Thorax (1947), **2**, 196.

TREATMENT OF BRONCHO-PULMONARY SUPPURATION BY LOCAL INJECTION OF PENICILLIN: REPORT OF 63 CASES*

BY

H. METRAS AND J. LIEUTIER

Hôpital "La Conception," Marseilles, France

[For Plates see pages 191-193]

After using Thomson's catheter for bronchography one of us designed a set of special radio-opaque rubber catheters (Figs. 1 and 2) which allow the injection of radio-opaque substances not only into a lobe but even into separate and selected broncho-pulmonary segments. A sound knowledge of the anatomy of the bronchial tree is essential in order to perform selective placing of the catheter, and this knowledge may be acquired by studying the French and American literature and from the book recently written by Brock (1946).

After we had used the special catheters for bronchography it occurred to us to use them also for injecting penicillin directly into a lung abscess by way of the natural route, namely the tracheo-bronchial tree.

At first sight the procedure seems illogical, but an earlier study of the behaviour of radio-opaque fluids in the bronchial tree had shown us that it is possible to inject fluids with suitable physical characters into a diseased area. Lipiodol, which is a viscous fluid, spreads throughout the bronchi, if they are normal, chiefly by aspiration on inspiration. Thus if a catheter is placed in the upper lobe bronchus the lipiodol will reach the bronchioli of the apical segment even if the patient remains erect. If, however, this segment is diseased or imperfectly aerated, and especially if the bronchi are slightly narrowed or obstructed, such a viscous fluid will not pass beyond the larger bronchi. On the other hand, if less viscous oil be used this will run down the bronchi and, aided by gravity, will pass through narrowed bronchi provided these are directed vertically downwards. Thus, if a catheter be placed at the orifice of the bronchus draining a selected segment and the patient be placed so that this segment is dependent, fluid of low viscosity will flood only this one segment. In the same way an aqueous solution of penicillin can be directed into a selected broncho-pulmonary segment provided the bronchus is catheterized and the patient placed in the appropriately favourable position.

Several workers have shown that penicillin acts more powerfully if placed directly into the area of suppuration instead of being given systemically. This is true in the case of the brain, pleura, and bones, and we hope to show that it is also true for the lungs.

---

*From Dr. Isemein's Endoscopy Department.

Thorax: first published as 10.1136/thx.2.4.196 on 1 December 1947. Downloaded from http://thorax.bmj.com/ on April 9, 2024 by guest. Protected by copyright.

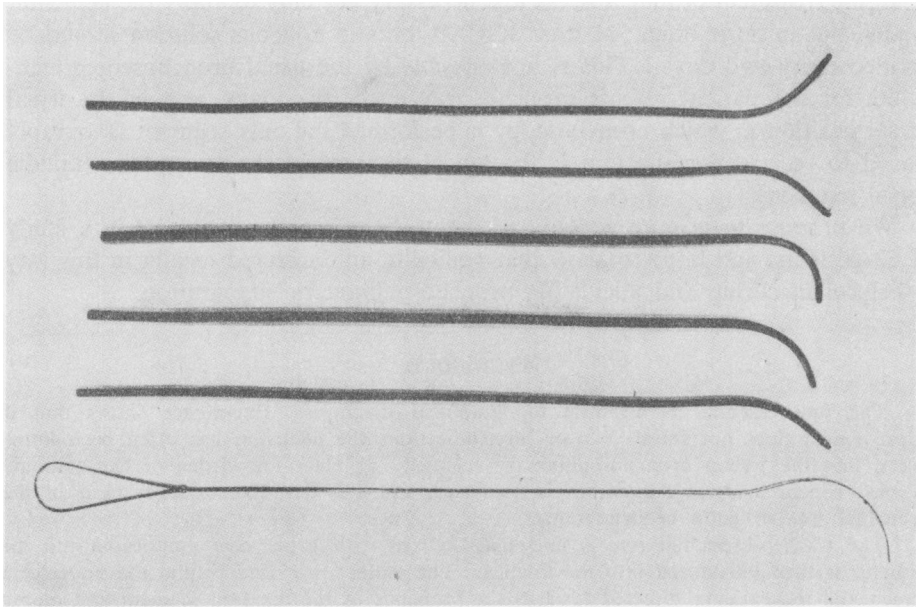

FIG. 1.—A series of five radio-opaque catheters and the introducer.

