck vessels, acute airway obstruction, and disseminated sepsis with possible thrombophlebitis and Lemierre syndrome[8,11].

The spontaneous course of AT is usually favorable, and the need for antibiotic treatment should be considered critically[12]. Nevertheless, if bacterial pathogens are suspected, antibiotic therapy can reduce the duration of contagiousness[12]. In cases of severe distress and pronounced symptoms, hospitalization may be indicated. Particularly in cases of a suspected abscess, hospital admission, and intravenous antibiotic therapy, as well as abscess drainage by incision or abscess tonsillectomy, are indicated. In patients with AT without the presence of an abscess, tonsillectomy is now obsolete[12-14].

To date, scoring systems such as the Centor score or McIsaac score have been used to differentiate between group A streptococcal tonsillitis and tonsillitis caused by other microbiologic agents[1,15], rather than to assess the development of an abscess or other severe complications. The scores take into account the patient's clinical presentation, such as body temperature >38°C, cough, swollen cervical lymph nodes, tonsillar swelling or exudate, and age. No significant differences between viral and bacterial tonsillitis in relation to CRP levels or the leukocyte count have been observed in previous studies[16] and, similarly, no considerable differences have been seen in the presence of abscess formation[10]. However, factors indicating the need for in-patient treatment were not investigated in these reports. To the best of our knowledge, factors capable of predicting and helping to identify at an early stage a complicated course, such as abscessing tonsillitis, have not been elaborated. Early and adequate treatment can be critical for avoiding a severe course or the development of complications. Patients presenting with AT should, therefore, be routinely examined and monitored in order to ensure adequate management. The aim of the present study was to identify factors that may be helpful in predicting a complicated course in patients with AT and prompting appropriate early treatment measures.

Patients and Methods

Study Design

This retrospective study was conducted at a tertiary hospital and academic center. The study was approved by the Local Institutional Ethics Committee (approval number 370_20B) and carried out in accordance with the Helsinki Declaration.

Eligibility Criteria and Management of Patients

Consecutive patients who presented at the department between January 2012 and February 2021 with AT, with or without suspected abscess formation, were included. Epidemiological data and data on clinical symptoms were obtained from patient records. The patients all underwent clinical examinations, and blood samples were taken to assess inflammatory parameters (CRP, leukocyte count). In some cases, the patients received imaging procedures such as ultrasound or CT scanning. The management of suspected abscess formation consisted of puncture, incision of the peritonsillar region, or tonsillectomy. The diagnosis was confirmed if pus was visible on any measure, and such patients were defined as having abscess-positive cases. If an abscess was not identified, conservative treatment was initiated, and all patients were monitored for at least 2 weeks to rule out delayed abscess formation. If secondary abscess formation could not be excluded, US or CT and abscess incision were performed if there was no improvement in the clinical symptoms. If delayed abscess formation occurred, conservative therapy was switched to surgical treatment.

Outcome parameters

All clinical information was obtained from a retrospective review of medical charts, including data for age, sex, duration of symptoms, outpatient antibiotic treatment, history of tonsillitis, smoking, and Epstein-Barr virus (EBV) association. Presenting symptoms included fever, severe odynophagia/dysphagia, trismus, palatal arch protrusion, and uvular and laryngeal edema. In addition, the leukocyte count, and CRP (mg/dL) were assessed in the laboratory tests. On the ba-

sis of the course of the disease, the patients were then divided into a non-abscessing group and an abscessing group.

Statistical Analysis

Frequencies are presented as absolute and relative values for the patients' history and clinical parameters. Data are given as mean plus or minus standard deviation (SD). Binary parameters were compared using the Chi-square test. Measured scaled parameters were compared for normal distribution using the two-tailed *t*-test. The Mann-Whitney test was used to compare means for tests without a normal distribution, both graphically and analytically, or nominal scaled parameters. In a binary logistic regression analysis, the probability of occurrence was assessed as a function of an independent metric-scaled variable.

In addition, binary logistic regression and linear logistic regression models were constructed to identify predictors of a complicated course of the disease. Finally, we used a receiver operating characteristic (ROC) curve to determine cut-off values for inflammatory parameters to diagnose abscess formation. A *p*-value lower than 0.05 was considered statistically significant. IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA) was used for the analysis.

