RESPIRATORY OBSTRUCTION IN HAEMOPHILIC PATIENTS

BY

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The dangers of bleeding from external wounds in haemophiliacs are well known; bleeding into the muscles, joints, urinary tract, and gastro-intestinal tract also produces syndromes that are well recognized and have been the subject of many articles. A less common condition, but of far greater immediate danger to the patient, is the extravasation of blood into the tongue, the tissues of the floor of the mouth, and the fascial planes which surround the pharynx, larynx, and trachea. Haemorrhage here can produce gross swelling of the tissues with consequent encroachment on the space within the mouth and the pharyngeal and laryngeal air-passages. At best the patient suffers some degree of discomfort, with difficulty in speech and dysphagia; and, where very gross distortion of the tissues occurs, there is grave risk of death from asphyxia. Biggs and Macfarlane (1957) regard this complication as the most dangerous than can occur in haemophilia.

Numerically the problem is small, since it is estimated that the haemophilic population of this country is only 2-3 per 100,000. However, it can occur in other conditions that are characterized by a haemorrhagic diathesis: one case in the series under review was in a patient suffering from Christmas disease. Judging from reports in the literature, the syndrome is not common amongst known haemophiliacs. I can find records of only 21 such patients, of whom 16 suffered from some degree of respiratory embarrassment. These were reported by Umbreit (1910), Feliciangeli (1921), Lesné *et al.* (1921), Dujarier (1930), Troutt (1931), Voit and Paus (1933), Endicott *et al.* (1942), Baird and Fox (1943), Fox *et al.* (1946), Davidson *et al.* (1949), Boyd (1950), Herson (1950), Edmonds (1951), MacDonald *et al.* (1953), Tempest (1953), Perrella and Costa (1954), Archer and Zubrow (1954), and Skolnik and Fornatto (1955).

Twelve further instances are described in this paper, and their management is discussed, with particular reference to the assistance that the anaesthetist may be called upon to give. Between 1953 and the end of 1958 79 patients with haemophilia were admitted to the United Oxford Hospitals; as several were admitted on more than one occasion the total number of admissions was 145. Of these, six suffered in greater or less degree from the syndrome described, and two were admitted twice for the same reason. In addition, three cases are described which were seen at other hospitals—one from the records of the Central Middlesex Hospital and two from St. Bartholomew's Hospital. Respiratory embarrassment severe enough to cause grave anxiety occurred in six patients; in three of these active intervention was needed to restore the patency of the airway. One of the three died.

Case Histories

Case 1

A 3-year-old boy, who had been a known haemophiliac since infancy, developed a swelling behind the angle of the

mandible on the right side. There was no history of any precipitating factor. Over the next 24 hours the extravasation of blood extended to the tissues of the floor of the mouth and he had difficulty in eating owing to displacement of the tongue. At this stage he was admitted to hospital. There was no indication that the airway was impaired, and an intravenous drip was set up under rectal anaesthesia (500 mg. of thiopentone). After 400 ml. of fresh frozen plasma had been given in one hour the swelling rapidly diminished in size. He was discharged from hospital two days after admission.

Diagnosis and admission to hospital in this case were carried out before the bleeding had produced any impairment of the airway. As a result, resolution of the condition was accomplished by antihaemophilic treatment alone. Had admission been delayed a further 24 hours the child's condition would have been much more serious.

Case 2

A 9-year-old boy—a known case of Christmas disease—was admitted to hospital with the following history. Five days before admission he complained of a sore throat. He then developed swelling of the right side of his face and neck which gradually increased in size. On the morning of admission he complained of being unable to swallow and was having some difficulty in talking. On examination he had a sublingual haematoma, and some bruising and swelling of the soft palate and the right side of the face and neck. Obviously he was on the verge of acute respiratory obstruction, and an intravenous transfusion was set up at once and 2 pints (1,140 ml.) of fresh frozen plasma was given. The swelling subsided, and in four days had disappeared from within the mouth and the face and neck. Again measures to correct the clotting defect were sufficient to check the process in this patient, but some anxiety about him in the first 24 hours after admission made it essential that his condition was most carefully watched.

