Pathogenesis of So-called Idiopathic Spontaneous Pneumothorax and Related Conditions*

A. SATTLER, M.D., F.C.C.P.
Vienna, Austria

Since the research work of Fischer-Wasels by anatomic methods, we know that in the pathogenesis of so-called idiopathic spontaneous pneumothorax certain bullae, situated on the surface of the lung, play an important part. Later our concept was further extended by pleural endoscopy which made possible not only exact diagnosis, but also effective therapy. We learned by means of biopsy that the bullae can be small or large, even gigantic, usually multiple, but sometimes isolated, particularly the large kind. The bullae are by no means limited to the apex; they may also be found on the whole surface of the lung. The bulla arising from a cicatrized region is a very frequent phenomenon but not necessarily so.

According to general opinion the beginning of spontaneous pneumothorax based on bullae, comes from the rupture of a bulla. This has been proved by anatomy, endoscopy and by operation. There can, therefore, be no doubt concerning this mechanism of the origin of spontaneous pneumothorax. There also can be no doubt that another mechanism exists, that is the permeability of a bulla—without rupture, and without collapse of the latter. In 1940 I established in a monograph,† concerning spontaneous pneumothorax, that a bulla with a very attenuated wall is able to produce and maintain chronic pneumothorax without any previous rupture.

This conclusion was founded on observation with the endoscope. Before the operation it had been determined by the intrapleural pressure that the air had not ceased to escape from the lung. Endoscopy showed one solitary bulla of a gigantic size, originating in the inferior lobe of the right lung with greatly attenuated walls and in a state of tension. This was treated successfully by local irritation of the bulla.

The hypothesis of passage of air through the visceral pleura which has become thin, without macroscopic lesion is not without analogies. Sohminccke in 1924 describes a case in which he supposed the pleura to be permeable because of defective develop-

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ment. Lately Brock, based on operative results, described a "porous pleura."

Recently I have observed two cases, following closely on each other, which by clinical and biopsy findings proved the permeability of certain bullae.

Case 1: Sch., aged 30. There was a question of a tuberculous infiltration of the left lung. Artificial pneumothorax was established and completed on November 25, 1949, by a Jacobaeus operation. At the end of the operation one solitary bulla of the size of a chestnut was visible in the inner part of the apex of the totally collapsed lung. When leaving the hospital, the attention of the patient was drawn to the possibility of spontaneous pneumothorax. On January 17, at 11 p.m. the expected accident took place, while the patient was in bed. She felt a sudden oppression on the left side. Next day a control proved a slight increase of the intrapleural pressure and a pronounced collapse. Some exsufflations relieved the patient but only temporarily. For this reason endoscopy was done on February 16, 1950. We were surprised to find the bulla in its whole size tender and protruding but with no adhesions or other remarkable change. After local irritation of the bulla and repetition of this procedure, the intrapleural pressure and collapse of the lung became normal.

Case 2: This is the case of a woman R. M., aged 49. At the age of 20 she suffered from apicitis and in 1939 of spontaneous pneumothorax of the right side for three weeks. At the beginning of 1949 she had a recurrence on the same side. The pneumothorax was benign, not very large, and circular with moderately elevated pressure.

In the right apex were a few cicatrices of no great importance. In the right eye was a chronic tritis supposed to be specific. After six weeks of irritation therapy the lung reexpanded. In April 1950, the third attack occurred. She was sitting in an armchair and suddenly felt pain on the right side. This time the pneumothorax was larger and the intrapleural pressure was above zero. The x-ray film revealed evidence of quite thin adhesions. On April 27, 1950, it was surprising to see a nearly infinite number of thread-like adhesions which suspended the superior lobe. Below the apex on the anterior surface of the lung there was a solitary bulla the size of a prune, very taut and fixed by a group of adhesions in the cupula of the pleura. After section of the adhesions the bulla remained taut and its shape did not change. Half an hour later, when the total section was concluded, a renewed inspection of the bulla showed that it had distended but not collapsed and that it was in a lower position. Next day the intrapleural pressure was negative, two months later there was complete re-expansion of the lung. What is certain in this case is, that there was no gaping fistula held open by fixing adhesions, as is usually presumed in medical literature and which occurs sometimes if there is a torn bulla. Here the bulla was macroscopically intact, it remained tightly stretched immediately after section and only at the end of the operation it had distended but not collapsed.

I conclude from this that it was a permeable bulla. The adhesions acted as a valvular mechanism in the bronchioles belonging to the bulla. After their section the mechanism of the valve was
abolished and the pressure in the interior of the bulla corresponded again to the pressure in the interior of the lung. This is why air ceased to escape through the permeable bulla.

**SUMMARY**

There exists two forms of so-called idiopathic spontaneous pneumothorax. One is very benign and due to a sub-pleural bulla which has become permeable. The intrapleural pressure is moderately increased; the volume of air escaping through the bulla is small. Soon an equilibrium is established between the pressure of the bulla and that of the pleural cavity which limits the outgoing air. The part played by the adhesions consists of favoring the genesis and the swelling of the bulla. It is the nature of this benign form that there is never any pleural effusion or hemothorax. Evacuation of air gives real relief and continual drainage is not necessary. In these chronic or recurring cases pleural irritation appears indicated, and in cases of adhesions, their section.