Results

Characteristics of the Study Cohort

Table I lists the characteristics of the patient cohort. A total of 752 consecutive patients – 374 women (49.7%) and 378 men (50.3%) – with a mean age of 29.4 years (SD 14.2 y) were included in the data analysis. All patients presented with odynophagia and erythema or swelling of the palatine tonsil and were admitted for in-patient treatment due to the severity of their symptoms. A total of 382 patients (27.6%) had already received outpatient antibiotic therapy. The time of onset of symptoms at presentation in the department showed a mean of 2.9 days (SD 1.5). A total of 236 patients (31.4%) received ultrasound examinations before treatment. Overall, nonabscessing tonsillitis was diagnosed in 594 patients (79.0%) and abscessing tonsillitis in 158 patients (21.0%). In the abscess group, 133 patients (84.2%) were diagnosed with PTA, 16 patients (10.1%) with ITA, and nine patients (5.7%) with parapharyngeal abscess (PPA). All patients with an abscess received drainage. Abscess drainage with local anesthesia was carried out in 77 patients (48.7%). Unilateral tonsillectomy was carried out in 19.6% (31/158), and bilateral tonsillectomy, including the uninvolved tonsil, was performed in 31.7% (50/158).

Table I. Characteristics of patients with abscessing and non-abscessing tonsillitis in the study cohort.

	Non-abscessing (n = 594)	Abscessing (n = 158)	Total (n =7 52)	*p*-value
Male/female (n, %)	292 (49.2%)/02 (50.8%)	86 (54.4%)/72 (45.6%)	378 (50.3%)/374 (49.7%)	0.239
Age (years ± SD)	27.9 ± 13.2	34.9 ± 16.4	29.4 ± 14.2	0.000*
Symptom duration (days ± SD)	2.9 ± 1.6	3.0 ± 1.3	2.9 ± 1.5	0.640
Outpatient treatment (n, %)	313 (52.7%)	69 (43.7%)	382 (50.8%)	0.044*
History of recurrent tonsillitis (n, %)	70 (11.8%)	26 (16.5%)	96 (12.8%)	0.118
Smoking (n, %)	43 (7.2%)	8 (5.1%)	51 (6.8%)	0.334
Inflammation parameters				
Temperature ≥ 38°C (n, %)	166 (27.9%)	29 (18.3%)	195 (25.19%)	0.015*
CRP level (mg/dl ± SD)	104.0 ± 85.7	112.6 ± 69.3	105.9 ± 82.4	0.018*
Leukocyte count ($\times 10^9$/± SD)	13.7 ± 5.1	14.7 ± 4.8	13.9 ± 5.1	0.027*
EBV association (n, %)	112 (18.8%)	1 (0.6%)	113 (15.0%)	0.000*
Clinical presentation				
Dysphagia (n, %)	504 (84.8%)	143 (90.5%)	647 (86.2%)	0.068
Trismus (n, %)	45 (7.6%)	66 (41.8%)	111 (14.8%)	0.000*
Palatal arch protrusion (n, %)	52 (8.7%)	129 (81.6%)	158 (21.0%)	0.000*
Uvular edema (n, %)	25 (4.2%)	19 (12.0%)	44 (5.9%)	0.000*
Laryngeal edema (n, %)	13 (2.2%)	2 (1.3%)	15 (2.0%)	0.458
Palatal arch protrusion (n, %)	52 (8.7%)	129 (81.6%)	158 (21.0%)	0.000*
Uvular edema (n, %)	25 (4.2%)	19 (12.0%)	44 (5.9%)	0.000*
Laryngeal edema (n, %)	13 (2.2%)	2 (1.3%)	15 (2.0%)	0.458

*Significant value. CRP, C-reactive protein; EBV, Epstein-Barr virus; SD, standard deviation.

Differences Between Patients with Non-abscessing and Abscessing Infection

Table I also gives details for patients with abscessed and non-abscessed infections. No differences were observed between non-abscessing and abscessing tonsillitis with regard to the onset of symptoms (2.9 days, SD 1.6 *vs.* 3.0 days, SD 1.3; p=0.640). Overall, 70 patients (72.9%) with non-abscessing tonsillitis and 26 patients (27.1%) with abscessing tonsillitis had a history of recurrent infections (p=0.118). Outpatient antibiotic treatment was initiated in a total of 313 patients (81.9%) with non-abscessing tonsillitis and 69 patients (18.1%) with abscessing tonsillitis (p=0.044). Patients who received abscess drainage were discharged after an average of 5.2 days (SD 1.7). After conservative treatment alone, patients were discharged after 3.7 days (SD 1.9; p=0.001).

