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Assessment of the Accuracy of Paranasal Sinuses Limited CT Scans in the Diagnosis of Sinusitis

Objective/Background: CT scan of paranasal sinuses (PNS) has replaced the standard plain radiography in patients suspected of sinusitis. Since the standard CT scan (SCT) of PNS has high patient x-ray absorption dose, limited CT scan (LCT) of PNS is performed. The purpose of this study is to assess the diagnostic accuracy rate of PNS LCT in cases suspected of sinusitis.

Patients and Methods: This cross-sectional study was performed on 120 patients with paranasal sinuses SCT requested by clinicians to diagnose sinusitis. After interpretation of paranasal sinuses SCT, limited slices consisting of 5 noncontiguous slices of 5 mm thickness in both axial and coronal plains were selected to be interpreted by another radiologist.

Results: In this study paranasal sinuses LCT had a sensitivity of 95%, specificity of 92%, positive predictive value (PPV) of 96% and negative predictive value (NPV) of 90%.

Conclusion: The limited CT scan in diagnosis of sinusitis has acceptable sensitivity and specificity which indicates a suitable diagnostic value.

Keywords: sinusitis, CT scan, limited, screening, standard

Introduction

Failure to detect sinusitis can lead to serious complications such as cellulitis and osteomyelitis.¹ Standard plain radiography, such as Caldwell or Water's views, used to be the primary imaging methods. These imaging methods do not have an acceptable diagnostic accuracy in cases of sinusitis.² Therefore, currently CT scan of PNS is the imaging of choice for sinusitis.¹ Standard CT scan (SCT) of PNS consists of coronal and axial sections. Coronal sections are composed of contiguous slices of 5 mm thickness from the frontal sinuses to the sphenoid sinuses, and axial sections are composed of contiguous slices of 5 mm thickness from the maxillary sinuses to the frontal sinuses. For further details in the coronal sections, slices of 3 mm thickness through ostiomeatal complex (OMC) can be taken.³ Because of these multiple slices, paranasal sinuses SCT has a high patient x-ray absorption dose.³

For this reason, CT scan of PNS with fewer sections is one of the guidelines, which has been named as, simple, screening, or limited CT scan (LCT).⁴ PNS LCT consists of coronal and axial sections both of which, comprise noncontiguous slices of 5 mm thickness at almost equal intervals passing through four major paranasal sinuses; frontal, ethmoidal, maxillary and sphenoidal sinuses (Figure 1 and 2). This PNS LCT method was applied in this study. The purpose of this study was to determine the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of PNS LCT in the diagnosis of sinusitis.

Patients and Methods

This cross-sectional study was performed on 130 patients, clinically suspicious

of acute sinusitis, who were referred to our radiology department by their clinicians for standard CT scan of paranasal sinuses (paranasal SCT) and had a definite diagnosis by this method. Ten patients with history of functional endoscopic sinus surgery (FESS) were excluded, and finally 120 patients were included in the study. The CT scan device was a third generation TOSHIBA-XVID, China. All patients were in the supine position for axial sections and in the prone position for coronal sections, during the imaging. Exposure parameters were 20 mA, 120 KV and 2.4 sec, for each slice. PNS SCT consisted of coronal and axial sections; coronal sections composed of 5-mm contiguous slices from frontal sinuses to sphenoid sinuses; and axial sections composed of 5-mm contiguous slices from maxillary sinuses to frontal sinuses (Figures 1 and 2).

Both bone and soft tissue windows of PNS were assessed. Imaging variables were as follows: 1) Diffuse and polypoid mucosal thickening >2 mm, 2) Total opacity of sinuses, 3) Air-fluid level, 4) Retention cysts, 5) Ostiomeatal complex (OMC) patency, 6) Erosion and sclerosis of sinus walls.

OMC included the frontoethmoidal recess, middle meatus, maxillary sinus infundibula, uncinate process and middle turbinate, which are the normal drainage of paranasal sinuses.