Case 3

A 12-year-old boy, a known haemophiliac since infancy, was admitted to hospital with a history that over the previous 24 hours he had developed a swelling under his tongue which was spreading to the tissues on the right side of his mouth. There was no history of any precipitating factor, and though he could swallow fluids he was unable to chew solid food owing to displacement of his tongue. Over the next 24 hours he was watched in the ward, and his condition appeared to be static. Treatment was complicated by his persistent refusal to submit to venepuncture. As there was no impairment of the airway a general anaesthetic was given and a drip set up. Two pints (1,140 ml.) of fresh frozen plasma was given during the next two days, and thereafter the swelling rapidly disappeared.

All precautions (these are discussed later) were taken to deal with obstruction of the airway should this have arisen. Fortunately, no such trouble occurred, and the administration of an inhalational anaesthetic presented no difficulty.

Case 4

This patient, a known haemophiliac, was admitted on two separate occasions for bleeding in the area of the tongue and mouth.

On the first occasion, when 7 years old, he bit his tongue, which began to swell, and he was admitted to hospital at once. On admission his tongue was swollen but was not bleeding into the mouth. His swallowing and breathing were unaffected. He was kept under observation in the ward for 24 hours, when it was clear that the condition was resolving without the need of any active treatment; he was then discharged.

A year later he developed a sore throat. One week after the onset a swelling appeared in his neck just below the left ear. During the course of the day this rapidly increased in size and spread down to the angle of the jaw. He had dysphagia and difficulty in speaking. He was at once admitted to hospital, where it was noted that the left side

of his face and neck was swollen and that a haematoma was causing swelling of the tissues of the floor of the mouth, displacing the tongue. Again severe respiratory embarrassment within a few hours was an obvious hazard, and he was transfused with 1 pint (57 ml.) of fresh frozen plasma; a further pint (570 ml.) was given the next day, when the swelling rapidly subsided. He could talk and swallow without difficulty in two days, and was discharged from hospital shortly afterwards.

Case 5

This patient was also admitted on two separate occasions on account of this syndrome. He had been a known haemophiliac since infancy.

On the first occasion, when 5 years old, he developed a haematoma of the floor of the mouth which spread over the chin and affected mainly the right side. He was admitted to hospital, and then developed signs and symptoms of haemarthrosis of the left hip and gastro-intestinal haemorrhage. Antihaemophilic treatment was at once instituted and bleeding from all three sites stopped. In this instance the sublingual haemorrhage caused him little more than mild discomfort, and more anxiety was felt on account of the bleeding from the other sites.

When 18 years old he was again admitted, with the following history. Two days before admission he complained of a sore throat, and the next day of a lump in his throat and hoarseness. Early on the day of admission he suffered from dysphagia, and was at once sent to hospital. On examination there was bruising of the palate, the tongue was swollen and bruised, and there was marked swelling and discoloration of the posterior pharyngeal wall. He was having difficulty in talking, and could not swallow anything. Two pints (1,140 ml.) of fresh frozen plasma were transfused at once, and he was watched carefully for 24 hours. At the end of this time he was comfortable, and the swelling in all areas had decreased. The next day he could talk and swallow with ease.

One other complicating factor in this patient was that he developed an allergic reaction during transfusion of the first pint (570 ml.) of plasma, which produced some oedema of his face. Mepyramine hydrogen maleate, 100 mg., was given into the drip, and a further 50 mg. was added to the second pint. The reaction subsided, and there was no more trouble of such a nature.

Again any further delay in admitting this patient to hospital would have entailed the risk of a serious deterioration in his condition. The risk of an allergic response to plasma, and, even more, antihaemophilic globulin (A.H.G.) obtained from animal sources, is well recognized as a hazard in treating haemophiliacs, and must be controlled with antihistamine drugs.

