Bronchoscopy and Bronchography in Emphysema and Chronic Bronchitis* **

Demonstration of Morphologic Changes in an Attempt at Appraisal of Severity of Functional Impairment


Baltimore, Maryland

As times and investigative methods change and contrast media are improved, one is tempted to assemble the various findings and correlate them with the known pathologic alterations in chronic bronchitis and pulmonary emphysema. The following text and illustrations deal with certain aspects of morphologic findings as seen by the clinician in the course of a pulmonary study. This study is based upon routine bronchoscopic and bronchographic examinations performed in a general hospital of pulmonary orientation, and from a thorough workup of advanced pulmonary emphysema cases preliminary to a surgical, space-reducing, therapy approach. It afforded the present authors some unusually bizarre findings which, in the light of newer concepts of bronchitis in relation to pulmonary emphysema, may help the clinician to a better understanding of the mechanism of these disease entities.

Most of the bronchoscopic findings of mucosal thickening, edema, hyperemia, ulceration, the presence of various exudates, and deformity by scarring are well known to every endoscopist. These manifestations of chronic bronchitis, with or without acute exacerbations, are easily visualized on direct view. Other findings, such as dilated

*From the Medical and Surgical Departments and the Pulmonary Laboratory, Church Home and Hospital.

**This study was aided, in part, by research grant H-5219 on Pulmonary Emphysema from the Division of Research Grants, National Institutes of Health, U. S. Public Health Service.

Figure 1A

Figure 1B

Figure 1A: Drawing of telescopic appearance of openings of dilated bronchial glands. A portion of the left upper lobe orifice and the posterolateral wall of the left main bronchus are shown, with numerous areas of pitting. Figure 1B: Bronchographic demonstration of irregularly dilated bronchial glands in the floor of the left upper lobe bronchus; advanced emphysema case.
openings of hypertrophied bronchial mucous glands, atrophic ridges of the mucosa, or true diverticula are seen only with the aid of telescopic magnifications. Dilated mucous gland openings present themselves as small circumscribed areas of pitting, minute holes or sharply defined sinus tracts (Fig. 1A). In a series of 315 consecutive bron-
choscopies, such openings were seen and described in the operative reports in 106 cases or 33.6 per cent. Of those cases in which there was evidence of dilated mucous glands, 61 per cent occurred in the left bronchus and its visible subdivisions, 67 per cent in the right bronchus; therefore 28 per cent of the total showed this endoscopic finding bilaterally. Confirmation of the presence of dilated gland openings may be obtained bronchographically in more than 90 per cent of instances.3

They appear as small outpouchings which are often round and regular, sometimes irregular (Fig. 1B), or in concertina fashion as shown elsewhere.4 At times they are seen next to diverticula or a diverticulum-like cystic structure (Fig. 1C). Histologically (Fig. 1D), there is evidence of dilatation of the gland openings and the gland ducts, as well as hypertrophy of the still functioning gland tissue in the submucosa.

Although the demonstration of such dilated mucous glands is universally accepted as accompaniment to chronic bronchitis,5 this finding also has been seen frequently in emphysema.6 Whereas in many cases there was a cough productive of sizable quantities of mucopurulent sputum, the same condition also was found in relatively dry cases. This would invariably indicate the presence of a catarrhal process in the distant past.

Bronchography in emphysema cases with or without associated clinical bronchitis shows a variety of morphologic details. In addition to outpouchings previously described, a serrated or saw tooth appearance of the bronchial wall can frequently be seen (Fig. 2). This represents atrophic segments of the diseased bronchial mucosa. Other findings seen bronchographically as a sign of chronic bronchitis consist of: (1) intermittent slight to moderate constrict-
tions and dilatations of the divisional bronchi from the secondary to the fifth or sixth generation, a finding described as *beading*; (2) constrictions upon the point of ramification; (3) secretory plugs; (4) secretory stops, also called *broken bough* pattern, a symptom of disturbed bronchial motility (Fig. 3); (5) irregular tapering of the distal bronchi, indicative of organic narrowing and obstruction of the smaller bronchi (Figs. 6 and 7).

