A COMPARISON OF VIRTUAL AND CONVENTIONAL ENDOSCOPY OF NOSE AND PARANASAL SINUSES

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ABSTRACT

We compare CT virtual rhino-sinus endoscopy (VRS) and conventional fibers optic endoscopy (FE) for the detection of phlogistic/obstructive rhinosinusal pathology. 158 patients were recruited, 100 (group A) affected by phlogistic/obstructive rhinosinusal disease, 58 (group B) had a previous history of rhinosinusal surgery.

All patients underwent virtual endoscopy of nose and paranasal sinuses within 2-6 hours from conventional endoscopy. VRS was able to demonstrate the anatomical details of nasal fossa and rhinofarynx with high correspondence to FE. A satisfying representation of anatomical detail both in group A and B was found.

VRS was able to visualize invasiveness the endosinusal cavities, not accessible at FE. VRS resulted in a fast, easy and non-invasive technique that could be integrated to FE or as alternative when this one is unfeasible. Because of the ability to explore sinus cavity, we suggest that virtual rhinosinusoscopy should be considered as the appropriate term, instead of virtual rhinoscopy.

KEY WORD

nose, paranasal sinuses, virtual rhinosinusoscopy, fiberoptic endoscopy, CT
INTRODUCTION

Nowadays fibers optic nasal endoscopy has achieved a primary role in diagnosis and therapy of rhino-sinusal diseases. The routine use of functional endoscopy sinus surgery (FESS) requires that the endoscopist be completely familiar with local-regional anatomy, a skilled training surgeon, and a defined pre-surgery planning.

Dedicate image processing performed by Computed Tomography (CT) scans allowed the development of non-invasive endoscopic virtual imaging (1,2,3). The purpose of this study was to compare for the first time the performance of virtual rhino-sinus endoscopy (VRS), a new method not yet so known among ENT specialist, and conventional fibers optic endoscopy (FE) for the detection of phlogistic/obstructive rhino-sinusal pathology.

MATERIALS AND METHODS

From May 2000 to October 2001, one hundred and fifty-eight patients (92 men and 66 women; age range 27 to 59; mean age 44 years), with no previous CT examination, complaining chronic nasal symptoms (nasal obstruction, rhinorrea, post-nasal drip, hyposmia, headache) were recruited. The study protocol was approved by the institutional review board of Tor Vergata University and written informed consent was obtained from all participants.

One hundred of them (group A) were affected by phlogistic/obstructive rhino-sinusal disease: 57 nasal polyposis (Fig.1), 34 chronic rhino-sinusitis and 9 “concha bullosa” (Fig.2) while fifty-eight (group B) had a previous history of rhino-sinusal surgery (endoscopic and traditional maxillary approach for chronic rhino-sinusitis): 47 nasal polyposis relapses and 11 chronic rhino-sinusitis. FE was performed by an experienced otolaryngologist. We studied
both group in order to see the differences in virtual navigation in a nose with anatomical
defects as it is mostly after traditional surgery.

Both stiff (0°, 30°, 70°, 120°) and flexible fibers optic endoscope with deflectable apical part
were used. Nasal spray vasoconstrictor (nitrate nafazolyne 0,1%) was used since turbinate
hypertrophy obstructed the advancement of the endoscope. The localization of each lesion
was documented, and the size was estimated.

All patients underwent virtual endoscopy of the nose and paranasal sinuses within 2-6 hours
from conventional endoscopy. A standard CT lateral scout view image of the skull was
acquired to assess the degree of the coronal and axial planes. All CT examinations were
performed by using a multi-detector scanner (Lightspeed, GE Medical System, Milwaukee,
Wis). Images were acquired with standard helical-CT using 2-mm collimation (table speed of
7.25 mm per second at 140 mA and 120 KV, and a matrix of 512 by 512) with the following
dose administrated: CTDIw 25.08 mGy, DLP 267.98 mGy*cm, dose efficiency 60.92%. All
images were obtained without contrast material administration. Images were reconstructed at
1-mm intervals, in axial plane on hard palate, with a 2-mm slice overlap, and reconstruction in
coronal plane perpendicular to the axial plane. The CT data were downloaded to a dedicate
workstation running software for three-dimensional-rendering (Advantage Workstation, GE
Medical System, Milwaukee, Wis). Using this software, a single radiologist, generated an
intraluminal virtual navigation through the volume of CT data. Virtual studies were stored in
a cine loop format and viewed directly from the workstation monitor.