Case 6

This patient was a 6-year-old boy who was a known haemophiliac. The day before admission he complained of a sore throat, and a few hours later began to bleed from a loose tooth, a lower right bicuspid. During the night, swelling of the floor of the mouth and tongue occurred, and early next morning he was sent to hospital. On examination he could not talk or swallow; the loose tooth was extracted without anaesthesia to allow blood to escape, and he was transfused with 2 pints (1,140 ml.) of fresh blood. It was, however, apparent that his airway was becoming obstructed. As there was no evidence that the obstruction was due to other than the grossly enlarged tongue blocking both the mouth and the oropharynx, it was decided to pass a nasopharyngeal tube. This produced immediate relief of his symptoms, and was left *in situ* for a total of 48 hours. The tube was well lubricated and its passage was carried out without a laryngoscope.

Two pints (1,140 ml.) of fresh frozen plasma was given, and the swelling began to subside. A further 4 pints (2,270 ml.) of plasma was given over the next three days. By then he could talk and swallow normally, and his convalescence was uninterrupted.

Case 7

A 15-year-old boy, a known haemophiliac since the age of 2, had been in hospital for three months, having had an extensive laminectomy for an extradural haematoma caused by a fall. He complained of a sore throat one evening, but nothing abnormal was seen on inspection. Twenty-four hours later his throat was still sore, and some slight external swelling of the left side of his neck was noted. By the next morning the swelling was larger and he was hoarse. By midday he had a marked haematoma of the floor of the mouth and neck, and his respiration was becoming laboured. His haemoglobin was 60%, and 3 pints (1,700 ml.) of fresh blood was given. By the following morning his breathing was much easier and the swelling had subsided slightly. Over the next 24 hours he was given a pint (570 ml.) of fresh plasma and 5 pints (2,840 ml.) of fresh blood. This was followed by a rapid resolution of the condition, and three days later the appearance of his mouth and neck was virtually normal.

Again there was a period of some 24 hours when considerable anxiety was present about his airway. Antihaemophilic treatment alone was sufficient to effect a complete recovery.

Case 8

This patient, who was admitted to the Central Middlesex Hospital, was the subject of an article by Joules and Macfarlane in 1938, though their interest lay in the extreme rarity of the condition. She was, in fact, a woman in her late fifties, suffering from pseudo-haemophilia, who bled into her tongue without obvious cause, and was admitted to hospital with a grossly enlarged and discoloured tongue with some swelling of the submental region. Her appearance is shown in Fig. 1, and this demonstrates well the reason for the severe dysphagia of which these patients may complain. No active intervention was called for in this case, and over the next 10 days her condition resolved. Her airway, despite the somewhat frightening appearance, was not in danger.

FIG. 1.—This patient (Case 8) could not close her mouth any further owing to the swollen tongue, the underside of which is seen projecting. Note also the swelling in the submental region.

No active intervention was called for in this case, and over the next 10 days her condition resolved. Her airway, despite the somewhat frightening appearance, was not in danger.

Case 9

This patient was an 18-year-old youth who was admitted to St. Bartholomew's Hospital in 1937, under the care of the late Dr. G. Evans. He had been a known haemophiliac since infancy. He gave a history of having had a sore throat a fortnight previously which apparently cleared up in four days. The day before admission he complained of discomfort under the left side of his jaw which grew worse, and he found himself dribbling saliva. During the night his tongue became swollen, and by morning he could neither talk nor swallow. On arrival at hospital a large sublingual haematoma was found to be displacing the tongue. Fresh blood was at once given, but the swelling increased throughout the day. His discomfort became worse, and it was clear that respiratory obstruction was supervening. Attempts to pass a tube by mouth and nose without anaesthesia were unsuccessful, as the patient was restless, and it was decided to administer a general anaesthetic and to intubate him before proceeding to an immediate tracheotomy. Just before passage of the tube his pulse suddenly vanished, and, despite resuscitative measures with oxygen and nikethamide, never returned.

The post-mortem specimen is shown in Fig. 2. This shows that respiratory obstruction was due entirely to the displacement of the tongue backwards and upwards. The extravasation of blood into the substance of the tongue and the tissues of the floor of the mouth can also be seen. The appearances of the other organs of the body were those of death from asphyxia.

