A new method for endoscopic evaluation in rhinology: videocapture*

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SUMMARY *The aim of the study is to analyze a new method for the elaboration of endoscopic images of the nasal cavity called "videocapture" and to compare the data from this technique with the ones obtained with anterior active rhinomanometry. Videocapture is based on a software program able to process endoscopic images, to file them and to measure perimeter and area of the structures inside the images recorded. We enrolled 27 patients with inferior turbinate hypertrophy and we performed, before and after nasal decongestion test, anterior active rhino-manometry, acoustic rhinometry, videocapture to compare the results obtained with these different techniques. The results we got confirm in a statistically significant way, the reliability of videocapture and its easy way of application.*

Key words: endoscopy, inferior turbinate, NDT, rhinopathy, videocapture

INTRODUCTION

During the last years new techniques to define nasal diseases have been carried out. The active anterior rhinomanometry (AAR), (Clement, 1984), recently supported by acoustic rhinometry (AR), (Hilberg, 1989), is well known and of worldwide use. These techniques, routinely used in our Rhinologic Center, give us information about nasal function and morphology; AAR measuring nasal resistances and AR finding areas and volumes inside the nasal cavities.

However, to have a complete view of the nose, it is necessary to use the endoscopic technique which allows us to identify the alterations not macroscopically evident in other ways, to find any nasal pathology and to obtain a therapeutic indication. "Videocapture" is a new, recently introduced software program and, connected to the endoscopic set, "captures" the images, records and processes them. It gives us a lot of possibilities: first of all after the acquisition of a film, we can split it into frames on which it is possible to make measurements as in echography: we have to give a metric landmark (for example centimeters or millimeters) and, using the mouse of the computer we can easily circumscribe the selected area. The computer calculates immediately area and perimeter of the structure that is desired.

Besides, we can enrich the film obtained with a commentary recorded during or after the film processing; images or films can be transferred to or from a CD ROM.

Finally, as other computerized tools, it files data from patients and their diseases, so it is possible to make investigations on patients and/or a particular pathology and get a dynamic and promptly available archive.

MATERIALS AND METHODS

We enrolled 27 patients, 16 males and 11 females, aging from 21 to 67 years old. Criteria for their inclusion were: age >18 years, evidence of turbinate hypertrophy, alterations of basal values of nasal resistances and nasal areas measured through AAR and AR, respectively. Exclusion criteria were: nasal traumas in the six months before the study, previous naso-sinusal surgery, drugs assumption for any systemic disease, use of nasal spray (decongestants), pregnancy, nursing and use of oral estroprogestinics.

Our study was organized as follows:

a) anterior and posterior rhinoscopy;
b) endoscopic view by videocapture of the image of the head of the inferior turbinate and measurement of its area and perimeter as explained above;
c) basal AAR;
d) basal AR;
e) nasal decongestion test (NDT): we performed this test administering two puffs of a nasal decongestant for each nostril then waiting five minutes and making a second

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decongestion. After five more minutes we repeated AAR and AR. If AAR and AR parameters are normalized (normal partial resistances <0,50 Pa/cm^3/sec, normal total resistances <0,25 Pa/cm^3/sec) the stenosis is functional, pharmacologically reversible. On the contrary, it is a structural stenosis liable to surgery;

f) Videocapture;
g) AAR;
h) AR.

In our experience, the "videocap" method can be considered reliable and repeatable, if some precious devices are used to obtain objective measurements.

The most important device is to give the computer a parameter to refer to, that the PC transforms into pixels.

To this purpose we used a piece of non adhesive cotton gauze (Non-Ad®) at known length (5 mm) that was cautionary stuck vertically to the mucosa of the septum at the level of the head of the inferior turbinate. In this way the measurement can be considered reliable at every distance (Figure 1).

In order to obtain comparable images and trying to capture them at the same distance before and after NDT, we performed the endoscopy with a flexible optic fiber with marks on it, even though the quality of the image is inferior (Messerklinger, 1978). Moreover, we tried to produce images with the same perspective, fixing some reference points on the pre-decongestion image (for example septal spurs) that were exploited during the post-decongestion endoscopy.

