

## Computed Tomographic Study of Paranasal Sinuses in Lepromatous Leprosy<sup>1</sup>

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The upper respiratory tract is one of the earliest sites to be involved in lepromatous leprosy which affects the mucosa of the nose, nasopharynx, and larynx (<sup>2</sup>). Maxillary antral mucosal involvement was reported in a previous study from our institute (<sup>3,4,6</sup>), and its involvement was associated with radiological changes, external nasal deformity and a high bacterial index (BI) (<sup>4</sup>). Involvement of the ethmoid, frontal and sphenoid sinuses by the lepromatous process has not been documented by direct studies in the reviewed English literature. This may be due to the relative inaccessibility of these areas and proximity to vital structures. In the present study we have used noninvasive computed tomography (CT) to demonstrate changes in the paranasal sinuses.

### MATERIALS AND METHODS

Twenty consecutive untreated patients with lepromatous leprosy attending the Leprosy Clinic of Nehru Hospital attached to the Postgraduate Institute of Medical Education and Research, Chandigarh, India, were recruited. The diagnosis was based on clinical examination, slit-skin smears from six sites, and skin biopsy. The Ridley-Jopling (<sup>5</sup>) classification of leprosy was followed. Patients were questioned about

nasal symptoms and the ears, nose and throat were examined. A CT examination was done using Somatome Hi Q (Siemens) and Shimadzu SCT 2000 scanners. Five-mm axial and coronal cuts of the paranasal sinuses (PNS) were taken in all of the patients, and 3-mm sections were taken in the region of the ethmoid sinuses. Ten age- and sex-matched controls undergoing CT scans for epilepsy or migraine were also studied for PNS. Mucosal thickening, partial or complete opacification, fluid level, polyp or integrity of bony boundaries of PNS were recorded. In the maxillary, frontal and sphenoid sinuses, mucosal thickening was defined as an increase in soft-tissue width along the bony boundaries of the sinus with the presence of air within the sinus. Soft-tissue density was defined as partial or complete opacification of the sinus cavity by a nondependent iso- or hyper-attenuating density. Fluid level was defined as soft-tissue density which formed a level with the air in the sinus in a dependent position. In the ethmoid gallery the presence of soft-tissue densities as defined above was taken to be abnormal when more than one air cell on each side was affected. It was based on results of a CT scan of PNS in the 10 controls.

In two selected patients, one each with abnormal and normal CT findings, an eth-

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TABLE 1. *CT findings of PNS in 10 controls.*

Finding	Maxillary	Ethmoid	Frontal	Sphenoid
Mucosal thickening	0	0	0	0
Soft-tissue densities	0	2 <sup>a</sup>	0	0
Polyp	0	0	0	0
Fluid level	0	0	0	0
Any other	0	0	0	0

<sup>a</sup> One air cell on each side, considered not significant.

TABLE 2. *CT findings in the maxillary antrum.*

Finding	Bilateral	Unilateral	Total
Mucosal thickening	3	5	8
Polyp	1	3	4
Fluid level	0	1	1
Total	4	9	13

moid sinus biopsy was carried out after informed consent.

### RESULTS

Twenty patients (18 males, 2 females) with a mean duration of disease of 28 months formed the study group: 14 patients had lepromatous leprosy (LL) and 6 had borderline lepromatous leprosy (BL). Type 2 reaction [erythema nodosum leprosum (ENL)] was present in 12 LL and type 1 reaction in 2 BL patients. All but two BL patients were smear-positive with a mean BI and morphological index of 3.4+ and 1%, respectively. Nasal symptoms in the form of epistaxis or nasal stuffiness were present in nine (45%) patients.

None of the 10 controls showed any abnormality in the CT scans of their maxillary, frontal and sphenoid sinuses. Two controls, however, showed soft-tissue densities in 1–2 air cells in the ethmoid galleries (Table 1).

Computed tomography of PNS showed abnormal findings in 15 (75%) patients. Maxillary antrum and ethmoid air cells were involved in 11 (55%) patients each, sphenoid in 4 patients (20%), and frontal in 1 (5%) patient. The maxillary antrum and ethmoid were involved together in 5 patients, and the maxillary antrum and ethmoid alone in 4 and 2 patients, respectively. Two patients showed concurrent involvement of the maxillary ethmoid and sphenoid

TABLE 3. *CT findings in the ethmoid sinuses.*

Finding	Bilateral	Unilateral	Total
Mucosal thickening	2	4	6
Soft-tissue density filling air cells	4	1	5
Total	6	5	11