FIG. 2.—Post-mortem specimen, Case 9. Asphyxia was caused by the grossly swollen tongue pressing against the posterior pharyngeal wall. Note that the larynx, apart from the petechial haemorrhages characteristic of asphyxial death, is quite uninvolved in the main pathological condition.

Case 10

This patient was also admitted to St. Bartholomew's Hospital, under the care of Lord Horder in 1935. He was aged 19 years, and had been a known haemophiliac since infancy. Five days before admission he complained of soreness of the gums of the lower jaw, and there was slight bleeding from the gingival margin. Swelling of the submental region began three days before admission. By the time that he arrived at hospital this was very pronounced, there was displacement of the tongue, and the gums of his lower jaw were swollen and discoloured. It was noted that some of his lower molar teeth were grossly carious. His airway at this time was not impaired, but shortly after arriving in the ward respiratory obstruction occurred. This was relieved by passage of a nasopharyngeal tube without the aid of a laryngoscope or of any form of anaesthesia. The tube was left *in situ* for four days, during which time fresh blood was administered to correct the clotting defect. The swelling decreased, and he made a good recovery.

Aetiology

As in all manifestations of haemophilia, only the slightest of stimuli is necessary to start bleeding; indeed, in many cases no precipitating factor can be elicited. In the 12 instances cited, trauma was a factor in one, sore throat in four, in two the cause was related to the dental condition, and in five no cause could be determined. Fox *et al.* (1946) and Davidson *et al.* (1949) state that haemophiliacs must be warned against excessive use of the voice; shouting and similar activity can be a factor in producing bleeding in the tissues around the upper respiratory passages. A further point made by Perrella and Costa (1954) is that the almost continuous movement and muscular activity present in the structures of the floor of the mouth and tongue will encourage bleeding once it has started.

In the cases reported in the literature, trauma as the obvious cause of the haemorrhage is mentioned only by Edmonds (1951). Under this heading must also be mentioned dental treatment in haemophiliacs, and two points must be emphasized in this connexion. The first is the danger of employing local analgesia. This is particularly important in the lower jaw; haemorrhage resulting from inferior dental nerve block or the

infiltration of the gum of the lower jaw can easily track into the tissues of the floor of the mouth and tongue. Tempest (1953) and Archer and Zubrow (1954) both report such occurrences. The second is the danger inherent in suturing a bleeding tooth socket in a haemophiliac (Macfarlane and Witts, 1942; Endicott *et al.*, 1942). Such a procedure deprives the blood of its only possible means of escape from the tissues and thus creates ideal conditions for this syndrome to arise. In the United Oxford Hospitals all dental extractions in patients with haemorrhagic diatheses are carried out under general anaesthesia, and the dental and anaesthetic techniques used have been described by Wishart *et al.* (1957) and Leatherdale (1958). The anatomy of the region obviously plays a very important part in determining the path followed by the extravasated blood, and these considerations are fully dealt with by Endicott *et al.* (1942) and by Fuller in the article of Archer and Zubrow (1954).

Treatment

Treatment may be considered under the two following headings.

Specific Antihaemophilic Therapy

This is the province of the haematologist, and no attempt is made to discuss it in any detail here. However, the anaesthetist and all others concerned in the treatment should have some knowledge of the subject, as this will give them a better understanding of the problems involved. For present purposes it suffices to say that the sooner antihaemophilic treatment is instituted and a haemostatically effective level of A.H.G. in the blood thus secured, the sooner will bleeding cease and resolution of the condition begin. This is the primary therapeutic consideration; and all other measures (with which this paper is mainly concerned) are directed towards overcoming any respiratory embarrassment that may arise before the bleeding has been arrested.

Measures to Ensure Maintenance of a Clear Airway

As is seen from the case-histories quoted, the degree to which the airway may be impaired is variable, and it follows that the amount of active intervention necessary to maintain adequate respiration varies from case to case. Experience in the United Oxford Hospitals suggests that certain facts are of great practical importance.