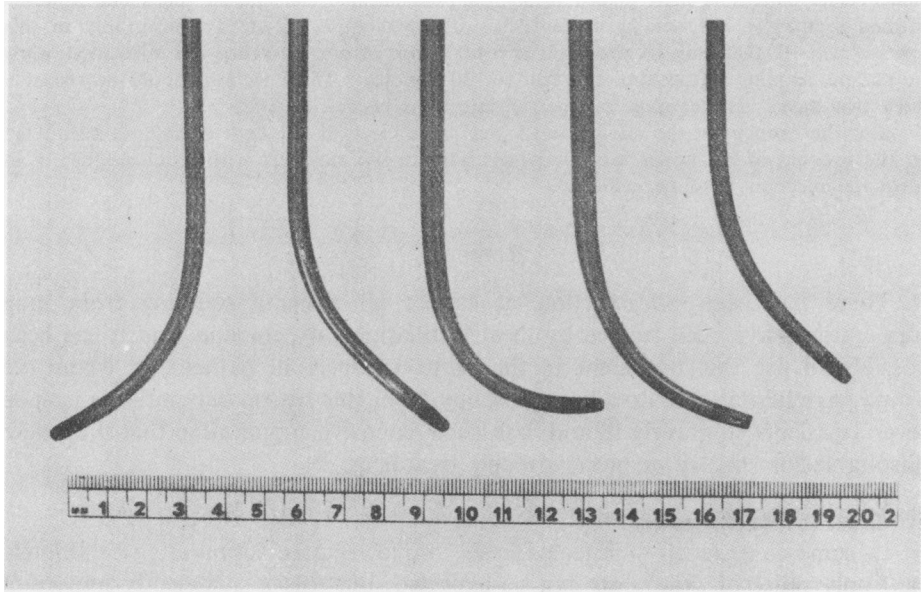

FIG. 2.—The same catheters as in Fig. 1 but arranged to show the size and shape of the instruments.

The double-curved catheter is specially designed for catheterization of the upper lobe bronchi.

Thorax: first published as 10.1136/thx.2.4.196 on 1 December 1947. Downloaded from http://thorax.bmj.com/ on April 9, 2024 by guest. Protected by copyright.

In the treatment of lung abscess it is necessary not only to apply the penicillin locally, but to do it often; at least 100,000 units in aqueous solution should be instilled every two days. This is not possible by the usual bronchoscopic technique, for the patient resents bronchoscopy every two days, and in the usual dorsal position in which bronchoscopy is performed the only segment favourably placed to receive the injection is the apical segment of the lower lobe (middle dorsal segment).

We propose to give an account of our technique and our results in a study of 63 patients, and hope to show that penicillin administered locally in this way is helpful in curing and alleviating broncho-pulmonary suppuration.

TECHNIQUE

The first essential is accurate topographical diagnosis. Experience shows that if improvement does not follow two or three injections the penicillin has often been introduced into the wrong broncho-pulmonary segment. A clear knowledge of the anatomy of the bronchi in three dimensions is necessary, and it is desirable to study casts of the bronchial tree or good bronchograms.

The tracheo-bronchial tree is first anaesthetized with 1 per cent pantocaine and the catheter is then introduced into the trachea. The patient is placed behind the fluorescent screen and the catheter directed towards the bronchus of the diseased segment and placed as near as possible to the bronchus of drainage. Manipulation of the catheter with the fingers enables it to be placed very accurately in position near the selected bronchus. To achieve this the bronchial tree must have been properly anaesthetized with a local anaesthetic. The patient is then placed in such a position that the end of the sound and the affected segment are vertically downwards. The patient is arranged comfortably in this position and 100,000 units of penicillin in 5 to 10 ml. of normal saline are injected slowly; the patient remains in the same position for 30 minutes. The injection should be repeated every two days. The average number of injections needed is eight.