After interpretation of PNS SCT, limited slices (LCT) of 5 noncontiguous 5-mm thick slices in the both axial and coronal plains were selected and interpreted. The radiologist was masked to the primary interpretation with no information about standard of both PNS SCT and PNS LCT. Findings were recorded and compared by χ^2 test in regard with the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) using PNS SCT as the gold standard of diagnosis.

Results

Standard and limited slices of 120 patients were interpreted by two radiologists independently and the interpretations were compared.

From 63 patients with maxillary sinus mucosal thickening diagnosed by standard CT scan, 60 cases were also diagnosed by limited method (sensitivity=95%). From 35 patients with ethmoidal air cell mucosal thickening diagnosed by standard CT scan, 34 cases were also diagnosed by limited method (sensitivity=97%). From 24 patients with frontal sinus mucosal thickening diagnosed by standard CT scan, 19 cases were also diagnosed by the limited method (sensitivity=79%) and from 21 patients with sphenoidal sinus mucosal thickening diagnosed by standard CT scan, 18 cases were also diagnosed by limited

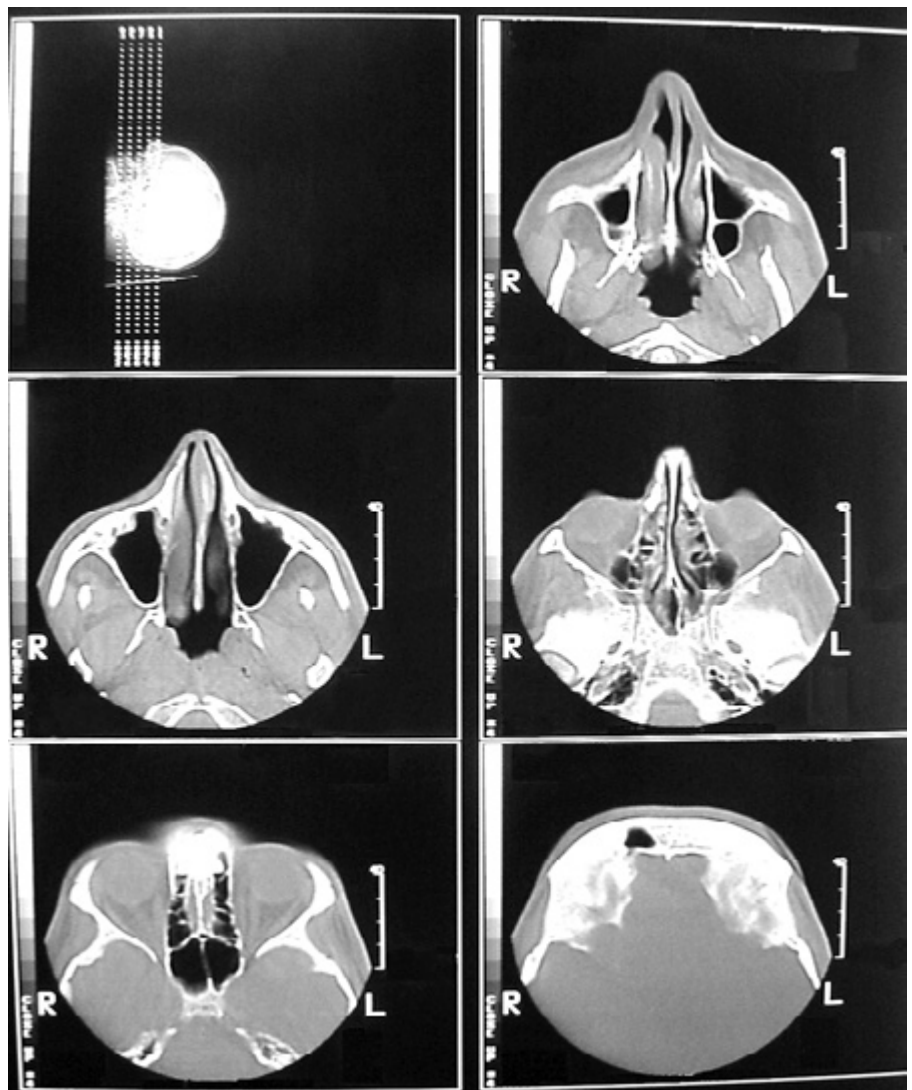


Fig 1. a-f Axial slices in Limited CT scan.

method (sensitivity=85%).

