Contribution of Angiopneumography to Some Problems of Pulmonary Physiopathology*

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At the Eighth Panamerican Meeting of Tuberculosis (México, 1949), it was said: "The comparative analysis of results obtained with both techniques, angiopneumography and bronchospirometry, is worthy of interest."1

In a similar way, at the Third Interamerican Meeting of Radiology (Santiago, Chile, 1949) it was established, as proposed by one of us, that angiocardiology may well serve to study pulmonary and circulatory physiology and phisiopathology.2

Recently it has been said3 that "angiocardiology allows to appraise lung functional value through the study of intrapulmonary vascularization."

The present paper deals with 41 angiopneumographic studies made on 37 patients with different pathological lung conditions which, with some exceptions, were of tuberculosis origin. A comparative study between angiopneumography and bronchospirometry has been made on 24 patients; in all of them appearance of the pulmonary circulation has been studied.

Comparison Between Angiopneumographic and Bronchospirometric Studies

Materials and Methods: We have intentionally selected different pathological conditions in which we could expect to find a diminished respiratory function. The pathological conditions existing in the aforementioned 24 patients were as follows:

I. thoracoplasty: 2 cases,
II. fibrothorax: 2 cases,
III. pachypleuritis: 6 cases,
IV. partial stenosis of the main bronchus: 1 case,
V. bilateral ulcerative tuberculosis: 4 cases,

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VI. pneumothorax: 7 cases (the stump was radiologically clear in three cases, partially clear in two cases and definitely opaque in two cases),
VII. reexpanded lung (after phrenicoparalysis and not complicated pneumothorax): 1 case,
VIII. ligature of the left branch of the pulmonary artery: 1 case.

We have followed the techniques presented in a former paper.4*

Results and Discussion: Within four seconds after the end of the injection, four films are obtained: normally, the main and segmental branches of the pulmonary artery may be seen in the first or second film and their arborizations may be followed up to the peripheral limits of the lung [Figure 1 (2)]. The venous circulation normally appears from the third film on, with more intensity in the last films as the arterial shadows become indistinct; the venous shadows present a characteristic mottling. The main veins may be seen in some cases, more caudally than the arterial main branches [Figure 1 (4)]. Localized modifications of the blood vessel shadows and changes

*Angiocardiography with a ventrodorsal x-ray projection was performed according to the Robb-Steinberg technique, with injection in the arm vein of 40 cc. of 70 per cent solution of the x-ray opaque substance as the standard adult dose. The numbers in the figures indicate the order of the films in the angiocardiographic series. In 180 cases studied for different purposes we have not had any important accident.

FIGURE 1: Normal anglopneumogram. (2) Note contrast of the right heart cavities and of the arterial pulmonary trunk; one can easily see the two arterial pulmonary branches and the arterial branches of the second, third, fourth and fifth order. (4) One can easily see the venous branches that flow together in the four pulmonary veins, which are in a more caudal plane than the two arterial branches; note also the left heart cavities and the aorta.
in the chronology of their development are seen in these different pathological conditions. Sometimes it is possible to see the reduction, even the complete absence, of vascular contrast in a certain region (Figures 2a and 2b), and in some cases we have observed the complete absence of the circulation of one lung (Figures 3a and 3b). It is also possible in some areas to see well contrasted arterial branches, even in the last films, when the majority of the arterial shadows have been replaced by the venous shadows in normal areas; in these cases the general appearance is similar to the one called "winter tree appearance" in bronchographic study (Figures 4a and 4b). This particular appearance is due to the partial stoppage of the contrasting fluid in some arterial branches, as a result of circulatory impediment localized in the small arborizations.

The bronchospirrometric tests were always performed within a few days of the angiopneumographic tests and, in the pneumothorax cases, it was tried to obtain the two tests with the same degree of collapse.

From our researches two important facts stand out which are evident in Figures 3, 4, 5, 6 and 8, some of the more characteristic cases.

**FIGURE 2:** (A) Refers to a case of a small cavity of the upper third of the right lung; a decrease of the contrast and an amputation of some vascular branches of the third order can be observed in the area corresponding to the process. (B) Corresponds to a case of a large cavity of the apex of the right lung; decrease of the contrast and amputation of the greatest part of the vascular branches corresponding to the upper third of the right lung can be noticed.
First: in the areas where the absence, the decrease or the delay of vascular contrast reveal that the circulation is lacking or scarce, there exists a proportional reduction in the oxygen consumption which is easily explained, it being that the local diminution of the blood flow causes a reduction in the gaseous interchange.

