

# CT Findings of the Nose and Paranasal Sinuses in Chromium Intoxication

Myung Joon Kim<sup>1</sup>, Jong Doo Lee<sup>1</sup>, Hong Sik Choi<sup>2</sup>, Dong Ik Kim<sup>1</sup>  
Tae Sub Chung<sup>1</sup>, Jung Ho Suh<sup>1</sup> and Jae Hoon Roh<sup>3</sup>

*We performed computed tomography (CT) of the nose and paranasal sinuses in 21 patients with chromium induced septal perforation or thinning. Twenty patients showed various magnitudes of septal perforation. Twelve of 20 had perforation at the mid portion of the cartilaginous nasal septum. One patient had a sheet-like thinning of septal cartilage. Sixteen patients had mucosal thinning of the nasal conchas. In most cases, unilateral involvement of the inferior concha was seen. Eleven of 21 cases showed paranasal sinus mucosal thickening and one patient had a cyst or polyp in the sinus cavity. The main finding was nodular thickening of mucosa. Septal perforation by inhalation of chromic acid was located in the cartilaginous septum and there was no destruction of the bony septum and wall of the sinuses.*

**Key Words:** Chromium intoxication, nose, paranasal sinuses, computed tomography

Persons working in mines, plating factories, cement industries and so on are mainly exposed to chrome substances. Industrial exposure to chrome substances may cause various local and systemic effects. Among them, perforation of the nasal septum is caused by inhalation of chromic acid (CrO<sub>3</sub>), a highly corrosive and toxic material (Stokinger 1981; Mancuso 1951). Kleinfeld *et al.* (1965) reported 9 patients who had ulceration of the nasal septum due to inhalation of chromic acid mist. To our knowledge, there has been no report of the computed tomographic (CT) findings of the nose and paranasal sinuses in patients with septal perforation from chromic acid. So we present CT findings of the nose and paranasal sinuses of 21 cases of perforation of the nasal septum due to inhalation of chromic acid mists and we attempt to differentiate this from other causes of septal perforation.

## MATERIALS AND METHODS

All 21 patients were males working at chrome plating factories, and the age range was 20 to 47 years. The mean duration of chrome exposure was 6.7 years with a range of 1 to 14 years. Perforation of the nasal septum was found on routine physical examination. None of the patients had constitutional symptoms related to chromium intoxication. The diagnosis of chrome induced septal perforation was based on the history, and laboratory and pathological findings. In 14 of 21 patients, the chrome level was checked in blood and urine and a biopsy was done in the area of septal perforation. Chrome was detected in urine but not in blood. The range of chrome level in urine was 1.8 to 15.0 ug/l, and the average level was 4.96 ug/l. Pathological examination of 14 biopsied materials showed chronic nonspecific inflammation without granulomas or vasculitis. In the remaining 7 patients, a CT scan only was done. In all cases, CT scans were performed by an Ohio-Nuclear Delta Scan 50 FS-2. The axial sections were performed parallel to the infra-orbitomeatal plane. Eight millimeter thick consecutive axial slice were made from the level of the frontal sinus to the level of the alveolar recesses and hard palate. For the evaluation of magnitude and site of the

Received May 30, 1989

Accepted June 29, 1989

Departments of Diagnostic Radiology<sup>1</sup>, Otolaryngology<sup>2</sup>, Preventive Medicine and Public Health<sup>3</sup>, Severance Hospital, Yonsei University College of Medicine, Seoul, Korea

This study was supported by a Faculty Research Grant from Yonsei University College of Medicine.

Address reprint requests to Dr. M J Kim, Department of Diagnostic Radiology, Yonsei University College of Medicine, Seodaemun-ku, Shinchon-dong 134, CPO 8044, Seoul, Korea, 120-749

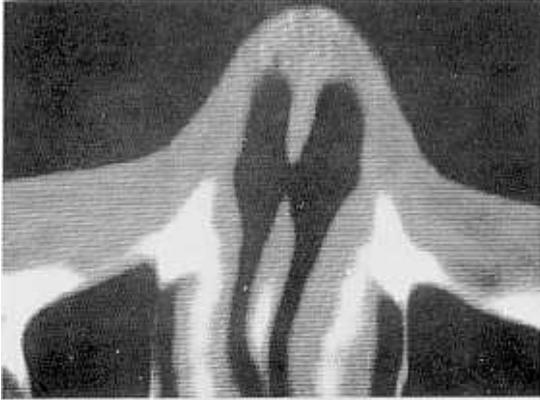


Fig. 1-a.