Total opacification of sinuses were equally detected by two methods.

The air-fluid level was detected in maxillary sinuses in 24 patients in standard method, whereas, 23 cases were also detected by the limited method (sensitivity =95%). Sensitivity for detection of air-fluid level was 100% in ethmoidal air cells (1 of 1 case), 71% for frontal sinuses (5 of 7 cases) and 100% for sphenoidal sinuses (15 of 15 cases).

In evaluation of maxillary sinuses, limited sinus scanning was interpreted normal in 3 cases, whose sinusitis was confirmed by the standard method (3 of 75 cases show false negative results), and also limited method show abnormal sinus in one case of 45 cases, whom standard CT scan confirmed no evidence of sinusitis (false Positive), so sensitivity of 96% and

specificity of 97% were achieved.

Results for other sinuses are also evaluated in this way. For ethmoidal sinusitis false negative rate was 2.7% (one case of 36), and false positive rate was 0 (sensitivity = 97.2%, specificity = 100%).

In frontal sinusitis false negative rate was 16% (4 cases of 25 cases) and false positive rate was 5.2% (5 Cases of 95 Cases), so sensitivity of 84% and specificity of 94% were achieved.

In sphenoid sinusitis, the false negative rate was 12.5% (3 of 24 cases) and the false positive rate was 3.1% (3 of 96); therefore, a sensitivity of 87.5% and specificity of 96% were achieved (Tables 1 and 2).

Congruity of the standard CT scan method with the limited technique in detection of OMC patency was 82.5%.

Overallly, of 120 standard PNS CT scans, 80 cases

had sinusitis which the limited method failed to show sinusitis in 4 cases. Of 120 standard PNS CT scans, 40 had no evidence of sinusitis which the limited method showed abnormality in 3 cases (Table 3).

The limited CT scan method had 95% sensitivity, 92.5% specificity with PPV=96.2% and NPV = 90.2%.

Discussion

As noted, sensitivity and specificity of limited CT scan was 95% and 92.5% respectively for detection of sinusitis in our study. The limited method had the sensitivity in the range of 84% to 97% in detection of sinusitis in various sinuses, with the highest sensitivity for ethmoidal sinusitis and lowest sensitivity for frontal sinusitis. Specificity of limited CT scan varies between 94% and 100%.

In our study, sensitivity and specificity of the limited CT scan method was higher than similar studies. For instance, Goodman et