Either two-dimensional and endoluminal three-dimensional reconstruction were evaluated by
two radiologists who jointly reviewed the CT images. A threshold value ranging from -300 to
-550 Hounsfield units was applied. The Virtual endoscopy studies were reviewed on a 17-inch
(43-cm) monitor (GE Medical System, Milwaukee, Wis) at a variable frame rate of 5 to 30
frames per second. Final interpretations were made on the basis of combined evaluation of
axial and coronal CT images and virtual endoscopy reconstruction. The results of FE were compared with findings of VRS together by experienced ENT specialist and Radiologist.

RESULTS

VRS was able to demonstrate the anatomical details of nasal fossa and rhinofarynx with high correspondence between conventional and virtual imaging, in opinion of both ENT specialist and Radiologist. A satisfying representation of anatomical detail both in primary (group A) and in patients with history of rhino-sinus surgery (group B) was found.

In the group A, which had not previous surgery, VRS was able to visualize the endosinusal cavities which are not accessible at conventional endoscopy (Fig.3). Table 1 and 2 show the results of VRS and FE.

Concerning group A (100 patients), conventional endoscopy was able to visualize the following: the inferior turbinate in 100 patients, the middle turbinate in 81, the superior turbinate in 71, the choana in 100, the rhino-pharynx in 100, the torus tubarius in 90, the uncinate process in 36, the hiatus semilunaris in 22 and the sphenoidal recess in 43.

For the same group of patients (group A), the VRS identified: the inferior turbinate in 100 cases, the middle turbinate in 91, the superior turbinate in 82, the choana in 100 (Fig.4), the rhino-pharynx in 100, the torus tubarius in 100, the uncinate process in 53, the hiatus semilunaris in 46 and the sphenoidal recess in 46 patients. Moreover VRS was able to see: the maxillary sinus in 80 patients, the frontal sinus in 90, the ethmoid sinus in 34 and the sphenoid sinus in 83 (p<0,05).

Considering group B (58 patients), conventional endoscopy visualized: the inferior turbinate in 58 cases, the residual middle turbinate in 48, the superior turbinate in 32, the choana in 58, the rhino-pharynx in 58, the torus tubarius in 58, the sphenoidal recess in 34 patients, the maxillary sinus in 30, the ethmoid sinus in 13 and the sphenoid sinus in 2 patients. The
performance of VRS (group B) was: the inferior turbinate in 58 cases, the residual or middle turbinate in 56, the superior turbinate in 51, the choana in 58, the rhino-pharynx in 58, the torus tubarius in 58, the sphenoid recess in 50, the maxillary sinus in 58, ethmoid sinus in 58 and the sphenoid sinus in 57 patients (p<0.05).

DISCUSSION

Independent of the anatomic characteristic, the virtual imaging reconstruction enabled a 3D study of nose and paranasal sinuses in additional views and perspectives comparing to FE. VRS demonstrated useful in comparing to FE in the case of occlusive pathology where the advancement of the endoscope resulted impossible. Even when a flexible endoscope was used, VRS proved more helpful in demonstrating the distal segments to stenosis without any discomfort for the patient. Using intraluminal navigation software and varying the view angle, virtual imaging was able to depict all the anatomical details even in case of severe occlusive pathology.

Our VRS study was performed in selected patients that, in any case, needed a CT study; therefore, there was no further or useless exposure to ionizing radiation, because virtual images are made with a post-processing software using data already acquired from helical CT scan.