The other fact, different from the first, but closely related to it, is that in the lung where the respiration (oxygen consumption) is diminished, there always exists a parallel reduction of the circulation. This last observation helps to decide the debate existing on this problem, improperly called the pulmonary short-circuit (shunt). This problem brings up for discussion the fact of whether it is possible that a functionally important circulation could persist in certain pathological conditions which affect the gaseous interchange of a more or less large area of the lungs. It is clear that if this happened the venous blood passing through this area would arrive at the left heart without being oxygenated and would abnormally decrease the degree of the arterial oxygen saturation.

Many authors still give great importance to this possibility during the course of certain pulmonary diseases; on the contrary, others are opposed to this thesis. In 1934 Bjorkman5 wrote: "It is probable that a reduction in oxygen consumption, which has been shown bronchospirimetrically in almost all unilateral lung conditions, is related to a corresponding reduction in blood circulation in the affected areas, with an increased circulation in the unaffected lung."

FIGURE 3: (A) Corresponds to a case of left upper thoracoplasty; circulation, evidently increased, is found only in the right lung; in the left thoracoplastied lung no arterial or venous branch is seen. In parallel form oxygen consumption is found only in the right lung. (B) Refers to a case of ulcerated fibrothorax due to pleural effusion; "amputation" of the left branch of the pulmonary artery; increased circulation in the healthy lung. In parallel form oxygen consumption is found only in the right lung.
The veracity of the latter statement arises clearly from our findings. In effect, according to them, the possibility that appreciable quantities of blood cross some pulmonary zones without being oxygenated is (if it exists) of secondary importance in the pathological conditions studied and probably in all pleuro-pulmonary processes once stabilized.*

In reality the pathological anatomy shows that the processes studied and similar others, have a tendency to reduce the number, the elasticity and the caliber of the pulmonary vessels, in other words, to increase the resistance of the local circulation. If we keep in mind that the possible derivations of the pulmonary circulation are very abundant, we can deduce that any pathological process, parenchymatous or pleural, which causes a small local increase of the vascular resistance in the lung, lobe or segment, forces the blood to deviate in a greater or lesser quantity from the damaged areas towards the healthy areas, where that resistance is less; this easily produces a localized circulatory deficit with a corresponding decrease in oxygen consumption. On the other hand, the local decrease of oxygen absorption could produce, reflexly, a deficit of the flow in the damaged area.

From the theoretical viewpoint it is convenient to remember in this respect the studies of von Euler and Liljestrand6 who experi-

*From this we naturally exclude those processes as arterio-venous aneurysms of the lung, in which a real short-circuit in the parenchyma exists.

FIGURE 4: Ulcerated cirrhotic pleural and pulmonary process of one half of the left lung. In this lung one only observes the inferior lobular arterial branch, that appears late (A) and that maintains its invariable aspect in the rest of the plates (B) (sluggish flow). Circulation is essentially found only in the right lung; in parallel form oxygen consumption is only found in the right lung.
mented with cats breathing in an atmosphere of low oxygen concentration and found an increase in the pressure of the pulmonary artery which they attributed to a generalized constriction of the pulmonary vessels due to direct action of the anoxia on the vessel walls.

From the practical viewpoint the question arises as to whether poorly irrigated areas regain their function when circulatory re-

FIGURE 5: Two cases of left postpneumothoracic pachypleuritis. In both cases absence of irrigation is found in the upper half and sluggish circulation in the lower half of the left lung. In a corresponding form the oxygen consumption is very much decreased in the left lung.

FIGURE 6: Right therapeutic pneumothorax with clear stump. Normal circulation in the left and good arterial (1) and venous (3) circulation in the right stump. In a corresponding form the oxygen consumption is good in the right stump.
sistance increases in formerly healthy or less diseased areas, or when the latter areas have been suppressed by a surgical intervention.

The bronchospirometrical method allows the obtaining of partial data, useful in the study of the respiratory function. It has the advantage of being quantitative, but it also has the inconveniences of being rather bothersome for the patient and of requiring skill on the part of the technician. Some mistakes are also possible.