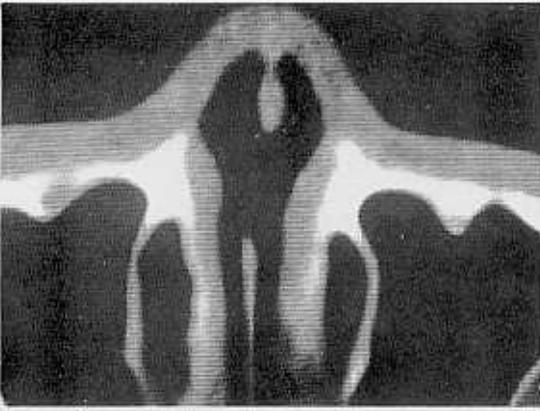


Fig. 1-b.



Fig. 1-c.

Fig. 1. Magnified images of axial CT sections at the level of the maxillary antra and inferior conchas show mild (a), moderate (b), and severe (c) perforation of the cartilaginous nasal septum. No abnormality is seen in the bony septum.

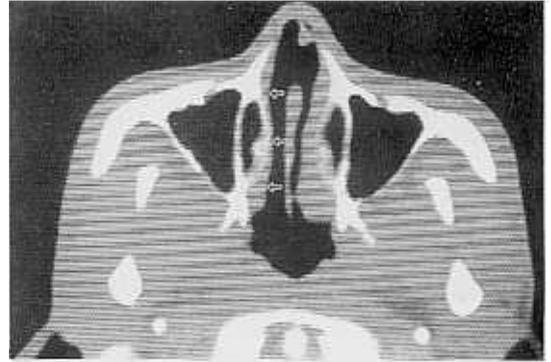


Fig. 2. Axial CT section at the level of the maxillary antra and inferior conchas shows mucosal thinning of the right inferior concha (arrows).

septal perforation, we divided the cartilaginous septum into upper, mid, and lower portions.

## RESULTS

Table 1 summarizes CT findings of the nose and paranasal sinuses in patients with chromium intoxication.

Perforation of the nasal septum was only located in the cartilaginous portion, and the most frequent site was the mid portion. The upper and lower portions of the septal cartilage were less frequently involved. In moderate and severe perforation of the septal cartilage, the perforation was extended to the articulation of septal cartilage with the perpendicular plate of ethmoid bone (Fig. 1). No abnormality was seen in the greater alar cartilage, upper lateral cartilage and the bony septum.

Mucosal thinning of the concha was revealed in 16 patients (76.2%) and this was presented unilaterally in 12 patients. Among the nasal conchas, the inferior concha was most commonly involved and it was presented in nine of 16 patients (Fig. 2).

Ten of 21 patients (47.6%) showed paranasal sinus mucosal thickening. The maxillary sinus was involved in all cases and three patients also exhibited increased density in the ethmoid sinus. In seven patients, nodular mucosal thickening of the maxillary sinus was seen (Fig. 3). Complete opacification or air fluid level was revealed in three patients. One patient had a cyst or polyp in the right maxillary sinus.

Among the 21 patients with septal perforation or thinning, 11 patients had both mucosal thinning of the conchas and paranasal sinus mucosal thickening. Five

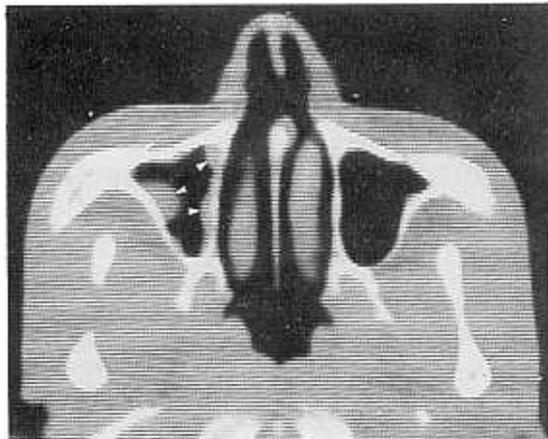


Fig. 3 Axial CT section at the level of the maxillary antra and inferior conchas shows nodular mucosal thickening of right maxillary sinus (arrowheads).

patients had only mucosal thinning of the conchas. The remaining 5 patients had no lesion of the conchas and paranasal sinuses.