Predictors of A Complicated Disease Course

Significant differences were noted in the leukocyte count and CRP level in relation to the presence of an abscess. CRP levels of 104.0 mg/dL (SD 85.7) and 112.6 mg/dL (SD 69.3; p=0.018) and leukocyte counts of 13.7×10^9/L (SD 5.1) and 14.7×10^9/L (SD 4.8; p=0.027) were observed in patients with non-abscessing and abscessing tonsillitis, respectively. Patients with and without outpatient antibiotic treatment had mean CRP levels of 107.8 mg/dL (SD 85.3) and 103.8 mg/dL (SD 79.1; p=0.026), and leukocyte counts of 13.3×10^9/L (SD 5.2) and 14.6×10^9/L (SD 4.8; p<0.001), respectively. In addition to inflammatory parameters, clinical symptoms were investigated as possible predictors of complications. Significant differences were seen between abscessing and non-abscessing tonsillitis in relation to fever (p=0.015), trismus (p<0.000), uvular edema (p<0.000), palatal arch protrusion (p<0.000), and an absence of EBV infection (p<0.000). Half of the patients (50.8%) had already had antibiotic treatment started before presentation. A significant difference was noted here in relation to abscess development (52.7% *vs.* 43.7%; p=0.044). In contrast, there were no significant differences in relation to dysphagia (p=0.068) or laryngeal edema (p=0.458). However, laryngeal edema was only seen in 2% of cases. There were also no statistically significant differences between the two groups in relation to a history of recurrent tonsillitis (p=0.118).

Binary logistic regression analysis showed that there was a significantly higher probability of abscess developing in the presence of trismus and palatal arch protrusion, with odds ratios of 2.392 (95% CI, 1.305 to 4.383; p=0.005) and 29.679 (95% CI, 17.460 to 50.447; p=0.000), respectively. In contrast, the probability decreases significantly in the presence of EBV infection [odds ratio 0.091 (95% CI, 0.011 to 0.731); p=0.024]. Table II gives all the values for the regression analysis.

In the ROC analysis, an area under the curve of 0.561 was calculated for the CRP level and 0.568 for the leukocyte count. Limit value analysis was, therefore, not appropriate.

Table II. Predictors for the occurrence of abscess using binary logistic regression.

	Exp (B) (95% CI)	*p*-value
Inflammation parameters		
Temperature ≥ 38°C	0.911 (0.496 to 1.675)	0.765
CRP level	1.001 (0.999 to 1.003)	0.515
Leukocyte count	1.035 (1.000 to 1.072)	0.051
EBV association	0.091 (0.011 to 0.731)	0.024*
Clinical presentation		
Dysphagia	1.01 (0.455 to 2.242)	0.980
Trismus	2.392 (1.305 to 4.383)	0.005*
Palatal arch protrusion	29.679 (17.460 to 50.447)	0.000*
Uvular edema	1.135 (0.467 to 2.758)	0.779
Laryngeal edema	0.939 (0.143 to 6.163)	0.948
History of recurrent tonsillitis	1.390 (0.691 to 2.800)	0.356
Outpatient treatment	0.995 (0.599 to 1.654)	0.986

*Significant value. CRP, C-reactive protein; EBV, Epstein-Barr virus.

Discussion

Tonsillar abscess, which needs to be distinguished from acute tonsillitis, is a clinical diagnosis with a sensitivity of 78% and specificity of 50%, as reported in the literature[11]. In the present study, significantly increased incidences of typical clinical symptoms such as trismus ($p<0.000$), palatal arch protrusion ($p<0.000$), and uvular edema ($p<0.000$) were observed, confirming the results of earlier studies[17]. However, there was no distinction in relation to the abscess location. There have been reports that symptoms may differ depending on the location of the abscess[7,18]. However, intratonsillar abscesses account for only 7% of patients presenting with abscessing tonsillitis[7]. With regard to the development of tonsillar abscesses in the present study, no significant differences were seen in relation to a patient history of recurrent tonsillitis. However, there is evidence that abscesses may occur more frequently with recurrent tonsillitis and peritonsillar cellulitis and that tonsillectomy on the affected side is indicated for recurrent tonsillar abscesses[19]. Abscess formation was significantly less likely ($p=0.044$) when AT had already been treated with antibiotic therapy on an outpatient basis.