1. The patient should be admitted to hospital at the earliest moment, irrespective of the apparent triviality of the condition when first seen. There is no time or place for expectant treatment in the patient's home. There is the ever-present hazard of death from asphyxia, and, moreover, antihaemophilic treatment can be carried out satisfactorily only in hospital.

2. Care of these patients involves close co-operation between the physician in charge, the haematologist, the ear-nose-and-throat surgeon, and the anaesthetist. Each must be informed when such a case is to be admitted to hospital. The last two should make preparations for any immediate treatment that may be needed to relieve respiratory obstruction; this is discussed in detail later, but the necessary instruments for passage of a pharyngeal or endotracheal tube, and for tracheotomy, must be kept by the patient's bedside so long as there is any danger of asphyxia.

3. Some person (nurse or doctor) who is fully conversant with the dangers must be at the patient's bedside continuously while the slightest risk of respiratory obstruction exists. Every breath must be seen or heard.

4. As in the nursing of unconscious patients, the supine position is to be avoided. The lateral or semi-prone position helps to keep a congested and swollen tongue away from the posterior pharyngeal wall. A rubber airway, such as Guedel's, well lubricated with local analgesic, may be of assistance. A metal airway should not be employed, owing to the danger of producing further trauma.

5. If obstruction to respiration has become established then some means of by-passing it must be performed. Fig. 2 shows the mechanism causing the obstruction, and four methods of relieving are available: (i) orotracheal intubation, (ii) nasotracheal intubation, (iii) nasopharyngeal intubation, and (iv) tracheotomy.

6. Incision and drainage of the collection of extravasated blood has been reported as a means of reducing the swelling and thus relieving the airway (Umbreit, 1910; Feliciangeli, 1921; Troutt, 1931; Edmonds, 1951; Tempest, 1953; MacDonald *et al.*, 1953). Most of the objections to tracheotomy—continuing bleeding, sepsis, and delayed healing—apply here, too. It has not been necessary in any of the cases admitted to the United Oxford Hospitals. It should not be regarded as a substitute for the institution of antihæmophilic treatment; recent advances in this field have rendered the procedure obsolete.

Methods of Relieving Obstruction

Orotacheal and Nasotracheal Intubation

Boyd (1950) reports a case where the former method was employed under general anaesthesia, and MacDonald *et al.* (1953) one where the latter method was used with local analgesia. The endotracheal tubes were left in 96 and 36 hours respectively and both patients made a good recovery. There are certain objections to these procedures. First, general anaesthesia in the presence of respiratory obstruction has long been recognized as notoriously hazardous (Macintosh and Pratt, 1940); Case 9, quoted above, is an example of this. In addition, exposure of the glottis and the passage of an endotracheal tube via the nose or mouth may well be extremely difficult in such distorted anatomical conditions whatever method of anaesthesia is employed. Such manœuvres also carry the risk of producing yet more trauma and bleeding. This method is not recommended.

Nasopharyngeal Intubation

In the two patients quoted (Cases 6 and 10) where passage of a tube was necessary to by-pass the obstruction a nasopharyngeal tube proved very satisfactory. There is no need for the assistance of a laryngoscope, and, provided that the lower end of the tube lies beyond the site of obstruction produced by the swollen tongue and floor of the mouth, there is no need to advance it further. Haemorrhage from the nasal mucosa is an obvious risk, but this is minimized if the following points are adhered to. Spraying the nose with 5% cocaine will cause vasoconstriction of the mucosal vessels as well as local analgesia; the tube must be no larger than will pass easily through the nose and it must be well lubricated with local analgesic ointment. Once it is in position, patients tolerate its presence without complaint, particularly if it is relieving their asphyxial symptoms. Should bleeding occur the patient must be postured to allow drainage from the nose; it will soon be brought under control by the institution of antihæmophilic treatment.