## DISCUSSION

Inadequacy of the ventilation systems accounted for the excessive concentration of chromic acid in mists throughout the chrome plating factories. If the workers do not wear protective masks, they are exposed to inhalation of excessive chromic acid. The principal toxicologic reaction sites are the skin, upper respiratory tract, larynx, lung, kidney, liver, and gastrointestinal tract (Kleinfeld *et al.* 1965; Stokinger 1981). It is well known that chromic acid ( $\text{CrO}_3$ ) is a highly corrosive and toxic substance among chromium compounds. Its capacity to precipitate protein accounts for the highly acidic and corrosive action resulting in ulceration and perforation of the nasal septum (Stokinger 1981).

Mancuso (1951) reported the incidence of septal perforation in chromium intoxication as 63% (61 of 97 cases), chronic chemical rhinitis 86.6% and nasal polyp 2.1% and he also reported 2 cases of destruction of the bony septum. Anatomically, the marginal portion of the septal cartilage is thicker than the central portion and the sphenoidal process of the cartilaginous septum is very thin. In our cases, the most frequent site of septal perforation was mid portion, that is, the thinner area of the cartilaginous septum. The extent of perforation was varied in each case.

But there was no case of destruction of the other

Table 1. CT findings of the nose and paranasal sinuses in 21 patients with chromium intoxication

Location	Findings	No. of patients(%)
Septal cartilage	1. Perforation	20 (95.2)
	lower	2
	lower & mid	1
	mid	12
	mid & upper	5
	2. Sheet-like thinning	1 ( 4.8)
Nasal conchas	1. Normal	5 (23.8)
	2. Thinning of the mucosa	16 (76.2)
	unilateral	12
	bilateral	4
	inferior	9
	inferior & middle	5
	middle	2
Paranasal sinuses	1. Normal	10 (47.6)
	2. Mucosal thickening	10 (47.6)
	3. Cyst or polyp	1 ( 4.8)

nasal cartilage and the bony septum. We believe that perforation of the septal cartilage without concomitant destruction of the greater alar cartilage could be explained by fact that the former is covered by mucosa while the latter is covered by skin.

Of 21 patients, 16 (76.2%) had mucosal thinning of the nasal conchas. Though there was no pathological proof of atrophy of the mucous glands, this finding might be a manifestation of chronic chemical rhinitis.

Mancuso (1951) reported that 37% of 97 cases had some involvement of the paranasal sinuses, directly related to a predominant exposure to soluble chromium, and he reported the incidence of thickened mucosa of the paranasal sinuses as 27%, polyp or cyst 7.9%, and fluid in the antrum 2.2%. In our cases, 47.6% had paranasal sinus mucosal thickening. One patient had a cyst or polyp in the right maxillary sinus. The maxillary sinus was frequently involved and the main finding on CT scan was nodular thickening of the mucosa. We suspect that mucosal thickening, a cyst or polyp of the paranasal sinuses may be due either from the extension of mucosal inflammation of the nose or incidental findings unrelated to chromium inhalation.

Septal perforation may be caused by many etiologic factors (Table 2) (Cody *et al.* 1981; Osborn *et al.* 1982). Usually differentiation from chromium intoxication is possible from the history, clinical and radi-

**Table 2. Causes of nasal septal perforation**

A. Trauma	
1. Surgical .....	submucous resecton
2. Nonsurgical .....	digital trauma, electrocautery, cocaine abuse, chemical inhalant
B. Granulomatous nasal lesion	
1. Infectious rhinitis	.... tuberculosis, syphilis, leprosy, aspergillosis, rhinoscleroma
2. Wegener's granulomatosis	
3. Sarcoidosis	
4. Idiopathic midline granuloma	

ologic findings. Granulomatous diseases of the nose and paranasal sinuses are relatively uncommon. These diseases involve the paranasal sinuses after first involving the nasal cavity (Bergeron *et al.* 1984). In the late stage of syphilis, gumma in the mucous membrane of the nose results in perforation of the posterior bony septum which is rare in chromium intoxication (Scully *et al.* 1985).

