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MEDIASTINAL EMPHYSEMA

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J. W., boy aged 10, referred for removal of tonsils and adenoids. There had been so many attacks of acute tonsillitis, and the tonsils appeared to be so adherent that instead of a guillotine operation being performed, they were removed by dissection. The adenoids were removed by the La Force type of adenotome. The operation was performed by my house-surgeon under my supervision, and looking over his shoulder, everything seemed to go on quite normally, and in the light of subsequent events, there was no aspiration of blood. (May 28th, 10 a.m.)

Three hours later free bleeding occurred from the adenoid area. There was a large clot hanging from the nasopharynx, this was removed and the patient propped up. Bleeding ceased after one hour. His condition during the night seemed quite satisfactory considering his reactionary hæmorrhage. His pulse rate was taken hourly and varied between 140 and 110.

However, at 7.30 a.m. on May 29th he complained of pain in the front of the chest and upper abdomen and his pulse rate rose to 150.

At 8.30 a.m. he became cyanosed with marked respiratory distress and on examination there appeared to be bronchial breathing with loud moist râles over both bases. Temperature remained normal and pulse rate still 150.

At 9.30 a.m. surgical emphysema appeared in the base of the neck, at the angles of the jaw, over the upper part of chest, and in the axillæ. At 10 a.m. I saw him and his condition was now critical, cyanosed, semi-conscious, difficulty in breathing (oxygen was being administered) and restless at times. His pulse rate was now up to 160, temperature still normal and respirations up to 60. The surgical emphysema at the time could not be explained, but his respiratory signs seemed to point to some bronchial obstruction.

An X-ray film was taken with the patient lying on his mattress still propped up with pillows, as this position seemed to cause least respiratory

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embarrassment. His pulse now could not be counted, and had become much weaker. The film (fig. 1) showed air in the mediastinum and neck, and the heart pushed over to the left side. It was decided therefore that there was definite ballooning of the right lung by a valvular obstruction to the right bronchus. This ballooning had resulted in rupture of an alveolus and spread of the air through the interstitial tissue of the lung to the hilum and mediastinum.

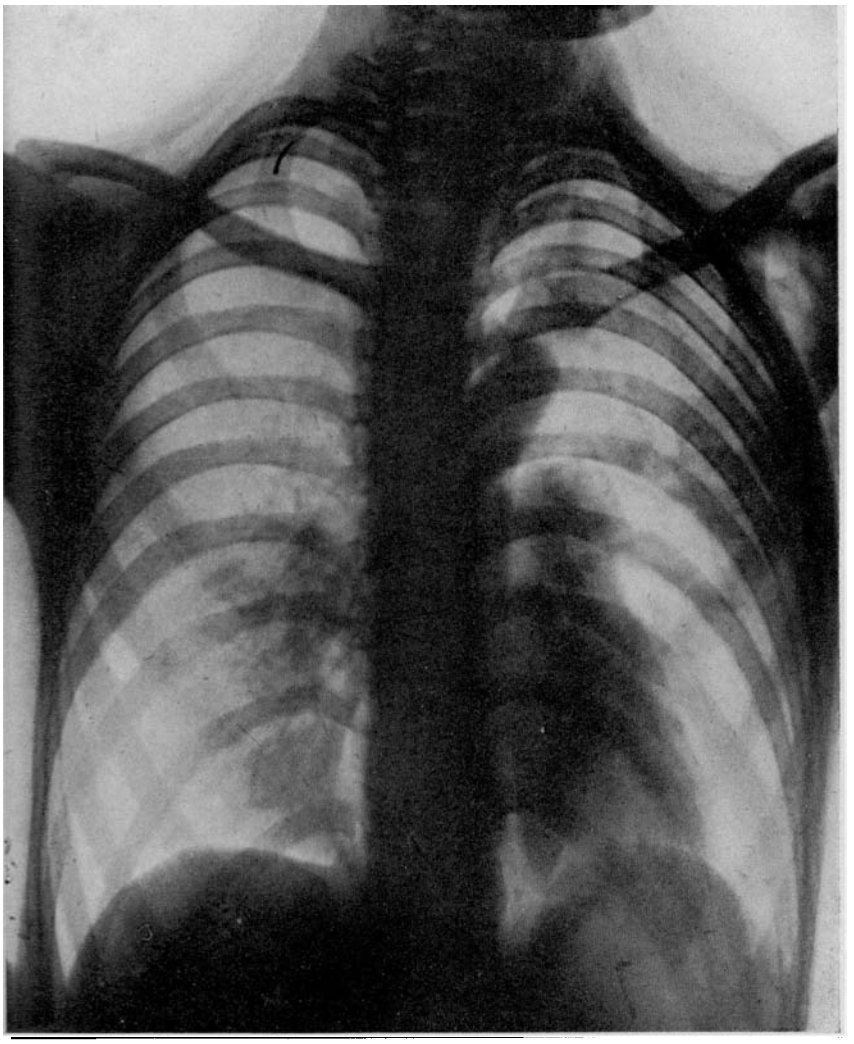
He was transferred immediately to the operating theatre, still propped on his mattress on a trolley, and still having oxygen. There, a laryngoscope was inserted without any difficulty, there was a small amount of dark blood and mucus coming from the nasopharynx. A bronchoscope was passed into the trachea ; a suction tube was attached and also a tube from an oxygen cylinder attached to the anæsthetic tube. This improved his colour slightly. The lower part of the trachea was occupied on the right side by some blood clot which continued down into the right bronchus. This was removed by a suction tube and a good deal of mucus with it. The right bronchus then was clear, and the left one also was cleared of bubbly mucus. His colour was now much better and pulse now countable at 150. Both bronchi and trachea seemed narrower than usual and there was not the usual contraction and relaxation of the posterior muscle with respiration. This may have been due to his mediastinal emphysema. On removing the bronchoscope, his general condition was good, no cyanosis, pulse rate 150, respiration rate 32, he was able to speak and in fact asked for some water. This was given, naturally taking care to see that he swallowed it properly without aspirating any. Owing to his surgical emphysema, his swallowing was slow and difficult.