TABLE 4. *CT findings in the sphenoid sinus.*

Finding	Bilateral	Unilateral	Total
Mucosal thickening	0	1	1
Soft-tissue density filling sphenoid	1	1	2
Fluid level	0	1	1
Total	1	3	4

noid sinuses, and one each had maxillary antrum involvement in association with the sphenoid and frontal sinuses. Mucosal thickening was the commonest change observed in all PNS: in 8 patients in the maxillary antrum, in 6 patients in the ethmoid cells, and in 1 patient each in the sphenoid and frontal sinuses. The second most common change was soft-tissue densities seen as polyps in the maxillary antrum in four patients. Soft-tissue densities filling the ethmoid cells were seen in five patients; sphenoid sinuses in two patients. A fluid level was noted in one patient each in the maxillary antrum and sphenoid sinuses. CT changes in individual sinuses are summarized in Tables 2–4.

**Correlation of CT changes and bacterial load.** A BI of 4+ or more was frequently associated with involvement of the PNS, especially the maxillary antrum, compared to patients with a BI of 3+ or less (75% vs 37.5%;  $p > 0.05$ , Table 5).

**Correlation of CT changes and nasal symptoms.** Eight out of nine patients with clinical symptoms showed PNS involvement on a CT scan.

**Histological changes.** An ethmoid sinus biopsy showed changes consistent with lepromatous leprosy with large numbers of acid-fast bacilli (AFB) in both patients, including the one with an apparently normal CT image.

### DISCUSSION

The paranasal sinuses are an important part of the upper respiratory tract since they can produce ideal conditions for the growth of bacteria. They have been studied mostly by X-ray of PNS in occipitomeatal and occipitofrontal views (<sup>1,3,6</sup>). All PNS, including the maxillary, ethmoid and frontal sinuses, have been reported to be affected.

TABLE 5. Correlation of CT changes and bacterial index.

Bacterial index	No. studied	No. patients with sinuses affected			
		Maxillary	Ethmoid	Sphenoid	Frontal
4+ or more	12	8	2	2	1
3+ or less	8	3	3	2	0
Total	20	11	5	4	1

Maxillary antrum involvement is the commonest observed in 57%–60% patients followed by the ethmoid sinuses (33%) and the frontal sinuses (30%)<sup>(3,7)</sup>. Barton<sup>(1)</sup>, however, reported maxillary sinus involvement in all (100%) of his 16 cases.

The present CT scan study of PNS in leprosy is the first of its kind to the best of our knowledge. CT was chosen for this investigation because it gives a three-dimensional picture. Moreover, the details of soft tissue and opacity (homogenous or heterogenous) and the integrity of adjoining bone can be clearly delineated. A CT scan also can give us a better idea of the PNS pathology by ascertaining the extent and type of disease. The PNS contain air which is a natural contrast and, since these are cross-sectional images, the overlapping of bones which obscures details on plain X-rays is avoided. Pneumatization of sinuses can be assessed better in CT which

may be seen as haziness on plain X-rays. The anterior ethmoid cells and sphenoid sinuses are better seen on CT than on plain X-rays. In addition, when both coronal and axial sections are reviewed together the extent of involvement of the PNS can be clearly delineated.

In our present study the involvement of the maxillary sinus was seen in 11 (55%) patients which is in agreement with previous radiological studies. In addition to mucosal thickening, polyps could be seen in four (20%) patients. Ethmoid cells are not easy to visualize in detail on an occipitofrontal view, but CT demonstrated their involvement in 11 (55%) cases. It was frequently associated with involvement of the maxillary antrum because of its proximity. Involvement of the ethmoid on CT was more frequent than previous reports<sup>(1,7)</sup>. The involvement of the frontal sinus was least frequent; only one patient showed uni-