Tracheotomy

Tracheotomy is the most certain method of relieving respiratory obstruction occurring at or above the level

of the glottis, but the operation has very special hazards in the hæmophilic. Bleeding at the actual operation is unlikely to be excessive, but, unless adequate hæmostasis is assured, a steady persistent ooze is likely to start some hours post-operatively. This greatly delays healing, and blood may be inhaled or track into the mediastinum. The ultimate success of the operation depends on adequate hæmostasis, which can be achieved only by using animal A.H.G. Fresh plasma transfusion will usually arrest and reduce a hæmatoma but will never be sufficient for operation. Thus, if operation is decided on, animal A.H.G. must be obtained as a matter of great urgency. It is not necessary further to endanger the life of an asphyxiating patient by delay in waiting for supplies of A.H.G., but since it can be obtained within a few hours, treatment can at least be started early in the post-operative period.

An analysis of cases reported in the literature shows that of seven patients who were submitted to tracheotomy, four died; while in 14 where no tracheotomy was performed only two died. Too much importance should not be attached to these figures, as the high mortality in tracheotomized patients might well have been due to too long a delay in relieving obstruction and to the operation having been carried out on a moribund patient. In addition, many patients who did not have a tracheotomy suffered only mild local discomfort. There was never any question that the airway was anything but patent, and, since the risk of asphyxia did not materialize, there was never any indication for tracheotomy.

As the operation of tracheotomy in a hæmophilic patient is one which should not be undertaken lightly the indications for carrying it out should be clarified. Hæmophilic patients with hæmatoma giving rise to the syndrome under discussion may be divided into two categories according to the acuteness and degree of anatomical distortion present:

1. Those with a slowly developing hæmatoma which has been present for 6–12 hours and which is not known to be regressing. These patients should be given immediate treatment with fresh frozen plasma. But an E.N.T. surgeon and anaesthetist should see the patient, and all equipment for relieving respiratory obstruction by passing a tube or tracheotomy should be at the bedside.

2. Patients in whom the hæmatoma has continued to enlarge despite the treatment suggested above and in whom some degree of respiratory obstruction has developed; also patients seen for the first time with respiratory obstruction. This category can be considered under two headings.

- (a) Those patients in whom relief of the obstruction is afforded by the passage of a nasopharyngeal tube. Further antihæmophilic treatment should also be given, and the hæmatologist should try to find out why the original treatment was ineffective.

- (b) Those in whom obstruction is not relieved by intubation. In these patients an immediate tracheotomy is essential. There can be no excuse for allowing a patient to die an asphyxial death through failure to attempt the operation despite the known dangers. Early diagnosis and adequate antihæmophilic treatment before there is any question of respiratory embarrassment should eliminate the need for tracheotomy, and it is suggested by experience in the United Oxford Hospitals that these factors are the most important ones in determining the management of these patients. In

none of the cases quoted was there an interval of less than 12 hours between the first symptoms and the onset of respiratory discomfort (often it was much longer). Since adequate antihæmophilic therapy should reverse the swelling in 6 to 12 hours, the first 24 hours should allow time for assessment of the airway and the making of a decision on what measures are needed to ensure free respiration. This decision, which must be made on purely clinical grounds, may well be very difficult.

One further point must be made here—namely, if the hæmatoma involved the larynx *ab initio*, as a result of direct trauma (Edmonds, 1951). Here obviously there is no alternative to immediate tracheotomy.

Summary

The syndrome arising from bleeding into the tongue, floor of the mouth, and adjacent tissues in hæmophilias is described.

The aetiology and treatment of the condition, with particular reference to the risk of asphyxia and the role that the anaesthetist may be asked to play in the treatment, are discussed.

Twelve further instances of the syndrome, in 10 patients, are described.

Of these, one patient died, two patients required nasopharyngeal intubation to overcome respiratory obstruction, seven cases resolved with antihæmophilic treatment alone, and two required no therapy beyond a short stay in hospital for observation to ensure that spontaneous resolution was taking place.