In our opinion, through these devices, videocap can be considered as an objective method and perhaps could still be improved through the use of an optometric craniostat as during performing acoustic rhinometry (Passàli et al., 1996).

Statistical analysis of the results by videocapture was made through the Correlation Test.

The same test was used to compare the results of AAR and Videocap before and after NDT.

RESULTS

For each test we carried on, we considered specific parameters:

- videocapture: perimeter and area in mm and mm^2;

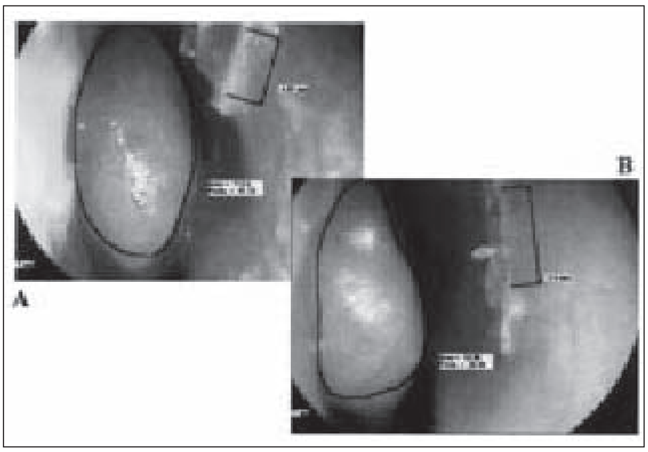

Figure 1. Measurement of the area and perimeter of the head of the inferior turbinate before and after decongestion by the videocapture device.

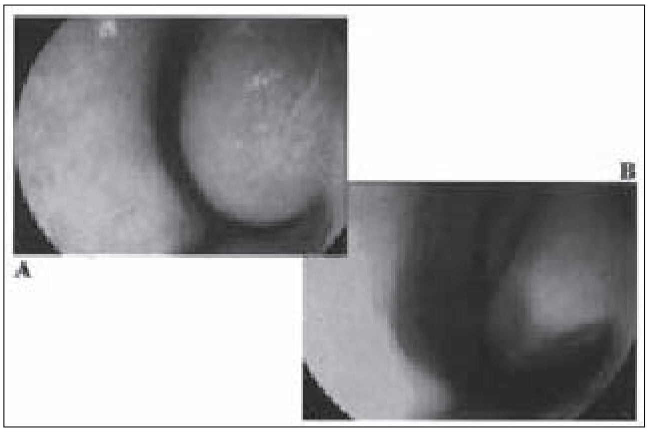

Figure 2. Head of the inferior turbinate before and after decongestion.

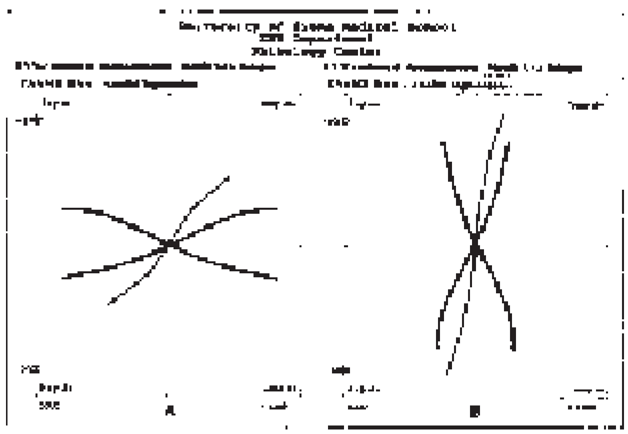

Figure 3. Rhinomanometry graphic presentation in a patient affected by a functional rhinopathy: A) before decongestion; B) after decongestion.