In other instances the previously enumerated signs are less pronounced but still present, though overshadowed by attenuation of the localized bronchial segments which suggest a bronchospastic component. In the more advanced cases of chronic bronchitis, the term *chronic deforming bronchitis* seems more appropriate. The process of diffuse organic bronchial wall changes shows the outline of all bronchi uniformly *ragged*, with the peripheral branches revealing severe constrictions and dilatations resembling a true string of beads (Figs. 4A and 4B). Here the term bronchiolectasis is truly appropriate. The most advanced cases already show diffuse parenchymal changes simulating advanced pulmonary fibrosis or diffuse fibrocavitary disease (Fig. 5A). On bronchographic visualization the severest degree of deforming bronchitis is found together with diffuse distal bronchiectasis, sometimes known as varicose bronchiectasis. The histology of the lung parenchyma (Fig. 5B) shows extensive infection with obliteration of the alveolar structures, combined with drastic changes in the bronchial and bronchiolar walls, as well as plugging by inert secretions.

**Figure 5A:** Bronchogram, right half, of a 54-year-old female whose roentgenogram showed a diffuse infiltrative and suggestive cavitary process. Bronchographically, there is evidence of the severest form of diffuse chronic deforming bronchitis, with transition to diffuse bronchiectasis. **Figure 5B:** Histology of lung biopsy, indicating replacement of lung parenchyma by leukocytic and lymphocytic infiltrate, fibrosis, and numerous bronchioles, showing inflammatory wall changes and mucous plugs obstructing lumina; also presence of fibrosed, narrowed arteriole.
**Figure 6:** Closeup oblique view of a bronchogram of a 50-year-old railroad worker suffering from severe obstructive and restrictive emphysema, showing numerous areas of pooling. Variously sized pools are demonstrated; the larger ones showing a distinct lobulated appearance (arrow).

**Figure 7:** Bronchogram of a case of severe emphysema in a 50-year-old female, showing large areas of irregular pooling together with deforming bronchita and leafless tree pattern, also organic tapering of diseased bronchi.

**Figure 8:** Bronchogram of a case of moderately severe obstructive emphysema, in a 52-year-old physician, showing the pattern of leafless tree with fruit, indicating numerous evenly sized peripheral pools. Also broken bough appearance of many bronchial branches and bronchospastic attenuation of many peripheral branches.
In cases of what clinically is considered primarily emphysema, any of the previously cited bronchial abnormalities can be frequently found on bronchographic examination. There is, however, a persistent finding, the origin of which is still disputed. Multiple areas of pooling or lilies of the valley (brin de muquet, mugheotto, in French and Italian, respectively), can be seen (Fig. 6). These areas, mostly spherical in shape, usually measure about 2 mm. in diameter, but can be much smaller or a great deal larger. A study of some of the larger areas of pooling (Fig. 6) reveals a distinct lobulated appearance, suggesting that the wall of these pools actually represents dilated, distended alveoli. Although Reid originally demonstrated the pools to be dilatations of small bronchioles with obliteration beyond, she thus confirmed the term bronchiolectasis as suggested by Di Rienzo. 

In a symposium on chronic bronchitis and emphysema the damage leading to a certain type of destruction emphysema is described as occurring at the bronchiolo-respiratory junction (terminal bronchiole). Gough, in his concept of centrilobular emphysema, places the area of destruction
in the respiratory bronchioles. The pattern of pooling, a bronchographic pattern seen in the living (Figs. 6 and 8) strongly suggests that this is a manifestation of a stage in the extension of centrilobular emphysema, where the destruction of centrally located respiratory bronchioles within the secondary lobule leads to an area of common pool. In some of the advanced cases of emphysema, the pooling pattern is irregular (Fig. 7). This would indicate such a high degree of loss of elasticity that there is no longer a spherical configuration discernible. It would more simply explain what has been labeled a mimosa-like pattern. In many cases of emphysema one finds the pattern of leafless tree with fruit (Fig. 8), which is another descriptive term for areas of pooling combined with incompletely dividing peripheral branches. The tree stump or dead tree pattern indicates marked interference with peripheral filling caused by diffuse bullous emphysema of great extent.

Pulmonary function studies indicate that the larger the areas of pooling, the more drastic and irreversible are the changes. Cases of minute pooling, associated with attenuation of the bronchial divisions (Fig. 9), yield function studies suggesting moderate obstructive changes which are completely reversible by bronchodilators.