The changes of the nasal mucosa and paranasal sinuses in leprosy resemble any of the chronic granulomatous diseases. But destruction of the anterior nasal spine of the maxilla is pathognomonic of leprosy (Bergeron *et al.* 1984). An aggressive form of aspergillosis occurs as a soft tissue mass in the nasal and sinus cavity with rapid, extensive bone destruction (McGill *et al.* 1980; Valvassori *et al.* 1988). Rhinoscleroma shows a granulomatous mass in the nasal cavity, destruction of bone and cartilage of the nose, and opacification of the paranasal sinuses. These granulomas may present in a localized form or by aggressive extension through the nasal bone extranasally (Becker *et al.* 1981; Shum *et al.* 1982). More than 90% of Wegener's granulomatosis cases involve the nose and paranasal sinuses, showing pansinusitis with destruction of the nasal septum and conchas. In severe cases, erosion of the wall of the sinuses can occur (Fauci *et al.* 1973, 1983; Kornblut *et al.* 1982; Valvassori *et al.* 1988). Nasal sarcoidosis may occur in 3 to 20% of systemic sarcoidosis. It involves the nasal skin, mucosa, and bone separately or simultaneously and shows multiple small granulomas of the septum and turbinates. But the CT features are nonspecific and consist of polypoid tissue in the nasal cavity and polypoid thickening of mucosa of the sinus (Gordon *et al.* 1976; McCaffrey *et al.* 1983; Valvassori *et al.* 1988). Idiopathic midline granuloma is characterized by

chronic necrotizing inflammation of the nose, paranasal sinuses, midline facial tissues, and upper airways. But radiologic findings are nonspecific (Bergeron *et al.* 1984).

As compared with characteristic features of the granulomatous diseases, septal perforation in chromium intoxication could be differentiated radiologically with regard to the absence of bony destruction and soft tissue mass.

## REFERENCES

- Becker TS, Shum TK, Waller TS, Meyer PR, Segall HD, Gardnen FC, Whitaker CW, Simpson WR, Teal JS, Hawkins DR: Radiological aspects of rhinoscleroma. *Radiol* 141:433, 1981
- Bergeron RT, Osborn AC, Som PM: *Head and Neck Imaging*. St. Louis, Toronto, The C.V. Mosby Company, 1984, 67
- Cody DTR, Kern EB, Pearson BW: *Disease of Ear, Nose, and Throat: A Guide to Diagnosis and Management*, Chicago, London, Year Book Medical Publisher, 1981, 233
- Fauci AS, Wolff SM: Wegener's granulomatosis: Studies in eighteen patients and a review of the literature. *Med* 52:535, 1973
- Fauci AS, Haynes BF, Katz P, Wolff SM: Wegener's granulomatosis: Prospective clinical and therapeutic experience with 85 patients for 21 years. *Annals of Internal Medicine* 98:76, 1983
- Gordon WW, Cohn AM, Greenberg SD, Komorn RM: Nasal sarcoidosis. *Arch Otolaryngol* 102:11, 1976
- Kleinfeld M, Rosso A: Ulcerations of the nasal septum due to inhalation of chromic acid mist. *Industrial Med and Surg* 34:242, 1965
- Kornblut AD, Wolff SM, deFries HO, Fauci AS: Wegener's granulomatosis. *Otolaryngologic Clinics of N Am* 15:673, 1982
- Mancuso TF: Occupational cancer and other health hazards in a chromate plant: A medical appraisal: II Clinical and toxicologic aspects. *Industrial Med and Surg* 20:393, 1951
- McCaffrey TV, McDonald TJ: Sarcoidosis of the nose and paranasal sinuses. *Laryngoscope* 93:1281, 1983
- McGill TJ, Simpson G, Healy GB: Fulminant aspergillosis of the nose and paranasal sinuses: A new clinical entity. *Laryngoscope* 90:748, 1980
- Osborn AC, McIlff EB: Computed tomography of the nose. *Head & Neck Surg* 4:182, 1982
- Scully RE, Mark EJ, McNeely BU: Case records of the Massachusetts General Hospital. *N Engl J Med* 313:1142, 1985

## CT Findings in Chromium Intoxication

Shum TK, Whitaker CW, Meyer PR: Clinical update on rhinoscleroma. *Laryngoscope* 92:1149, 1982

Stokinger HE: *Padly's Industrial Hygiene & Toxicology*. 3rd ed. A Wiley-Inter Science Pub, 1981, 1589

Valvassori GE, Buckingham RA, Carter BL, Hanafee WN,

Mafee MF: *Head and Neck Imaging*. 2nd ed. New York, Thieme Medical Publisher, 1988, 216

Valvassori GE, Mafee MF: Diagnostic imaging in otolaryngology II: Sinuses, neck, and temporomandibular joint. *Otolaryngol Clinics of N Am* 21:429, 1988

---