For the bronchi of the middle and lower lobes the ordinary bent catheter is adequate; for the bronchi of the upper lobes it is necessary to use catheters with a double turn if an adequate injection is to be achieved.

RESULTS

There has been no selection of cases; all patients suffering from lung suppuration have been treated by local instillations of penicillin, and it has been possible to use this treatment in the more seriously ill patients in whom we would have hesitated to do a bronchoscopy. For this reason our statistics include several patients so gravely ill and with such extensive suppuration that they were unsuitable for surgery or bronchoscopic treatment.

Results in regard to symptoms

In some cases (such as infected cysts, bronchiectasis, suppurating carcinoma, etc.) only relief of symptoms can be expected, but this is sufficiently important not to be neglected. Instillations of penicillin alleviate or temporarily control

Thorax: first published as 10.1136/thx.2.4.196 on 1 December 1947. Downloaded from http://thorax.bmj.com/ on April 9, 2024 by guest. Protected by copyright.

both local infection and general toxaemia, and are a valuable preparation for any operation which may be necessary later on.

Expectoration.—This is a leading symptom. Fetid sputum, which is an indication of the virulence of the infection and of its anaerobic nature, decreases after the first instillation and disappears almost always after the second. The sputum must be studied both on a graph showing its amount, and also by inspection of its character in a specimen glass. The purulent layer decreases after the first instillation and disappears after the fourth or fifth; a sero-mucous secretion often persists. Some patients who seem to be intolerant of the repetition of local anaesthesia maintain an abundant serous bronchial secretion for several weeks. We have found intravenous alcohol beneficial in such cases. We would like to stress that it is not enough to measure the quantity of sputum alone; this observation must be correlated with a study of the qualitative modifications of the sputum.

Fever.—The fall in fever generally runs parallel with the decrease in the volume of the sputum. When we first used this technique we found that the temperature sometimes rose to 40° C. (104° F.) on the evening of an instillation at a time when the rest of the temperature chart was constant at 37° C. (98.6° F.). This was due to impure penicillin and we have not observed it since.

Weight.—As soon as the sputum diminishes and its worst quality, fetidness, goes, the appetite returns and the patient begins to regain weight quickly.

Other symptoms follow the same course and this alone would justify the use of intrabronchial penicillin. The improvement that follows is rapid, and within eight or ten days what was a desperate situation may have been relieved; in favourable cases, complete healing may be achieved. Even if irreversible changes are present which make operation necessary, this can be done under more favourable conditions when the expectoration has been reduced and the severity of the inflammatory phase abated, although the remission may sometimes be only temporary.

Results in regard to the primary condition itself

In this connexion it is necessary to divide lung suppuration into three categories.

1. This group includes suppuration occurring in pre-existing cavities in the lung, such as congenital cysts, bronchiectasis, breaking-down carcinoma, tuberculous cavities, etc.; in these, suppuration is only one feature and the primary course of the disease is not altered by penicillin, which can be palliative only. Operation alone will provide a cure.

2. In this group we include true lung abscess—that is, suppuration occurring in a lung which was previously healthy.

3. The last group includes cases of suppuration within the bronchi, the interstitial tissue of the lung itself being affected only mechanically. This group would include patients suffering from suppurative bronchitis and emphysema.

Thorax: first published as 10.1136/thx.2.4.196 on 1 December 1947. Downloaded from http://thorax.bmj.com/ on April 9, 2024 by guest. Protected by copyright.

Analysis of Sixty-three Cases

Suppuration in pre-existing cavities

Congenital cysts (6 cases).—In 2 cases of simple cyst recently infected, complete resolution of infection and expectoration was achieved. In 4 cases of polycystic disease involving the whole lung we obtained clinical improvement (1 lobectomy and 2 pneumonectomies) after a course of eight to fifteen days.