Bronchography in localized bullous or cystic emphysema renders an invaluable service in demonstrating the narrowing and elongation of the respective segmental bronchi (Fig. 10), as well as the displacement and crowding of the unaffected branches. The presence of numerous areas of pooling confined to one (posterior) segment of the affected upper right lobe of the lung, with bullous changes demonstrated in the other segments (apical and anterior), poses an unanswered question as to the mechanism of the development of single bullous cysts.

Summary

An attempt is made to review briefly certain morphologic features of chronic bronchitis and pulmonary emphysema as they appear on bronchoscopic view and on bronchographic films. The frequency of endoscopic visualization of dilated bronchial gland openings occurring in 33.6 per cent of 315 consecutive bronchoscopies is emphasized. As a rule, the dilated glands may be demonstrated in 90 per cent of corresponding subsequent bronchograms. This evidence of present or past instances of chronic bronchitis is observed in conjunction with a multitude of unusual bronchographic findings, the more severe of which add up to what properly should be termed chronic deforming bronchitis. The transition to true bronchiolectasis or to diffuse bronchiectasis is demonstrated. A bizarre finding of pooling frequently seen in bronchograms of emphysema cases is briefly correlated with the most recent concepts of the pathology of emphysema. There is a suggestion that the size of the peripheral pools is directly proportionate to the extent of emphysema, and that reversibility of impaired pulmonary function can only be hoped for in those cases showing minimal and minute pooling collections. Finally, in single bullous cysts the value of bronchography in demonstrating bronchial position and displacement is emphasized.

Resumen

Se intenta revisar ciertas características morfológicas de la bronquitis crónica y del enfisema pulmonar tal como aparecen a la broncoscopia, así como en la broncografía.

La frecuencia de la visualización endoscópica de las glándulas se hace notar; esto ocurre en 33.6 por ciento de 315 broncoscopías consecutivas. Como regla las glandulas dilatadas pueden demostrarse en 90 por ciento de broncogramas subsiguientes. Esta evidencia de casos actuales o anteriores de bronquitis crónica se nota en conjunción con multitud de hallazgos broncográficos insustituidos. La forma más severa de estos hallazgos se podría llamar bronquitis crónica deformante. Se demuestra la transición a la verdadera bronquiectasia o a bronquiectasia crónica difusa. Un hallazgo sorprendente de la formación lagunar vista frecuentemente en los bronchogramas de enfisema se correlaciona con los hallazgos mas recientes de la patología del enfisema. Hay una sugestión en el sentido de que el tamaño de las lagunas periféricas es proporcional directamente a la extensión del enfisema y que reversibilidad
de la fonction, détériorée du poumon peut s'esperer pour les cas qui tengan mínima colección lagunar. Finalmente se reca, en los quistes bulosos simples el valor del la broncografía para demostrar la posición bronquial y el desalojamento.

**RESUME**

L’auteur a essayé de passer brièvement en revue les caractéristiques morphologiques de la bronchite chronique et de l’emphysème pulmonaire, telles qu’elles apparaissent à la vision bronchosкопique et sur les clichés bronchographiques. Il insiste sur la fréquence de la vision endoscopique d’orifices de glandes bronchiques dilatées, constatée dans 33.6% des cas sur un total de 315 bronchoscopies. En règle, la dilatation des glandes peut être mise en évidence dans 90% des bronchogrammes correspondants. Cette preuve de l’existence d’une bronchite chronique actuelle ou passée se trouve associée à une multitude de symptômes bronchographiques inhabituels, les plus sévères d’entre eux s’additionnant pour former ce qu’on pourrait proprement appeler *bronchite chronique déformante*. Le passage à la vraie bronchiolectasie ou à la bronchectasie diffuse est mis en évidence par l’auteur. Une curieuse constatation de groupements fréquemment vus dans les bronchographies d’emphysème est sommairement reliée aux concepts les plus récents d’anatomie pathologique de l’emphysème. L’auteur suggère que la dimension de ces groupes périphériques est directement proportionnée à l’étendue de l’emphysème et que la réversibilité du trouble de la fonction pulmonaire peut seulement être espéré dans ces cas qui montrent des groupement minimes. Enfin, dans les kystes bulleux isolés, l’auteur insiste sur la valeur de la bronchographie pour mettre en évidence la position bronchique et le déplacement.

**ZUSAMMENFASSUNG**


**REFERENCES**