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Evaluation of combined medical and surgical treatment in nasal polyposis – III. Correlation between symptoms and CT scores before and after surgery for nasal polyposis

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Abstract

Conclusion. Computed tomography (CT) in nasal polyposis (NP) patients has three functions before any treatment. CT provides objective evidence of the disease and precise topography of the disease, and is an indicator of the disease severity. After functional endoscopic sinus surgery (FESS), CT is an indicator of the residual disease severity and permits detection of asymptomatic mucoceles. Objective. NP affects nearly 4% of the population. CT has become the examination of choice for the exploration of NP. FESS is accepted for NP treatment in the setting of failure of medical management. The aim of this study was to find out whether any correlation exists between symptom severity and CT scan score before and after FESS. Patients and methods. A total of 114 CT scans were performed in NP patients without contrast medium before and after FESS (mean follow-up 5 years), and were scored according to the Lund-MacKay system. Results. Lund-MacKay scores before treatment ranged from 8 to 24. There was a correlation between symptom and CT scores before any treatment. Postoperative Lund-MacKay scores ranged from 0 to 24. There was a correlation between symptom and CT scores after surgery. There was no correlation between postoperative symptom and baseline CT scores. Eleven asymptomatic mucoceles were found.

Keywords: Nasal polyposis, CT, surgery, ethmoidectomy, mucocele, nasal obstruction, rhinorrhea, olfaction, anosmia

Introduction

Nasal polyposis (NP) is a chronic inflammatory pathology of the paranasal sinus mucosa, leading to the protrusion of benign polyps into the nasal cavity. NP affects nearly 4% of the total population in Western countries, and presents a real challenge to the physician because of its severity, chronicity and recurrence rate [1,2]. NP can be primary or may occur as a symptom of various syndromes, including asthma and aspirin idiosyncrasy. Non-specific bronchial hyperresponsiveness (BHR) and/or asthma are more frequent in patients with nasal polyposis than in the general population [3]. The aspirin triad (nasal polyposis, asthma and sensitivity to aspirin), first reported by Widal in 1922, is a well-recognized clinical entity [4].

Computed tomography (CT) of the paranasal sinuses has become the examination of choice for the radiological exploration of NP. Sinus CT provides objective evidence for the topographic diagnosis of NP and also provides a major road map before endoscopic sinus surgery. Sinus CT can be used for staging of NP. The American Academy of Otolaryngology Task Force on Rhinosinusitis has recommended the Lund-MacKay system for this radiographic staging [5]. The Lund-MacKay score produces a numerical value between 0 and 24 for the severity of the CT scan findings. Nevertheless, its clinical interpretation may be open to debate.

The management of NP has been the topic of controversial debates for many decades. The aims of treatment are to relieve nasal symptoms, restore nasal breathing and sense of smell, and prevent

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Patients and methods

Patients

Retrospective analysis of prospectively collected data was performed on a series of 114 consecutive patients (60.5% males; mean ± SE, age 47.7 ± 1.0 years) suffering from NP, undergoing FESS and with a minimal follow-up after surgery of 2 years (mean ± SE, 5.1 ± 0.2 years).

Two concomitant criteria were necessary to include the patient. The first inclusion criterion was a diagnostic one. Only patients with NP were included. The diagnosis was based on two criteria: (i) the presence of bilateral polyps in the nasal cavities on endoscopic examination and (ii) the existence on CT of bilateral opaque areas located in the ethmoidal sinuses, whether in the anterior or the posterior ethmoidal portions [7]. The second criterion was a therapeutic one. Before FESS, all patients received a systematic and standardized medical treatment including washing of the nasal cavities, steroid spray and oral steroid administration. FESS was only carried out when more than three systemic courses of prednisolone per year proved to be necessary to control NP symptoms. The results of such medical and surgical treatments were reported in a previous paper [7]. Patients with Wegener's granulomatosis, Churg-Strauss syndrome or cystic fibrosis were excluded from this study.