Bronchiectasis (16 cases).—In 3 cases clinical recovery was obtained, and in 10 there was marked clinical improvement. In one patient we observed broncho-pulmonary oedema immediately after the first injection and so stopped the treatment. This patient was gravely ill, suffering from bilateral bronchiectasis and an acute respiratory infection with marked cyanosis; he was also an alcoholic and syphilitic. In one case death occurred from progressive weakness. In 2 cases pre-operative penicillin enabled us to perform lobectomy with the patient in good condition.

Suppurating carcinoma (7 cases).—Positive biopsy was obtained by bronchoscopy in 5 cases. Complete clinical relief of infection was achieved in 5 cases; in 2 others the improvement was moderate. We have been able to perform pneumonectomy in one case with the patient in good condition, and in 2 others radiotherapy has been possible, with radiological improvement lasting eighteen months in one.

Suppurating hydatid cyst.—One case showed improvement.

Interstitial pulmonary suppuration

In 17 cases complete recovery, both clinical and radiological—the patients have been followed up for periods ranging from several months to two years—was obtained with from four to eight instillations. In our opinion the high percentage of good results rules out simple coincidence.

In 6 cases the clinical result has been good, but there has not been complete radiological clearing. Some of these patients have remained clinically well for several months and have resumed work.

There have been 5 failures, as shown by persistence of the radiological changes and return of symptoms as soon as the penicillin instillations were stopped. One patient was not classified, as he has left us, but he has written to say he has no symptoms. One patient who was cured of his lung lesion died of peri-renal and subphrenic abscesses which were unrecognized and so untreated.

The duration of suppuration in these cases ranged from ten days to seven months, with an average of two months. The only death occurred from extra-pulmonary suppuration. For the 5 failures we have performed resection in 2 cases, 1 pneumonectomy, and 1 lobectomy, and both these patients were in good pre-operative condition; in 1 case we performed external drainage of a cavity, but without improvement, and we are contemplating a lobectomy at a later date.

Bronchial suppuration

We have only treated cases of chronic bronchial suppuration complicated by serious local and general disturbance, and have not been able to analyse all our records, but 4 patients showed great clinical improvement after from two to four instillations.

Interpretation of Results

1. In cases of pre-existent cavities local instillation of penicillin seems to us to provide the best and quickest preparation for surgery. It will never cure the primary disease.

2. In true pulmonary suppuration the whole evolution of the disease is changed. The only results that can be compared with ours are those of

Thorax: first published as 10.1136/thx.2.4.196 on 1 December 1947. Downloaded from http://thorax.bmj.com/ on April 9, 2024 by guest. Protected by copyright.

Neuhof and Touroff, but our patients have included many who were in a grave, critical, and even moribund condition (for example, with suppuration of the whole of the lower lobe on one side and the middle lobe on the other); one truly moribund patient was completely cured radiologically and clinically.

The dominant fact is that no death occurred from lung suppuration, excluding the one case in which death was caused by overlooked and untreated subphrenic and peri-renal abscesses.

Chronic suppuration persisted in 5 out of 29 cases; as soon as local instillation of penicillin was stopped the sputum returned, copious and offensive. Moreover, some had severe haemoptyses and were exposed to the risk of metastatic abscesses. Operation became necessary in all these.

When treatment by local instillations of penicillin is begun it is not possible to predict whether cure or chronicity will follow, but the percentage of cures is high and the treatment allows one to proceed to resection, if this step should prove to be necessary, with greatly increased safety owing to the control of infection which the penicillin has given. Resections of the lung or lobes of the lung must be performed by dissection, and for the technical details of these operations we are indebted to the surgeons we have visited at the Brompton Hospital (London) and the Sabbatsberg Sjuskus (Stockholm). We are also indebted to our anaesthetist, Dr. L. Hartung.

3. In chronic bronchial suppuration sufficient improvement follows to allow the patient to live a more tolerable life; but the improvement is of short duration —some five or six months.

SUMMARY

A new method of local instillation of penicillin is described for the treatment of lung suppuration.

A special rubber catheter has been designed for this purpose. The instrument is shown, and the technique of passing it is described.

Since February, 1945, 63 patients have been treated. The results show that local instillation of penicillin is worth using, either because it provides an easy and quick method of improving the condition of the patient before operation, or because it can cure, with little disturbance and few manipulations, many patients who would otherwise be judged hopeless. In the whole series of 63 cases, 75 per cent recovered and 17 per cent have undergone an operation for extirpation of the disease.