The angiopneumographic method is apparently qualitative, but allows a global appraisal of the function not only of each lung, but also of each pulmonary segment; besides, it is simple to execute and, consequently, useful in a greater number of cases.*

Angiopneumographic Study in Different Pathological Processes of the Lung*

The studied material is distributed in the following way:

I. ulcerative tuberculosis: 4 cases,
II. unilateral pneumothorax: 13 cases,
III. bilateral pneumothorax: 1 case,
IV. re-expansion of the lung after pneumothorax: 8 cases,
V. pachypleuritis: 6 cases,
VI. fibrothorax: 2 cases,
VII. partial stenosis of a main bronchus: 1 case,
VIII. total atelectasis: 5 cases,
IX. pulmonary decortication: 2 cases,

I. Ulcerative tuberculosis: We have studied four cases: one with small cavities in both apices, the remaining three with unilateral cavity.

From results obtained in this group of patients, we can deduce that an appreciable decrease of irrigation (even the complete suppression in cases of important or ulcerative lesions) exists in diseased areas of the tuberculous lung (Figures 2a and 2b); this agrees with the observations of Ameuille et al.9 and of Cels et al.7

*While this was being written, we received a paper by Cells et al.7 and our conclusions agree perfectly with theirs.

We just prefer our technique to the one used by the Mexican authors. who introduce a catheter, through the previously exposed jugular vein, up to the right auricle. Using this method, they naturally obtain less dilution of the opaque substance and, for that reason, better contrast and more perfect radiographies. Thus, a small surgical intervention, which obviously requires to be executed in a specialized centre, is necessary instead of a simple venous puncture.

Any kind of simplification in the technique, any possibility to practice it, without risk, in the greater number of cases, without any particular preparation or special care, is what really matters.
In the healthy areas of the affected lung the circulation is practically normal.

II. Unilateral pneumothorax: The study of the pulmonary circulation during pneumothorax has always been of great interest to lung specialists.

The first angiopneumographies, done for practical purposes, were obtained to clarify this problem by L. and A. de Carvalho. They found on four cases the existence of a direct relation between the degree of pulmonary compression and the diminution of the circulation, as well as an increase of the circulation in the healthy lung.

Later, Ameuille et al. observed that the circulation in the compressed stump was delayed and that sometimes it was not possible to find blood vessels in the stump.

Recently, Bourgeois et al. observed in eight cases of pneumothorax an extreme variability in the circulation of the collapsed lung.

Even more recently, L. de Carvalho insists that it is enough to introduce a very small quantity of air into the pleura to produce an important diminution of the circulation. We have studied 13 cases of unilateral pneumothorax, which have maintained in hypotension, with the following characteristics:

a) with a clear stump: 4 cases (Figure 6),
b) with a partially gray stump: 2 cases; one due to atelectasis, the other due to infiltration,
c) with a gray stump: 3 cases; one due to atelectasis, one due to

FIGURE 7: (A) Refers to a partial right pneumothorax with pachypleuritis of the stump; complete absence of irrigation in the stump and increased circulation in the healthy lung. (B) Corresponds to a partial left pneumothorax, with axilar symphysis; the stump shows in its lower part an opacity due to visceral pachypleuritis; absence of irrigation in the stump and very much increased circulation in the healthy lung.
visceral pachypleuritis (Figure 7a) and the last due to infiltration, visceral pachypleuritis and symphysis (Figure 7b),
d) complication with serofibrinous effusion: 2 cases (Figure 8),
e) complication with purulent effusion: 2 cases (Figure 9).

The results obtained agree almost completely with the conclusions of Celis et al.,7 who have found in patients with pneumothorax “a decrease, without abolition, in the functional pulmonary irrigation; this decrease is related to the extent of the tuberculous process, the degree of the collapse, its age, the existence of pleural effusions, the thickening and stiffness of the visceral pleura.”

Evidently the values of the pleural pressure, determining the degree of the collapse, also have a certain influence on the circulation, according to the opinion of L. and A. de Carvalho,10,12 but we believe that among all causes acting on the circulation of the collapsed lung, the processes of infiltration or atelectasis (before or after the beginning of the treatment), and especially pleural complications (which can even abolish the functional circulation in the stump), all of them have a particular importance.

III. Bilateral pneumothorax: We have accomplished an angiopneumographical study in just one case, which we believe to be the first in medical literature. It may be observed in this case that the arterial and venous circulation is the same in both lungs,

FIGURE 8: Refers to a left hydropneumothorax, with good collapse and visceral pachypleuritis; in the right lung circulation is very increased; “amputation” of the left branch of the pulmonary artery. The broncospirogram shows that while the ventilation remains almost the same in both lungs, the hematosis (oxygen consumption) takes place practically only in the right lung.
which means that the resistance opposed by both stumps to the flowing of blood is practically the same (Figure 10).