There is evidence in the literature that higher inflammation values (CRP levels, leukocyte count) may suggest tonsillitis caused by group A streptococci, indicating a need for antibiotic therapy[20,21]. According to the literature, complications such as abscess formation cannot necessarily be predicted on this basis. In the present cohort, there was a significant difference in CRP values between abscessing and non-abscessing tonsillitis ($p=0.018$). At the same time, the leukocyte count was higher in patients with abscess formation ($p=0.027$). These results are in line with the findings of other studies[10]. An increase in inflammatory values alone plays a subordinate role in the diagnosis of tonsillitis, with low rates of sensitivity (66-90%) and specificity (45-75%)[1,22]. In the present cohort, predictor analysis at an odds ratio of 1.035 (95% CI; $p=0.051$) for the leukocyte count and 1.001 (95% CI; $p=0.515$) for the CRP level showed that increases in inflammatory values were associated with a slightly higher risk of abscess formation. However, in the ROC analysis, the data collected do not show the suitability of either of these inflammatory parameters for classification. Setting a threshold value at which the probability of an abscess would increase significantly is therefore not meaningful on the basis of this data set. The inflammation parameters are suitable for follow-up purposes, but that was not the subject of the present study.

With regard to the patients' clinical symptoms, it was confirmed once again that a peritonsillar abscess is primarily a clinical diagnosis. This retrospective review also showed that there is a significantly higher incidence of abscesses when symptoms such as trismus, uvular edema, and palatal arch protrusion are present. In spite of this, the clinical presentation is generally considered to have a sensitivity of only 78% and a specificity of 50% for the diagnosis of tonsillar abscesses[11].

The importance of the clinical presentation might be emphasized as the most important diagnostic criterion. However, complementary examinations such as puncture or imaging should be performed in case of uncertainty. Ultrasound should take priority as a safe and easy-to-perform examination; it is easily feasible and has a high level of diagnostic reliability[10].

Although significantly increased inflammation values were observed in the abscess group, this test procedure is uncertain, particularly since no significant differences emerged in the predictor analysis. However, follow-up tests may help confirm the success of treatment.

Antibiotic therapy that had already been initiated was found to be associated with a lower risk of abscess development in the present study. It is essential to consider a potential selection bias, given the absence of data pertaining to patients who underwent exclusively outpatient antibiotic treatment.

Despite the limitations of this retrospective study, with a dependence on medical documentation as a potential source of error, the large size of the cohort may provide a good overview of the course of tonsillitis and, in particular, the development of complications. In clinical routine work, early optimization of treatment can be achieved by combining findings and especially by noting changes in them. This may make it possible to avoid further complications. Future studies using prospective data collection are needed in order to monitor and evaluate this disease.

Conclusions

Overall, it can be shown that careful collection of clinical findings provides early indications of the potential development of compli-

cations, without a need for extensive additional diagnostic procedures such as imaging. This strategy can save resources and, above all, save time in order to ensure early and optimal care for the patient.

Conflict of Interest

The authors hereby declare that they have no financial or other conflicts of interest regarding the material discussed in this manuscript.

Authors' Contribution

Contributions to conception and design: MS, MM, and MK; contributions to data acquisition and interpretation: MS, MM, and MK; contributions to performance of all statistical analyses: MM and MS; contributions to the drafting of the manuscript: MS and MM; contributions to critical revision of the manuscript: MS, MM, KM, AG, VT, SM, MB, RR, HI, and MK. All of the authors have read and approved the final manuscript.

Ethics Approval

All procedures performed in this study involving human participants followed the institutional and national research committee's ethical standards and the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Ethical approval (approval number 370_20B) was provided by the Clinical Research Ethics Committee of the Medical Faculty of Friedrich Alexander University of Erlangen, Nuremberg, Germany.

Informed Consent

Informed consent was waived due to the retrospective design of the study.

Availability of Data and Materials

All data generated or analyzed during this study are included in this published article.

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