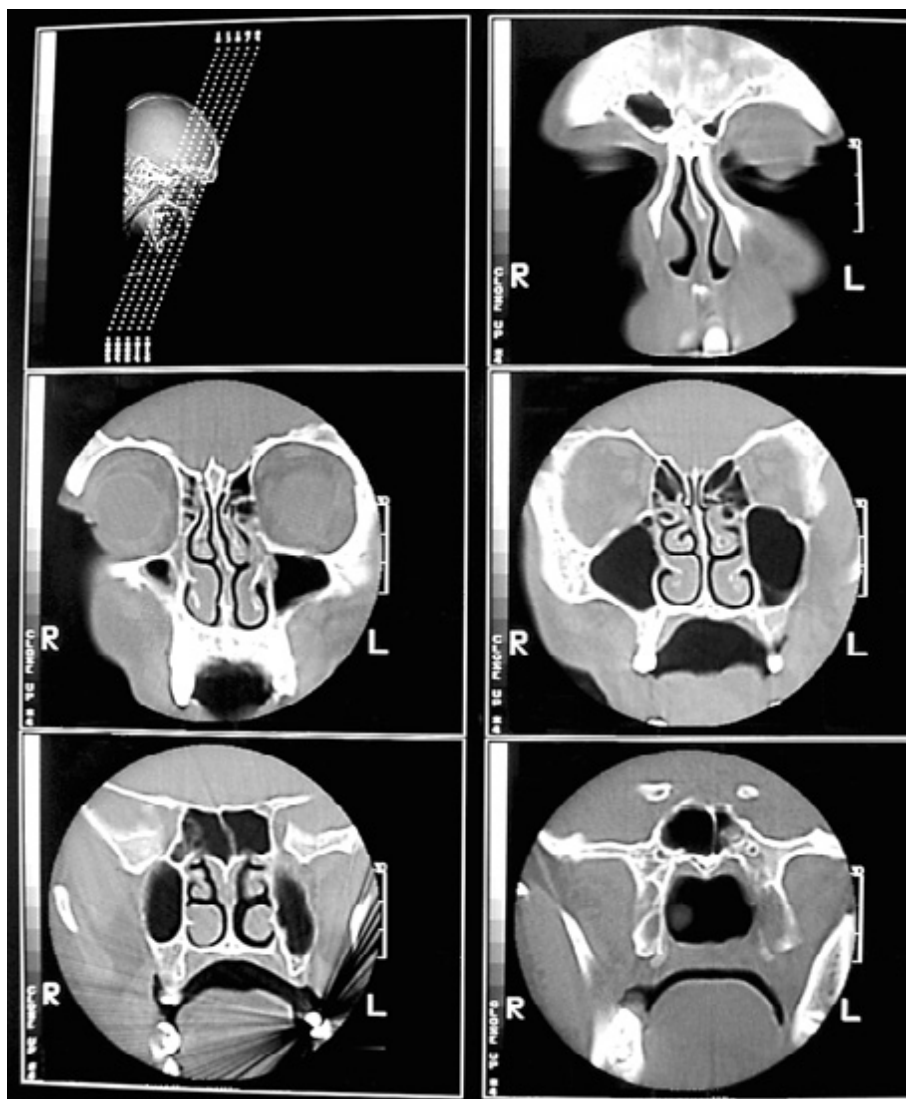


Fig 2. a-f. Coronal slices in the Limited CT scan.

Table 1. Comparisons of the standard and limited CT scans in the diagnosis of sinusitis in various sinuses

		Standard CT Scan	
		Normal	Abnormal
Limited method in maxillary sinuses	Normal	44	3
	Abnormal	1	72
Limited method in ethmoidal cells	Normal	84	1
	Abnormal	0	35
Limited method in frontal sinuses	Normal	90	4
	Abnormal	5	21

Table 2. Sensitivity and specificity of the limited CT scan in the diagnosis of sinusitis

	Sensitivity	Specificity
Maxillary Sinuses	96%	97%
Ethmoidal Cells	97%	100%
Frontal Sinuses	84%	94%
Sphenoidal Sinuses	87.5%	96%
All of Sinuses	95%	92.5%

Table 3. Comparison of normal and abnormal findings on two methods

	Normal on standard method	Abnormal on standard method
Normal on limited method	37	4

Abnormal on limited method 77. In another study with the 4-slice technique, sensitivity, specificity, NPV and PPV were 81%, 89%, 74% and 92%, respectively⁶, however, due to the more sections in our proposed limited CT scan method (5 slices), these variables in our study were 95%, 92%, 90% and 96%.

Partial volume averaging was the major cause of a false diagnosis of sinusitis in the limited CT scan method. False negative reports were due to the slight mucosal thickening, which was ignored on non-contiguous sections.

The low sensitivity of limited PNS CT scan for evaluation of OMC patency (82%) was due to non-contiguous slices in this method, which fails to show of anatomic details OMC.

Given that approximately 10% of patients with si-

nusitis need a complete diagnostic work-up and surgery, applying the limited method seems cost effective.⁵

Finally, we conclude that the limited CT scan in diagnosis of sinusitis has acceptable sensitivity and specificity, lesser cost and radiation dose in comparison with the standard CT.

Multislice CT scan (MSCT) with its low radiation dose in comparison with third-generation systems can now be an alternative method with advantages of standard slices. Thus, we recommend that the limited CT scan as an alternative when MSCT is not available.

Thus standard method is the modality of choice in planning surgery, evaluation of OMC anatomical details and in cases normal on the limited scan and clinically suspected of sinusitis.

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