IV. Re-expansion of the lung after pneumothorax: Of the eight cases studied, four were pneumothorax maintained without any parenchymatous or pleural complications during periods of time varying between 24 and 40 months. The remaining four refer to pneumothorax complicated by serofibrinous fluid.

The angiopneumographs we have done show in the first four cases only a moderate reduction in the circulation of the re-

![Figure 9: Left postpneumothorax empyemata. The left plate shows in the left lung an expansion of the pulmonary arterial branch, with few ramifications having the aspect of sluggish circulation. In the right plate, obtained one year after decortication, better irrigation in the left lung is observed, showing that its function has improved.](image)

![Figure 10: Bilateral pneumothorax, maintained in hypotension, with clear stumps with symphysis in both apices. The arterial (1) and venous (2) circulation of both stumps has the same character; the aorta appears from the second plate of the series on, showing that the circulation is accelerated.](image)
expanded lung (Figure 11) while the remaining ones (pneumothorax with complications) show a marked reduction of irrigation, which is rendered evident by the absence of arterial branches, as well as by the appearance of a sluggish circulation (Figures 5a and 5b).

This clearly proves that the collapse (even when maintained for a relatively long period) has a small influence on the circu-

FIGURE 11: Re-expanded lung after right pneumothorax maintained in hypotension during 30 months; a section of adhesions had been performed, without complications; re-expansion of the lung two months previously. Good arterial circulation (1) is noted in the right lung; the venous branches appear in the second plate (2). The good arterial and venous circulation in the right lung show that its function is good.

FIGURE 12: Total atelectasis. (A) Corresponds to a neoplasm of the left main bronchus. (B) Corresponds to a tuberculous lesion of the left main bronchus and thoracoplasty of nine ribs. "Amputation" of the left branch of the pulmonary artery is observed in both cases.
lation in the re-expanded lung, provided that pleural complications have not arisen. We want to point out that in three of the first group of four cases a section of the adhesions had been performed.

V. Pachypleuritis: Two of the six patients under observation suffered from right and four from left pachypleuritis. The beginning of the pleural process was the appearance of a serofibrinous effusion during pneumothorax in three cases; empyemata complicating the pneumothorax in one case; traumatic hemothorax in one case; and inflammatory pleural effusion, not treated, in one case. The first four patients were analyzed, when we studied the re-expansion of the lung, after complicated pneumothorax.

Not taking into consideration the factor causing the pachypleuritis, the results of these six observations are quite similar. In the affected area a great reduction of irrigation can be noticed, observing both the absence of the arterial branches and the sluggish appearance of the circulation (Figures 5a and 5b); this reduction (which is proportional to the intensity of the pachypleuritis) is much more important than could be expected through observations of ordinary plates. An increase in the irrigation may be observed in the opposite lung.

VI. Fibrothorax: Two cases were studied, both localized in the left lung: one started from the parenchyma and the other was the consequence of an untreated inflammatory pleural effusion.

In spite of the different origins they act in a similar way upon the circulation of the affected areas. As a matter of fact, the first case shows complete lack of irrigation in one half of the lung and sluggish circulation in the other half (Figure 4); the second case shows an "amputation" of the left branch of the pulmonary artery (Figure 3b). In both cases the circulation of the healthy lung is increased.

VII. Partial stenosis of a main bronchus: We have only been able to observe one case of pure bronchial stenosis, that is, without parenchymatous or pleural conditions which might, by themselves, influence the pulmonary irrigation.

In our case, the angio pneumography shows a sluggish and greatly reduced circulation in the lung with the stenosis; thus we cannot agree with the idea of a short circuit in such cases, as Vaccarezza and Soubré's support in their paper.

VIII. Complete atelectasis: The five patients studied had atelectasis of the left lung due to different causes: two were due to neoplasia of the main bronchus; two to total thoracoplasty, performed because of a tuberculous process of the lung; and one to tuberculosis of the main bronchus and total thoracoplasty.

In spite of the variety of provoking factors, the results of all these observations are very much the same. In all the cases one
can notice a real stoppage in the flow of the opaque substance at the branch corresponding to the pulmonary artery, which appears as “amputated,” without visible ramifications (Figures 12a and 12b). This stoppage is due very probably to the diffused resistance which the atelectatic lung offers to the flow of the blood, and not to an intrinsic or extrinsic arterial obstacle. In this group of cases too, the circulation of the healthy lung is increased.