The beginning of pneumothorax of this kind does not necessarily depend upon a mechanical factor. The moment when the bulla becomes permeable depends on the degree of attenuation or thinness of the wall.

Exceptionally the clinical situation is a dramatic one in case of bilateral pneumothorax, in the presence of serious lesions of the lung, of myocardial disease, or of aged patients. At necropsy, the pathologist endeavors in vain to find a torn bulla as I have witnessed many times.

The clinical picture of the second form of spontaneous pneumothorax is due to a ruptured bulla or laceration of pulmonary tissue, which is usually serious. Pressure is considerably increased and the lung greatly collapsed, while the mediastinum is deviated. Aspiration of air has a palliative effect since the volume of air coming from the bronchioles without the intermediary of a tightly stretched bulla is of importance. In order to save the patient's life, one must in some cases establish a continual drainage. The part played by adhesions is important in the pathogenesis of rupture of bullae and other lacerations. The starting of pneumothorax by physical effort or trauma is significant. Hemothorax or pleural effusion can occur because of the lesion of the lung and of the direct communication of the bronchial tree with the pleural cavity.

**RESUMEN**

Existen dos formas del llamado neumotórax espontáneo idiopático. Una es muy benigna y es debida a una bula subpleural que
se hace permeable. La presión intrapleural es moderadamente aumentada; el volumen de aire que escapa a través de la bula es pequeño. Pronto se establece el equilibrio entre la presión de la bula y la del espacio pleural, lo que limita la salida de aire. El papel desempeñado por las adherencias consiste en que favorece la génesis y la infiltración de la bula. En estos casos nunca hay derrame pleural o hemotórax. La evacuación del aire produce alivio y el drenaje continuo no es necesario. En estos casos crónicos o recurrentes la irritación pleural parece indicada y en casos de adherencias está indicada su sección.

El principio del neumotórax de esta clase no depende necesariamente de un factor mecánico. El momento en que la bula se perfora depende del grado de adelgazamiento de la pared de ella.

Excepcional la situación clínica es dramática en caso de neumotórax bilateral en presencia de serias lesiones del pulmón, de afecciones del miocardio o en personas de edad avanzada. En la necropsia el patólogo trata en vano de encontrar la bula desgarrada como lo he presenciado muchas veces.

El cuadro clínico del segundo tipo de neumotórax espontáneo se debe a una bula rota o laceración del tejido pulmonar que generalmente es seria. La presión aumenta considerablemente y el pulmón muy colapsado y el mediastino desviado. La aspiración de aire tiene efecto paliativo puesto que el volumen de aire viéndolos bronquiolos sin interposición de una bula distendida es de importancia. Para salvar la vida del enfermo se debe establecer el drenaje continuo. La importancia de las adherencias es grande en la patogenia de la ruptura de la bula y en otras laceraciones. El inicio del neumotórax por un esfuerzo o trauma es significativo. El hemotórax o el derrame pleural pueden ocurrir a causa de la lesión pulmonar y por la directa comunicación del arbol bronquial con la pleura.

RESUME

Il y a deux catégories du pneumothorax spontané et idiopathiques. L'une est très bénigne, elle est due au fait qu'une bulle sous-pleurale est devenue perméable à l'air qu'elle contient. La pression intra-pleurale est modérément augmentée, l'air qui s'échappé de la bulle est d'un volume réduit. Vite s'établit un équilibre entre la pression de la bulle et la pression de la cavité pleurale, et cet équilibre limite l'issue de l'air. Les adhérences jouent un rôle en favorisant la création de la bulle et son gonflement. Dans ces formes bénignes, il n'y a jamais épanchement pleural ou hémotorax. La simple évacuation de l'air donne une guérison véritable, et il est inutile de mettre le malade en drainage continue. Dans
les cas chroniques ou récidivants, l'irritation pleurale est indiquée. S'il y a des adhérences, elles doivent être sectionnées.

La création d'un pneumothorax de cette catégorie ne dépend pas nécessairement d'un facteur mécanique. La bulle devient perméable au moment où se constitue une diminution suffisante de l'épaisseur de sa paroi.

Exceptionnellement la situation est dramatique. Il s'agit alors de pneumothorax bilatéral, de lésions pulmonaires importantes, d'atteinte myocardique, ou de malades âgés. À l'autopsie, les constatations anatomo-pathologiques ne permettent pas de mettre en évidence la déchirure de la bulle.

Dans le second type de pneumothorax spontané, le tableau clinique est généralement sérieux. Il est en rapport avec une rupture de bulle ou une dilacération du poumon. La pression augmente considérablement, le poumon est violemment collabé, le médiastin est dévié. L'aspiration de l'air a un effet palliatif. Elle cesse d'agir quand le volume de l'air venant directement des bronches devient important. Il faut dans certains cas, pour sauver la vie du malade, mettre en œuvre un drainage continu. Le rôle joué par les adhérences est important dans l'origine de la rupture des bulles et des autres lésions. Il est significatif de constater qu'un pneumothorax peut se constituer après un effort physique ou un traumatisme. Un hémothorax ou un épanchement pleural peut survenir. Ces complications sont dues à la lésion du poumon et à la communication directe de l'arbre bronchique dans la cavité pleurale.