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REFERENCES

- Archer, W. H., and Zubrow, H. J. (1954). *Oral Surg.*, **7**, 464.
 Baird, K. H., and Fox, M. S. (1943). *J. Pediat.*, **23**, 90.
 Biggs, R., and Macfarlane, R. G. (1957). *Human Blood Coagulation*, 2nd ed., p. 265. Blackwell, Oxford.
 Boyd, W. H. F. (1950). *Lancet*, **1**, 302.
 Davidson, C. S., Epstein, R. D., Miller, G. F., and Taylor, F. H. L. (1949). *Blood*, **4**, 97.
 DuJurier, C. (1930). *Arch. int. Laryng.*, **9**, 1216.
 Edmonds, A. R. (1951). *Med. J. Aust.*, **1**, 227.
 Endicott, C. L., Mitchell, J. H., and Qvist, G. (1942). *Brit. med. J.*, **2**, 34.
 Feliciangeli, G. (1921). *Policlinico, Sez. prat.*, **28**, 8.
 Fox, J. R., Spencer, J. T., jun., and Tocantins, L. M. (1946). *J. Amer. med. Ass.*, **130**, 78.
 Herson, R. N. (1950). *Lancet*, **1**, 422.
 Joules, H., and Macfarlane, R. G. (1938). *Ibid.*, **1**, 715.
 Leatherdale, R. A. L. (1958). *Anaesthesia*, **13**, 27.
 Lesné, Powilewicz, and Récamier (1921). *Bull. Soc. Pédiat. Paris*, **19**, 308.
 MacDonald, A. C., Robson, J. G., and Wapshaw, H. (1953). *Brit. med. J.*, **1**, 1144.
 Macfarlane, R. G., and Witts, L. J. (1942). *Ibid.*, **2**, 140.
 Macintosh, R. R., and Pratt, F. B. (1940). *Essentials of General Anaesthesia*, p. 267. Blackwell, Oxford.
 Perrella, F., and Costa, F. (1954). *Arch. ital. Laring.*, **62**, 363.
 Skolnik, E. M., and Fornatto, E. J. (1955). *Eye, Ear, Nose Thr. Monthly*, **34**, 435.
 Tempest, M. N. (1953). *Brit. med. J.*, **1**, 1332.
 Troutt, J. M. (1931). *Milit. Surg.*, **69**, 419.
 Umbreit (1910). *Disch. Z. Chir.*, **105**, 608.
 Voit, K., and Paus, T. (1933). *Z. Hals-, Nas.- u. Ohrenheilk.*, **32**, 473.
 Wishart, C., Smith, C. A., Honey, G. E., and Taylor, K. B. (1957). *Lancet*, **2**, 363.

STAPHYLOCOCCAL INVASION OF PULMONARY INFARCTS

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Hospital patients run an ever-increasing risk of acquiring secondary staphylococcal infections. These infections are often resistant to antibiotics, for resistant strains may possess increased invasive powers (*Lancet*, 1959). The seriously ill patient has little resistance to staphylococcal invasion, and this added insult may well prove fatal. We have been impressed by the peculiar liability of patients with pulmonary infarction to develop secondary staphylococcal lung infections. Four such cases, seen in a period of 12 months, are described to increase awareness of this complication.

Illustrative Case Reports

Case 1.—A man aged 57 was admitted to the Central Middlesex Hospital on March 14, 1958, with an infarction of the left lung base which followed a superficial venous thrombosis of the right calf. He improved with anti-coagulant treatment, and a week's course of penicillin and streptomycin. On March 23, two days after the end of the first antibiotic course, fever recurred and the temperature rose to 104° F. (40° C.). The sputum became purulent for the first time, and *Staph. pyogenes*, sensitive only to chloramphenicol and erythromycin, was isolated from sputum and stool. He was treated with these antibiotics, but for several days was critically ill with delirium and stupor. The blood-pressure fell to 90/70 mm. Hg, and he received intravenous hydrocortisone for five days. A chest radiograph at the height of his illness showed a massive

FIG. 1.—Case 1. Chest radiograph showing a massive shadow in the right upper zone.