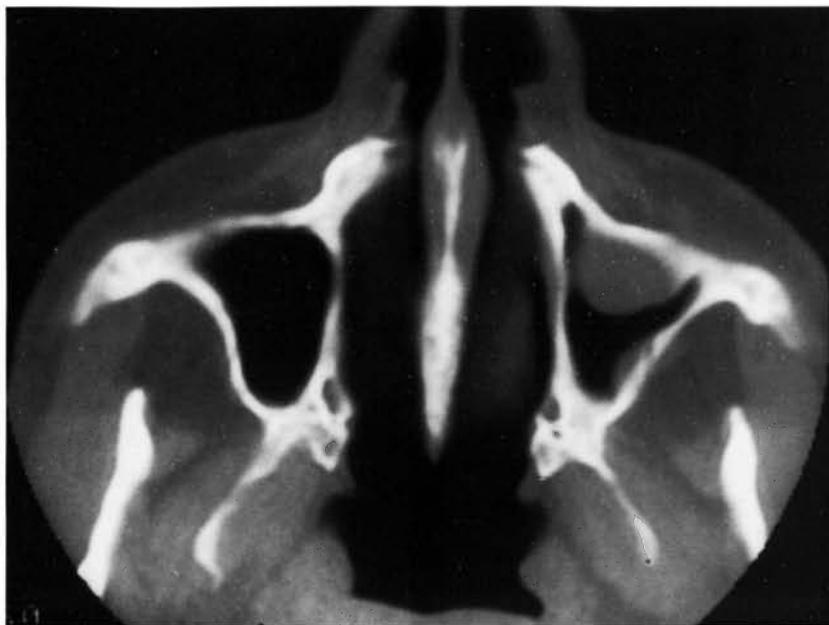


FIG. 1. Axial CT section showing a polyp on the anterior wall and mucosal thickening on the posterolateral wall of the left maxillary sinus.



FIG. 2. Soft-tissue density within the left half of the sphenoid sinus.

lateral mucosal thickening in association with septate maxillary antrum. This is in contrast to reports of frontal sinus involvement in 44% and 30% of cases (<sup>1-7</sup>), and may be due to partial pneumatization of the sinuses being interpreted as hazy on plain X-rays. The sphenoid sinus was also involved in four (20%) patients in contrast to the lack of comment in previous reports since it cannot be delineated on plain X-rays. A careful evaluation of the CT scans of PNS in our 10 controls served as a baseline for determining what may be considered as abnormal because none of them showed abnormalities in the maxillary antrum, frontal or sphenoid sinuses. The ethmoid sinuses showed soft-tissue densities in 1-2 air cells in two controls that were considered within normal limits.

Radiological abnormalities in the maxillary antrum were associated with histological involvement in 21 (70%) out of 30 cases in our previous report (<sup>4</sup>). Two patients who underwent ethmoid sinus biopsies showed involvement by the lepromatous process

even when CT images were normal. Moreover, all but one patient with nasal symptoms had CT changes, suggesting that involvement of PNS is part and parcel of the upper respiratory tract involvement in lepromatous leprosy. They serve as an important reservoir of infection since a wide surface area is involved, and they may serve as a constant source of reinfection of the nasal mucosa. Further sinusoscopic and histological studies are planned in addition to the CT scan of the PNS to validate the above findings.

#### SUMMARY

Twenty patients (18 males, 2 females) with lepromatous leprosy and 10 age- and sex-matched controls were subjected to computed tomographic (CT) scans of the paranasal sinuses (PNS). The mean bacterial (BI) and morphological indexes were 3.4+ and 1%, respectively. Nasal symptoms were present in nine (45%) patients; 15 (75%) out of 20 patients showed significant abnormalities on CT scans of the PNS com-

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FIG. 3a. Normal axial CT section for ethmoid sinuses. Note bony septas are thin and barely visible. FIG. 3b. Mucosal thickening of the septas within the ethmoid sinus, especially the anterior cells on both sides. FIG. 3c. Soft-tissue density partially or totally obscuring cells in the ethmoid sinuses of both sides.

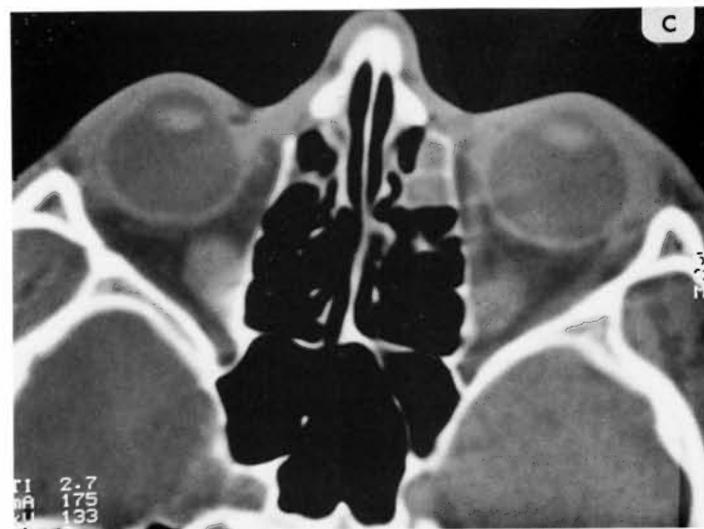
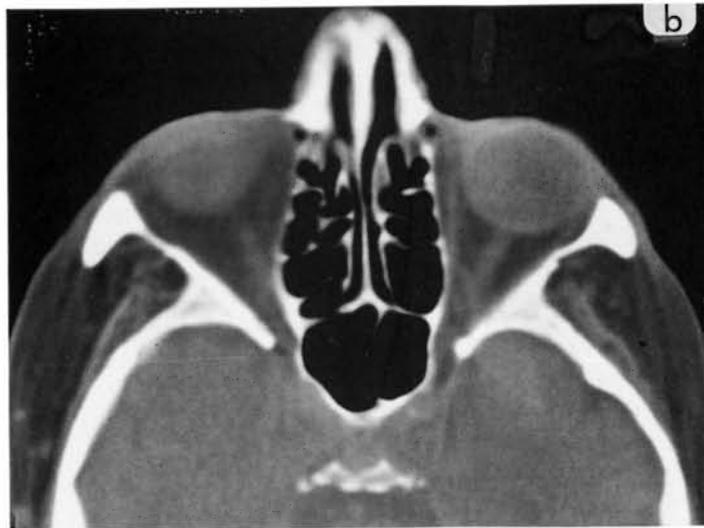