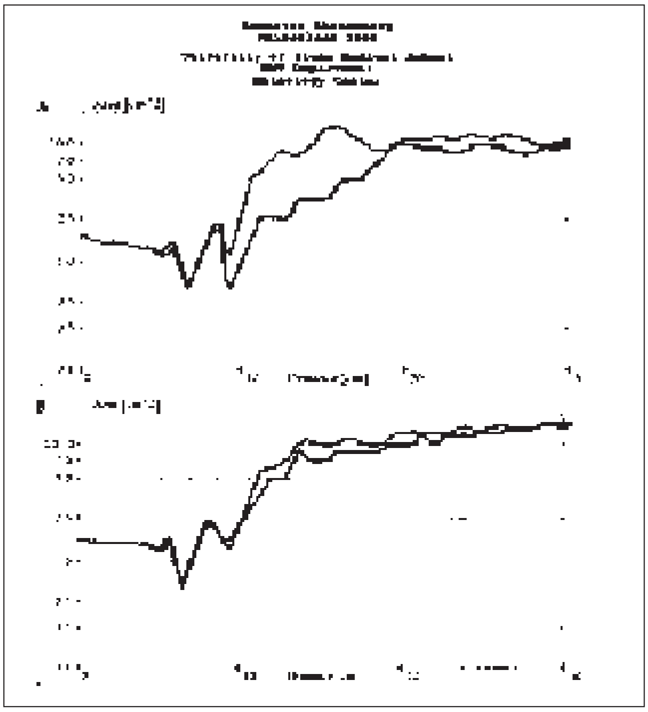

Figure 4. Acoustic Rhinometry graphic presentation in presence of a functional rhinopathy: A) before decongestion; B) after decongestion

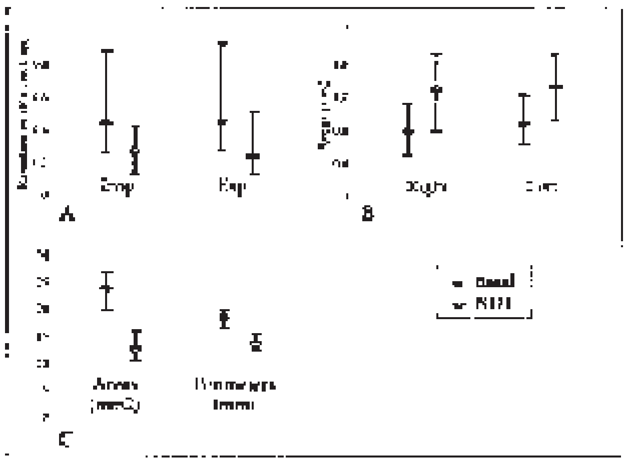

Figure 5. A) Mean values of total in/expiratory resistances by Active Anterior Rhinomanometry before and after NDT; B) mean values of right/left minimal cross-sectional area at the level of the inferior turbinate (C-notch) by Acoustic Rhinometry before and after NDT; C)mean values of areas and perimeters of the head of the inferior turbinate by videocapture before and after decongestion.

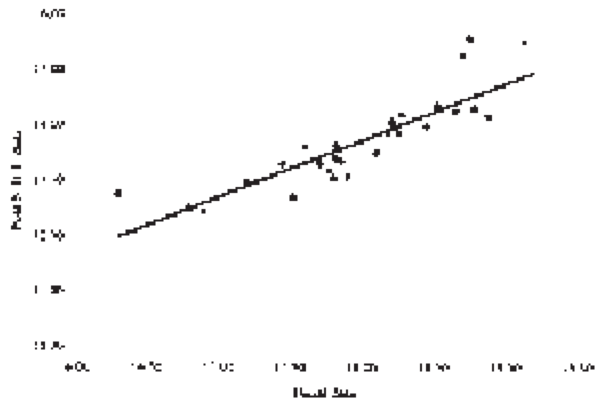

Figure 6. Correlation test of data of perimeters before and after decongestion. Correlation index =0,874.

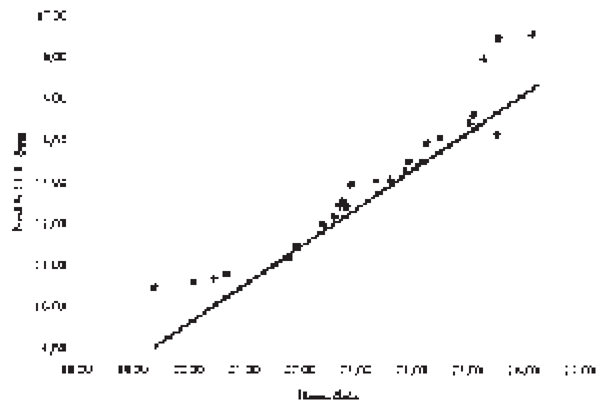

Figure 7. Correlation test of data of areas before and after decongestion. Correlation index =0,951.