The main limits of VRS consist in the impossibility to perform biopsy and to evaluate nasal mucosa and secretions features, and to differentiate fibrotic tissue from relapses in post-surgery patients. Further studies are needed to overcome this last issue. Probably the integration of conventional contrast CT scan might rule out this problem. According to our experience, VRS resulted in a fast, easy and non-invasive technique that could be integrated to FE, but we underline the necessity of a careful standard FE for all the patients always before performing CT and eventually VRS reconstruction. In fact VRS is not alternative to
FE. Finally, we suggest that, because of the ability to explore sinus cavity, the virtual rhino-sinusoscopy should be considered as the appropriate term, instead of virtual rhinoscopy. Moreover, as previously reported (4,5,6), CT virtual imaging could be a helpful preoperative tool for assisting the surgeon as well as a planning facilitator and a didactical device, because of a more familiar endoscopic view of the nose for the ENT specialist respect of bidimensional CT images. Furthermore, as seen in our figures, bidimensional images are always available during VRS in a small windows in the monitor, allowing a simultaneous complete informations for better interpretation of anatomical details and pathologies.

REFERENCES


### TABLES

<table>
<thead>
<tr>
<th>Turbinate</th>
<th>EF</th>
<th>VRS</th>
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<tbody>
<tr>
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<td>Middle turbinate</td>
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<td>91/100</td>
</tr>
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<td>Superior turbinate</td>
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<td>82/100</td>
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<tr>
<td>Choana</td>
<td>100/100</td>
<td>100/100</td>
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<tr>
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<td>-------------------------</td>
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</tr>
<tr>
<td>Rhino-pharynx</td>
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<td>Torus tubarius</td>
<td>90/100</td>
<td>100/100</td>
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<td>Uncinate process</td>
<td>36/100</td>
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<td>Hiatus semilunaris</td>
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<td>Sphenoethmoid recess</td>
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<td>Maxillary sinus</td>
<td>0/100</td>
<td>80/100</td>
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<td>Sphenoid sinus</td>
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Tab.1: Rhino-sinusal anatomical details visualized in primary diseases (100 patients)

<table>
<thead>
<tr>
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<th>VRS</th>
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<td>58/58</td>
</tr>
<tr>
<td>Middle turbinate (or residual)</td>
<td>48/58</td>
<td>56/58</td>
</tr>
<tr>
<td>Superior turbinate</td>
<td>32/58</td>
<td>51/58</td>
</tr>
<tr>
<td>Choana</td>
<td>58/58</td>
<td>58/58</td>
</tr>
<tr>
<td>Rhino-pharynx</td>
<td>58/58</td>
<td>58/58</td>
</tr>
<tr>
<td>Torus tubarius</td>
<td>52/58</td>
<td>58/58</td>
</tr>
<tr>
<td>Uncinate process*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Hiatus semilunaris*</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Sphenoethmoid recess | 34/58 | 50/58  
Maxillary sinus     | 30/58 | 58/58  
Frontal sinus      | 0/58  | 58/58  
Ethmoid sinus      | 13/58 | 58/58  
Sphenoid sinus     | 2/58  | 58/58  

Tab.2: Rhino-sinusal anatomical details in patients with previous history of rhino-sinusal surgery (58 patients).

*No more present in patients with previous history of rhino-sinusal surgery (58 patients).

**ILLUSTRATIONS LEGENDS**

Figure 1.
Comparison VRS-FE in a case of nasal polyposis. High correspondence of images and possibility to see the choanal posterior part of the nose with a single view at VRS.

Figure 2.
Comparison VRS-FE in a case of concha bullosa. VRS allowed the visualization of the cranial part of middle turbinate even in case of large hypertrophy, where the advancement of the endoscope resulted impossible (for this reason the FE view is not the same).
Figure 3.

VRS was able to visualize invasiveness the endosinusal maxillary cavity showing a cyst (after histopathology examination) in its roof, which is not accessible at FE.

Figure 4.

VRS of the choana from a postero-anterior view in a case of ethmoidal nasal polyposis.