Methods

Evaluation at baseline. All patients were examined, treated, operated and followed up by the same physician for the entire duration of the study. At baseline, before any medical or surgical treatment, nasal function was checked on the basis of three main criteria: nasal obstruction (NO), posterior rhinorrhea (PR) and the loss of smell (SL). The severity of each symptom was evaluated according to a three-point scale (0, no symptoms; 1, moderate symptoms that were frequently troublesome but not sufficiently to interfere with normal daily activities or sleep; 2, severe symptoms that interfered with normal activities or sleep). In regard to the particular case of disorders concerning the sense of smell, anosmia was noted as grade 2, hyposmia as 1, and normal function as 0. This grading was performed before any clinical, endoscopic or CT scan examination. A clinical global severity index (GSI) was derived; it represented the mean score of these three symptoms under analysis. Allergic investigation was performed with radioallergosorbent testing (RAST) [8].

Polyp size was rated on a three-point scale: 1, mild polyps (small polyps not reaching the lower edge of the middle turbinate); 2, moderate polyps (medium-sized polyps extending between the upper and the lower edges of the inferior turbinate); 3, severe polyps (large polyps extending below the lower edge of the inferior turbinate).

CT examination was performed without contrast medium (axial and coronal planes), was obtained in the non-infected state of each patient and was not carried out during a 6 week period after oral steroid consumption. CT examinations were performed on a multislice CT with a 1.25 mm slice thickness (120 Kv, 20 mA). For each patient, the CT scan of paranasal sinuses was scored according to the Lund-MacKay system. In this staging system, each paranasal sinus (maxillary, frontal, sphenoid, anterior ethmoid, posterior ethmoid sinus) for each side is assigned a score of 0 for no opacification, 1 for partial opacification and 2 for complete obstruction. The ostiomeatal complex is assigned a score of 0 for patent, 1 for partially obstructed and 2 for totally obstructed. Therefore, the Lund-MacKay score for each side may range from 0 to 12, and the total score may range from 0 to 24 [5].

Evaluation after surgery. FESS was performed between 1999 and 2004 by the same surgeon and under general anaesthesia. The FESS technique was reported in a previous paper [9]. After surgery, all patients received a systematic medical treatment including washing of the nasal cavities, steroid spray and oral steroid administration if needed. At every visit (three to four times a year), the regimen was tailored to the patient’s need. If deterioration of the patient’s physical condition was clearly threatening, the prescribing physician resorted to a new course of systemic steroid administration (i.e. prednisolone 1 mg/kg body weight per day for a 6 day period).
Evaluations after surgery were performed during the year 2006. At this visit, the patient was asked to evaluate the mean symptom severity. Polyp size was rated on a five-point scale: 0, normal mucosa; 0.5, absence of polyps but mucosal thickening; 1, mild polyps (small polyps not reaching the upper edge of the middle meatus antrostomy); 2, moderate polyps (medium-sized polyps extending between the upper and the lower edges of the inferior turbinate); 3, severe polyps (large polyps extending below the lower edge of the inferior turbinate). Preoperative and postoperative polyp sizes 1, 2 and 3 were rated identically. A new CT examination was performed without contrast medium (axial and coronal planes), was obtained in when the patient was in a non-infected state and was not carried out during a 6 week period after oral steroid consumption.

Statistics

The statistical analysis was performed using Statview 5.0 software (Statview, Inc.). For all continuous variables, applicable data were expressed as mean ± SEM. Being a composite of several rather independent qualitative variables, GSI was taken to be a continuous variable, and sample size was large enough for GSI distribution to be unimportant. For all continuous variables entering comparisons, Student’s unpaired t test was used to compare mean values between patients. Pearson correlation coefficients were used to evaluate the correlation between continuous variables.

Results

Results at baseline

At baseline, 57 patients (50% of the patients) were suffering from asthma and 23 (20%) had typical hypersensitivity reactions to aspirin or non-steroidal anti-inflammatory drugs (NSAIDs). The diagnosis of hypersensitivity reactions to aspirin or NSAIDs was made only if abnormal clinical manifestations (asthma, nasal symptoms, dyspnoea, etc.) occurred after aspirin or NSAID consumption. Nineteen patients (30.6%) had positive allergy tests.

At baseline, scores of nasal symptoms did not differ as a function of the presence of allergy. Lund-MacKay scores were higher in patients with asthma ($p = 0.01$) and hypersensitivity reactions to aspirin or NSAIDs.

Initial Lund-MacKay scores did not differ as a function of the presence of allergy. Lund-MacKay scores were higher in patients with asthma ($p = 0.01$) and hypersensitivity reactions to aspirin or NSAIDs.