REFERENCES

Brock, R. C. (1946). "The Anatomy of the Bronchial Tree." Oxford University Press. London.
Métras, H. (1947). *Presse méd.*, **17**, 198.
Neuhof, H., and Touroff, A. S. W. (1936). *Surg. Gynec. Obstet.*, **63**, 353.
Neuhof, H., and Touroff, A. S. W. (1940). *J. thorac. Surg.*, **9**, 439.
Neuhof, H., and Touroff, A. S. W. (1941). *J. thorac. Surg.*, **10**, 618.
Neuhof, H., and Touroff, A. S. W. (1942). *J. thorac. Surg.*, **12**, 98.

Thorax: first published as 10.1136/thx.2.4.196 on 1 December 1947. Downloaded from http://thorax.bmj.com/ on April 9, 2024 by guest. Protected by copyright.

APPENDIX

The following additional details have been provided by Dr. N. S. Hooton, who has used the catheters in treating and investigating some of Mr. R. C. Brock's patients at Horton War Hospital, England. The catheters are made by Gentile, 49, Rue St. André des Arts, Paris.

The patient is given premedication of omnopon 1/6 gr. and atropine 1/100 gr. one hour beforehand. An anethaine gargle is given just before the patient goes to the *x*-ray department. Here the lower aspect of the soft palate, the back of the tongue, and the oropharynx are sprayed with 2 per cent butyn. An assistant holds the tongue out whilst the larynx is visualized with the aid of a laryngeal mirror and a head-lamp. Under vision 1.5 ml. of 2 per cent butyn is squirted on to the vocal cords with a laryngeal syringe; this step is repeated using another 1.5 ml. The selected catheter is now threaded on to the introducer and the tip of the catheter is placed under vision exactly above, or just in, the rima glottidis. The laryngeal mirror is then put down and the hand thus freed is used to slide the catheter off the introducer into the trachea, and the introducer is then laid aside. A further 1 ml. of butyn is injected down the catheter to anaesthetize the trachea and main bronchi. The patient lies on his back on the *x*-ray table with lead sheeting placed under his head and neck to prevent irradiation of the hand holding the catheter. While the patient is being screened the radio-opaque catheter is manœuvred into the appropriate bronchus. In the case of the basal segments of the lower lobes and of the upper lobes the catheters can be introduced without simultaneous screening, the latter being used only momentarily to check that the catheter has been correctly placed. To catheterize the upper lobes, in which the majority of abscesses are situated, the catheter with the single 90° curve seems most suitable. A mark is made on the proximal end of the catheter to indicate the direction in which the curved end is pointing, and after the catheter has been introduced into the trachea a screw clamp is fixed on the proximal end to indicate the direction of the tip. After the catheter has been withdrawn far enough to be sure that the tip is above the carina, the instrument is rotated with the aid of the screw clamp towards the side of the upper lobe to be catheterized. The catheter is then gently pushed down until it will go no further. Screening then shows the tip to be in one of the primary divisions of the upper lobe bronchus. The patient now holds the catheter (pushing it gently downwards all the time to stop displacement) and is postured so that liquid injected into the catheter gravitates into the segment containing the abscess; in some cases the tip of the catheter can almost be introduced into the abscess itself. Penicillin, 100,000 units in 10 ml. of normal saline, is injected down the catheter, which can be removed without the patient coughing. The patient is postured for half an hour. It is inadvisable to inject butyn down the catheter immediately before putting in the penicillin, because not only does this increase the dose of butyn but we have found that, whilst after ten minutes the potency of a penicillin solution (128 units per 50 ml.) was not affected by the presence of an equal quantity of 2 per cent butyn, in thirty minutes it was only 74 per cent, and in three hours 34 per cent as potent.

Thorax: first published as 10.1136/thx.2.4.196 on 1 December 1947. Downloaded from http://thorax.bmj.com/ on April 9, 2024 by guest. Protected by copyright.