- AAR: total inspiratory and expiratory resistances in Pa/cm^3/sec;
- AR: cross-section area in cm^2.

As we can see in Figure 2, using videocapture the perimeter and area of the inferior turbinate can be calculated before and after decongestion, giving at the same time a complete and objective view of the inferior turbinate (Figure 2).

Figures 3 and 4 are representative graphics of AAR and of AR referable to a functional stenosis, reversible to NDT.

Figure 5 refers to data obtained with the three different methods, before and after decongestion.

Statistical analysis of correlation, which has its maximum correlation value when the correlation index is –1, has shown that there is a high correlation between the values got before and after decongestion with the videocapture, especially for the areas; the correlation between the perimeters is less high, but always significant (Figures 6 and 7).

A statistical analysis to correlate the different methods is in progress: this kind of analysis cannot be presented at this time because of the small number of patients we have enrolled up to now.

To validate our method we have submitted the results of AAR and the videocap to the correlation coefficient test. This test points out that the parameters taken into consideration (inspiratory and expiratory resistances at AAR and perimeters and areas measured by videocapture) change in a similar way showing no statistical significant differences between the two sequences before and after NDT (Table 1).

Table 1. Correlation coefficient (r): statistical analysis of differences before and after NDT between Videocap and AAR values.

	Inspiratory resistances	Expiratory resistances
Videocap perimeters	–0.0898 (n.s.)	0.121 (n.s.)
Videocap areas	–0.2012 (n.s.)	–0.0531 (n.s.)

DISCUSSION

All the patients chosen for our study were affected by hypertrophy of their inferior turbinates, caused by allergic rhinitis in 18 patients and by aspecific rhinopathy in 9 patients. The choice of these inclusion criteria was due to two reasons. The first reason was the NDT. This test was required to be positive in our study in order to obtain the normalization of the nasal values after decongestion as it happens in a functional stenosis of the nose. In this way we could show that videocapture was able to record changes of nasal morphology after decongestion and we could compare this technique with AAR, the gold standard technique for measuring the nasal respiratory function.

The second reason is that the inferior turbinate contributes highly to the resistance of the airflow that develops in nasal cavities. It is well known that the valvular area contributes to about 60% of the total nasal resistance in inspiratory flow (Bridger, 1970): more exactly, one third of the resistance is developed by the nasal valve. This refers to the zone between the alar, triangular and septal cartilages; a higher amount is given by the "turbinates valve", which is the cavernous tissue of the inferior turbinates (Haight et al., 1983).

For these reasons, the increase of the nasal resistances measured by AAR is often due to diseases involving the inferior turbinates (Passàli et al., 1997), besides AR recognizes in the head of inferior turbinate the values of cross-sectional area that are truly altered in case of rhinopathy. In case of hypertrophy of the inferior turbinate, the AR shows the typical "descending W" where the value of the nasal valve, expressed as the minimal cross-sectional area (MCA), is unchanged. However, the deflection corresponding to the head of the inferior turbinate increases with the same or often lower values compared to the valve (Passàli et al., 1996). At this moment a comparison with AR is still not significant due to the present problems related to this method (Fisher et al., 1995).

Endoscopic examination of the nasal cavity was not performed completely, because the aim of this study was to stress the alterations of the inferior turbinates and to analyze them by videocapture. In any case, each patient underwent complete endoscopic examination.

In conclusion, videocapture is able to give statistically significant values, comparable to AAR. The advantages of this method are:

- easy application and performance: the software and the pedal-keys allow the operator to use two hands while he is doing endoscopic examination, the pedal keys are useful for the selection of images and to calculate the parameters;
- filing of the images, useful for research and teaching.

We think that videocapture, although to be subjected to further evaluations, may become a method with diagnostic value that complements ARR and AR. Our study has shown the reliability of this method both for quality of images and the significant values that were obtained.

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