IX. Pulmonary decortication: In two of the cases formerly analyzed, one in the group of pneumothorax complicated by empyema and the other in the group of pachypleuritis, we have been able to repeat the angio pneumographic examination after a pulmonary decortication. In both cases may be noticed a rather remarkable improvement of the irrigation, without reaching, however, the circulatory appearance of the opposite healthy lung (Figures 9a and 9b). This indicates an improvement in the pulmonary function.

Discussion

From the foregoing results, we deduce that the various processes of the lung which modify its structure, reduce in a proportional degree the irrigation of the affected parenchyma. The mechanism of this circulatory deficit has been already discussed by the authors and by Celis et al.7

The angio pneumographic examination is a faithful guide for the estimation of the local function of the lung in the different processes studied. We believe we have factual support to arrive at the following conclusions:

In accordance with our paper on bronchospirometry4 and with those of Pinner et al.,14 local pulmonary processes of the ulcerative exudative type cause a reduction in the respiratory function, which is moderate and proportional to the extent of the process.

Bronchospirometries, carried out by the authors4 and by Bjorkman5 and by Vaccarezza and Soubré,15 confirm that the pulmonary collapse in itself does not much reduce the respiratory function; this moderate reduction is proportional to the degree of the collapse. Bronchial, parenchymal and especially pleural complications are the cause of a very marked diminution in function, which in certain cases may even disappear.

In the expanded lung also, the pleural processes greatly influence the circulatory and respiratory functions, whatever the cause may be, either primary processes or complications of therapeutic pneumothorax (Bjorkman,5 Besançon et al.,16 Pinner et al.,14 Arnaud et al.,17 Vaccarezza and Soubré18).

The angio pneumographic examinations by Celis et al.7 and several bronchospirometric studies already mentioned, carried out almost all of them on patients suffering from pachypleuritis, fol-
lowing abandoned pneumothorax with resorbed effusions, might suggest the idea of the functional irreversibility of pneumothorax. On the contrary, we think, as some of our cases show, that all the collapse therapy methods, pneumothorax is the one which causes the least functional mutilation, provided a correct prescription and technique are followed in order to reduce its possible complications to a minimum.

In the cases of fibrothorax, in which the parenchymal cirrhosis is added to the pleural process, the respiratory function is practically reduced to zero.

Partial bronchial stenosis greatly reduces the function of the lung, as can be seen from our bronchospirometric study and those by Arnaud et al.\(^1\) and Vaccarezza and Soubré.\(^1\)

When the bronchial stenosis produces parenchymal atelectasis, the function reduces itself to zero. The same thing happens when the atelectasis is of surgical origin.

Pulmonary decortication reestablishes in a larger or smaller, but anyway definite, degree the function of the lung.

**SUMMARY AND CONCLUSIONS**

A comparative angiopneumographic and bronchospirometric study was done in a group of 24 patients with definite pathological conditions of the lung, that essentially affected only one lung.

We have observed a definite relation between both methods, in the sense of a reduction of both the respiratory and circulatory functions of the abnormal lung. The following interpretation is offered: the pathological condition induces parallel changes on the circulatory and respiratory function at the same time. The phenomenon of circulatory shunt in lung pathology becomes less important than it was formerly though.

It is probable that the angiopneumographic study will take the place of the bronchospirometric study at least in the majority of cases. In practice the first named study makes more complete the information obtained by the latter; it also presents the additional advantages of making possible an appreciation of the function of the different segments of each lung.

We have also done 41 angiopneumographies on 37 patients suffering from different pathological processes of the lung, almost all of them of tuberculous origin. Based on our results we arrive at the following conclusions:

1) In ulcero-exudative tuberculosis there exists a diminution of the respiratory function, which is moderate and proportional to the extent of the process.

2) In unilateral pneumothorax, maintained by hypotension, with a clear and elastic stump, one can notice a certain diminution of
the function; on the contrary the function is very much reduced or abolished in cases complicated by atelectasis of the stump or by serofibrinous or purulent pleural effusion.

3) Logically, when initial parenchymatous conditions are equal, the residual capacity of a lung, after the pneumothorax has been abandoned, is inversely proportional to the degree of the complications which might arise.

4) In pachypleuritis and in partial stenosis of a main bronchus, the respiratory function is very much reduced, much more so than could be expected through observation of ordinary plates.

5) The respiratory function disappears in fibrothorax and in cases of atelectasis.

6) Pulmonary decortication, carried out because of previous pachypleuritis, causes an improvement in the respiratory function, demonstrated by the improvement of the pulmonary circulation.