FIG. 4. Composite sections for the maxillary (top), ethmoid (middle), and frontal (bottom) sinuses. Mucosal thickening is seen in the left antrum and frontal sinuses in addition to soft-tissue densities within both ethmoid sinuses in lepromatous leprosy.

pared to none of the 10 controls. The maxillary and ethmoid sinuses were affected in 11 (55%) patients each, followed by the sphenoid sinus in four (20%) patients. Frontal sinus involvement was least frequent, only one (5%) patient showed CT changes. Mucosal thickening was the most common finding followed by soft-tissue densities and, rarely, a fluid level was seen in the PNS. Involvement of the PNS correlated with a high BI of 4+ or more (75% vs 37.5%). Paranasal sinus involvement is an integral part of lepromatous leprosy since histological involvement was present even when the CT scan was apparently normal.

### RESUMEN

Veinte pacientes (18 hombres y 2 mujeres) con lepra lepromatosa y 10 controles de similar edad y sexo se sometieron al análisis por tomografía computarizada (CT) de los senos paranasales (PNS). Los índices bacteriano (BI) y morfológico fueron 3.4+ y 1%, respectivamente. Nueve pacientes (45%) tuvieron síntomas nasales; 15 de los 20 pacientes (75%) mostraron anomalías significativas en las CT de sus PNS. Ninguno de los 10 controles sanos mostraron alteraciones en las CT/PNS. Los senos maxilar y etmoideo estuvieron afectados en 11 (55%) de los pacientes y 4 pacientes (20%) mostraron alteraciones en los senos esfenoides. La afección de los senos frontales fue la menos frecuente; sólo uno de los pacientes (5%) mostró cambios en la CT de esta parte de la cabeza. El engrosamiento de la mucosa fue el hallazgo más común seguido por opacidad de tejido blando y raramente se observó acumulación de líquido en los PNS. La afección de los PNS es una parte integral de la lepra lepromatosa puesto que llegaron a haber alteraciones histológicas aun cuando la TC fue aparentemente normal.

### RÉSUMÉ

Les sinus paranasaux (SPN) de vingt patients (18 hommes, 2 femmes) affectés de lèpre lépromateuse et 10 témoins de même âge et sexe furent examinés par scannographie. L'index bactérien (IB) moyen et l'index morphologique moyen était de 3.4+ et 1%, respectivement. Neuf (45%) patients présentaient des symptômes au niveau du nez; parmi ces 20 patients, 15 (75%) montraient des anomalies significatives visibles sur les coupes tomodensitométriques des SPN, alors qu'aucune anomalie n'était visible chez les contrôles. Les sinus maxillaires et ethmoïdes étaient affectés chez 11 (55%) patients chacun, suivi du sinus sphénoïde chez 4 patients (20%). L'atteinte du sinus ventral était la moins fréquente, seulement un (5%) patient montrait des lésions au tomodensitomètre. Des épaisissements de la muqueuse respiratoire étaient la trouvaille la plus fréquente, suivie par des densités de type tissu

mou et, plus rarement, une accumulation de fluide fut constatée dans les SPN.

L'atteinte des sinus paranasaux corrélait avec un IB élevé de 4+ ou plus (75% versus 37,5%). L'atteinte des SPN est une caractéristique de la lèpre lépromateuse puisque une démonstration histologique de l'atteinte des SPN était présente même lorsque les coupes tomodensitométriques étaient apparemment normales.

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