CT scan in nasal polyposis

Figure 1. Mean GSI score as a function of polyp size rated on a three-point scale: 1, mild polyps (small polyps not reaching the lower edge of the middle turbinate); 2, moderate polyps (medium-sized polyps extending between the upper and the lower edges of the inferior turbinate); 3, severe polyps (large polyps extending below the lower edge of the inferior turbinate) ($p < 10^{-5}$).

Similarly, a significant difference of Lund-MacKay score was observed as a function of the polyp size ($p < 10^{-5}$).

Figure 2. Distribution of initial Lund-MacKay scores (mean ± SE, 19.09 ± 0.43).
A significant difference of Lund-MacKay score was observed as a function of the polyp size \((p < 10^{-3})\) (Figure 1). Patients with high polyp size had high Lund-MacKay scores. Statistical analysis confirmed that there was a correlation between GSI scores and Lund-MacKay scores before any treatment (Pearson correlation coefficient 0.29, \(p < 10^{-3}\)) (Figure 3).

**Results after surgery**

All patients had a minimal follow-up after surgery of 2 years (mean ± SE, 5.1 ± 0.2 years).

After surgery, the mean (mean ± SE) scores were 0.22 ± 0.04, 0.39 ± 0.06 and 0.93 ± 0.07 for NO, PR and SL, respectively. Mean GSI score was 0.51 ± 0.04.

Postoperative Lund-MacKay scores ranged from 0 to 24 with a mean (mean ± SE) of 6.76 ± 0.53 (Figure 4). Fourteen CT scans had a Lund-MacKay score ≤2. Thirty-nine CT scans had a Lund-MacKay score ≤4. A significant decrease of the Lund-MacKay score was observed after surgery \((p < 10^{-3})\). Statistical analysis confirmed that there was a correlation between GSI scores and Lund-MacKay scores after FESS (Pearson correlation coefficient 0.38, \(p < 10^{-3}\)) (Figure 5).

Sinus opacification was studied as a function of the sinus location. The mean Lund-MacKay index on CT scan after surgery is presented in Figure 6. The paranasal sinus presenting the higher index of opacification after surgery is the frontal sinus (mean ± SE, 1.03 ± 0.07). The Lund-MacKay indexes were 0.63 ± 0.06, 0.60 ± 0.06, 0.45 ± 0.07 and 0.46 ± 0.06 for the maxillary, the anterior ethmoid, the posterior ethmoid and the sphenoid sinuses, respectively.

**Detection of mucocele after FESS**

Systematic CT scan permitted the detection of 11 asymptomatic mucoceles located within the anterior ethmoid sinus \((n = 3)\), the posterior ethmoid sinus \((n = 2)\) or the frontal plus anterior ethmoidal sinus \((n = 6)\). The mucocele presented as an expansible mass on CT. On MRI, the typical signal reflected the protein content of the mucoid material of the mucocele. On T1-weighted images, the signal intensity of the content of the mucocele was isointense.
but became hyperintense when water was resorbed. On T2-weighted images, the signal of the mucocele was high. The diagnosis was confirmed during surgery. For all these patients, FESS was performed to open the mucocele.

Discussion

The aim of this prospective study was to define the function of CT scans in patients with NP after FESS. For this purpose, two strict inclusion criteria were taken into account [7]. Only patients with NP were included and the diagnosis was restricted to patients with bilateral polyps into the nasal cavities on endoscopic examination, and with bilateral opaque areas located in the ethmoidal sinuses, whether in the anterior or the posterior ethmoid portions, on CT scan. Thus, baseline CT scan was important to contribute to a topographic diagnosis of chronic rhinosinusitis [10]. Patients with unilateral symptoms or patients with only anterior opacities on CT scan were excluded from this study. On the other hand, FESS was only performed after systematic medical treatment including washing of nasal cavities, daily steroid spray and oral steroid administration [7]. FESS was only performed when three systemic courses of prednisolone per year proved to be necessary to control NP symptoms. These strict inclusion criteria explain the homogeneity of the series.

G.W. Caldwell, in 1893, commented that a staging system was necessary to have meaningful results in the treatment of chronic rhinosinusitis [11]. First, staging of NP symptoms was performed with three levels as previously published [7–9]. Second, CT scan staging used the Lund-MacKay score as recommended by the American Academy of Otolaryngology Task Force on Rhinosinusitis [5]. Third, grading of nasal polyps was carried out in accordance with the International Conference on Sinus Disease [12].