RESUMEN Y CONCLUSIONES

Se ha hecho el estudio comparado angioneumográfico y broncoespirométrico en una serie de 24 enfermos con intensos procesos patológicos que afectan predominantemente un solo pulmón.

Se ha observado una clara correlación entre ambos métodos, en el sentido de una reducción de las funciones respiratoria y circulatoria en el lado enfermo.

Se deduce que los procesos patológicos estudiados alteran al mismo tiempo las dos funciones, lo cual tiende a restar importancia al fenómeno del corto circuito en patología pulmonar.

Es muy probable que el examen angioneumográfico pueda sustituir al examen broncoespirométrico en casi todos los casos; prácticamente, lo complementa siempre y además tiene la ventaja de permitir apreciar la función en los diferentes segmentos de cada pulmón.

También, se han realizado 41 angioneumografías en 37 pacientes afectados de diversos estados patológicos del pulmón, casi todos de origen tuberculoso. Sobre la base de lo anteriormente dicho, los resultados obtenidos nos autorizan para emitir las siguientes conclusiones:

1) En la tuberculosis úlcero-exudativa existe una disminución de la función respiratoria, que es moderada y proporcional a la extensión del proceso.

2) En el neumotórax unilateral, mantenido en hipotensión, con muñón claro y elástico, se aprecia una discreta disminución de la función; por el contrario, ella está muy disminuida o abolida en los casos complicados con atelectasia del muñón o con derrames serofibrinosos o purulentos.

3) Lógicamente, a igualdad de condiciones parenquimatosas ini-
ciales, la capacidad residual de un pulmón, después de abandonado el neumotórax, es inversamente proporcional a las complicaciones ocurridas durante su realización.

4) En la paquipleuritis y en la estenosis parcial de un bronquio fuente, la función respiratoria está muy disminuida, mucho más de lo que podría hacer suponer el examen de la radiografía simple.

5) La función respiratoria está abolida en el fibrotórax y en la atelectasia.

6) La decorticación pulmonar, realizada por paquipleuritis, determina una mejoria de la función respiratoria, demostrada por una mejora de la circulación pulmonar.

RESUME ET CONCLUSIONS

Les auteurs ont réalisé une comparaison de l'angiopneumographie et de la broncho-spirométrie chez 24 malades, atteints d'affections définies, localisées électivement au poumon.

Ils ont observé une relation très nette entre les deux méthodes, avec réduction dans les deux cas de la fonction respiratoire et de la fonction circulatoire du poumon anormal. Ils l'interprètent comme étant la preuve que les altérations pulmonaires provoquent une modification parallèle des fonctions circulatoire et respiratoire. Le phénomène du "court-circuit circulatoire" en pathologie respiratoire parait beaucoup moins important qu'on ne le pensait autrefois.

Il est probable que l'étude angiopneumographique prendra la place de la broncho-spirométrie dans la majorité des cas. En pratique, la première de ces méthodes complète les informations qui peuvent être obtenues par la seconde. Il s'y ajoute l'avantage de rendre possible l'appréciation de la fonction des différents segments de chaque poumon.

Les auteurs ont également pratiqué 41 angiopneumographies chez 37 malades, atteints d'affections variées du poumon, dont la plupart étaient d'origine tuberculeuse. Leurs résultats les ont amené aux conclusions suivantes:

1) Dans la tuberculose ulcéro-caséuse, il y a une diminution de la fonction respiratoire qui reste modérée et proportionnée à l'extension des lésions.

2) Dans le pneumothorax unilatéral, maintenu en hypotension, avec un parenchyme clair, ayant gardé toute son élasticité, on peut noter une certaine diminution de la fonction. Mais par contre, la fonction est très réduite ou même abolie dans les cas qui sont compliqués d'atélectasie pulmonaire ou d'épanchement pleural, soit séro-fibrineux, soit purulent.

3) Logiquement, les conditions parenchymateuses étant égales, la capacité residual de pulmon après abandon du pneumothorax
est inversement proportionnelle au degré des complications qui ont pu survenir.

4) Dans les cas de pachypleurite et dans les stenoses partielles de la bronche souche, la fonction respiratoire est très réduite, beaucoup plus encore que l'on aurait pu l'imaginer.

5) La fonction respiratoire est nulle dans le fibrothorax et dans les cas d'atélectasie.

6) La décortication pulmonaire entreprise pour lutter contre la pachypleurite réalise une amélioration de la circulation pulmonaire que démontre l'amélioration de la fonction respiratoire.

REFERENCES