CT scan of the paranasal sinuses has become the test of choice for the radiological evaluation of chronic rhinosinusitis (CRS). The diagnosis of CRS is based primarily on strict clinical data. CT provides objective evidence of the disease and precise topography of the disease, and could be an indicator of the disease severity. However, many studies have failed to correlate CT staging with disease severity. Thus, many authors have advocated the use of CT scan only as a tool in evaluating paranasal sinus anatomy [13]. Our results show a clear correlation between symptoms (i.e. GSI) and Lund-MacKay scores before any treatment (Pearson correlation coefficient 0.29, \( p < 10^{-3} \)) (Figure 3). This result can be obtained because CT scans were performed when each patient was in a non-infected state, and were not carried out during a 6 week period after oral steroid consumption. CT performed in an infected patient overestimates the sinus opacities; the Lund-MacKay score will be unusually high. Moreover, CT performed in patients after oral steroid consumption underestimates the sinus opacities; the Lund-MacKay score will be unusually low. On the other hand, bronchial hyperresponsiveness, asthma and Widal syndrome can be considered major risk factors for steroid insensitivity in patients with NP [14]. NP patients with asthma \(( p = 0.01)\) and hypersensitivity reactions to aspirin or NSAIDs \(( p = 0.001)\) have higher Lund-MacKay scores. On the other hand, Lund-MacKay scores did not differ as a function of the presence of allergy that is not known as a prognostic factor in NP [8]. Thus, the severity of NP on preoperative CT scan predicts the
severity of symptoms as assessed by various parameters in patients undergoing FESS.

After FESS, our patients had a minimal follow-up of 2 years (mean ± SE, 5.1 ± 0.2 years).

The sensitivity, specificity and diagnostic accuracy of CT scan in the diagnosis of CRS was evaluated using a receiver-operator characteristic (ROC) curve. Selecting a Lund-MacKay score cut-off value >2 as abnormal, the paranasal sinus CT exhibited sensitivity and specificity of 94% and 41%, respectively. Increasing the cut-off value to 4 changed the sensitivity and specificity to 85% and 59%, respectively. Furthermore, CT scans in NP patients after FESS must be considered as abnormal. Moreover, the severity of NP on postoperative CT scan predicts the severity of residual symptoms. Statistical analysis confirmed that there was a correlation between GSI scores and Lund-MacKay scores after FESS (Pearson correlation coefficient 0.38, p < 10^{-5}) (Figure 5).

This study is the first to present the sinus opacification after FESS, sinus by sinus. The sinus presenting the higher index of opacification after surgery is the frontal sinus (mean ± SE, 1.03 ± 0.07). Lund-MacKay indexes were 0.63 ± 0.06, 0.60 ± 0.06, 0.45 ± 0.07 and 0.46 ± 0.06 for the maxillary, the anterior ethmoid, the posterior ethmoid and the sphenoid sinuses, respectively.

Is it possible to predict clinical results after FESS using preoperative CT scans? There is a correlation between baseline and postoperative Lund-MacKay scores (Pearson correlation coefficient 0.22, p = 0.01) (Figure 7) but statistical analysis confirmed that there was no correlation between postoperative GSI scores and baseline Lund-MacKay scores (Pearson correlation coefficient 0.03, p > 0.05). Thus, CT scores fail to predict the amount of symptomatic improvement after FESS. This result is in agreement with a recent publication [13].

The last objective of postoperative CT scan is to detect asymptomatic mucocles. In our study, 11 asymptomatic mucoceles located within the anterior ethmoid sinus (n = 3), the posterior ethmoid sinus (n = 2) or the frontal plus anterior ethmoidal sinus (n = 6) were found. This high percentage suggests that systematic control of nasal and paranasal cavities using CT scan after FESS is important. Such a complication of FESS in patients with NP was previously suggested in the literature [9,16].

Conclusion

CT scans in NP patients have three functions before any treatment. CT provides objective evidence of the disease and precise topography of the disease and is an indicator of the disease severity. After FESS, CT is an indicator of the residual disease severity, and permits detection of asymptomatic mucoceles.

References