In the evening his temperature went up to 103·4°, pulse 160, and respiration 35, and the next morning again, temperature 103·4°, pulse 150, and respiration 45. He continued with gradually smaller evening rises of temperature for the next five days, and his pulse gradually became slower to a rate between 80 and 90 (fig. 3). He had some slight cough, rather a cough of irritation and with no sputum. His surgical emphysema gradually receded first in the axillæ and then at the angles of the jaw, and last, at the base of the neck. An X-ray of his chest was reported normal on June 12th, 15 days after his bronchoscopy (fig. 2).

Some concern was caused on June 10th and 11th by a rise of temperature, but this was explained by the appearance of some small and tender glands in the anterior and posterior triangles of the neck. He was discharged from hospital on June 21st.

The case described above was felt to be rather a rare complication of bronchial obstruction, a condition which does not commonly follow removal of tonsils and adenoids. A search of the literature has not found a similar case in this country.

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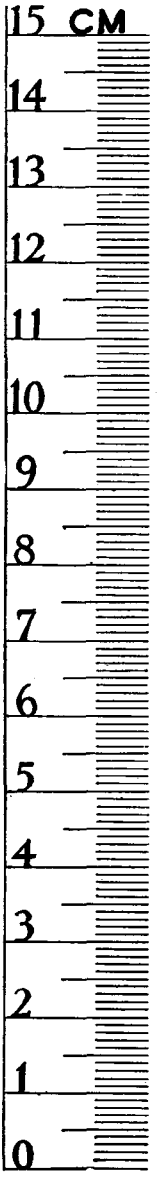


Fig. 1.

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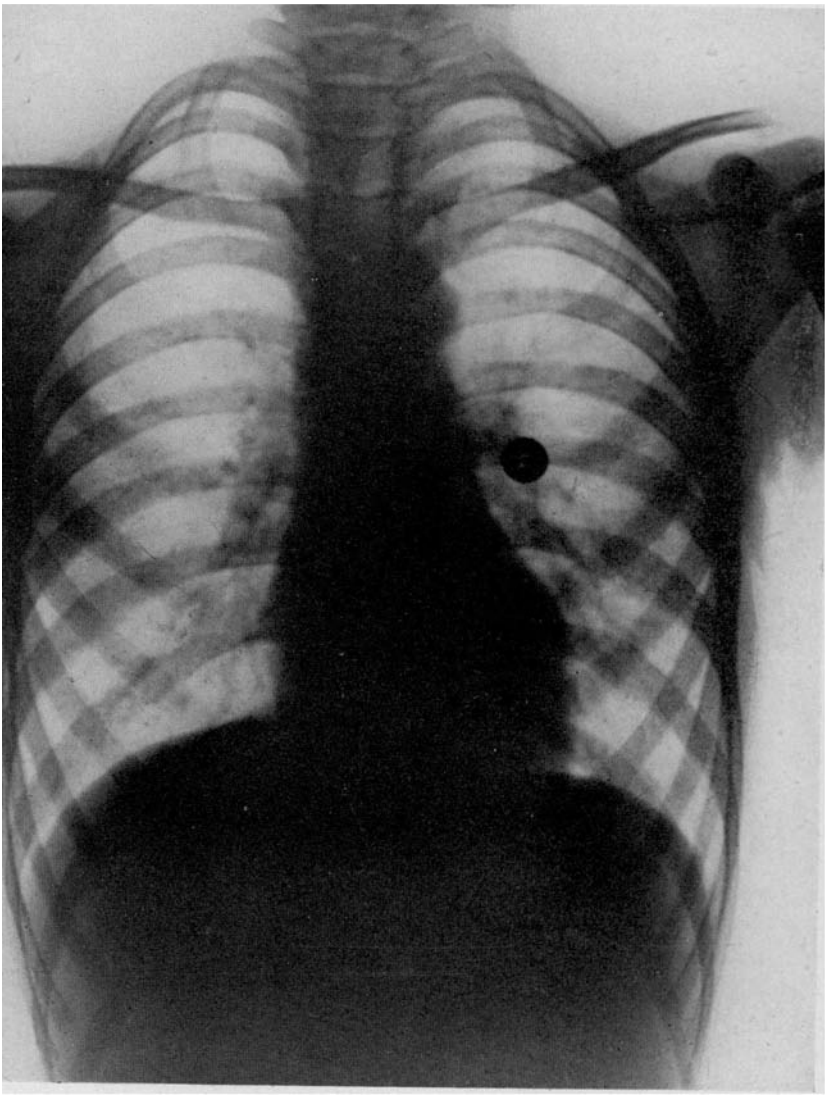


FIG. 2.

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Mediastinal Emphysema

Mediastinal emphysema may be due to a great variety of causes which as far as the lung is concerned, may be divided into intrinsic and extrinsic.

Extrinsic. 1. Injury to lung (from fractured ribs, gunshot wound or pleural puncture) the air passing from the alveoli into the interstitial

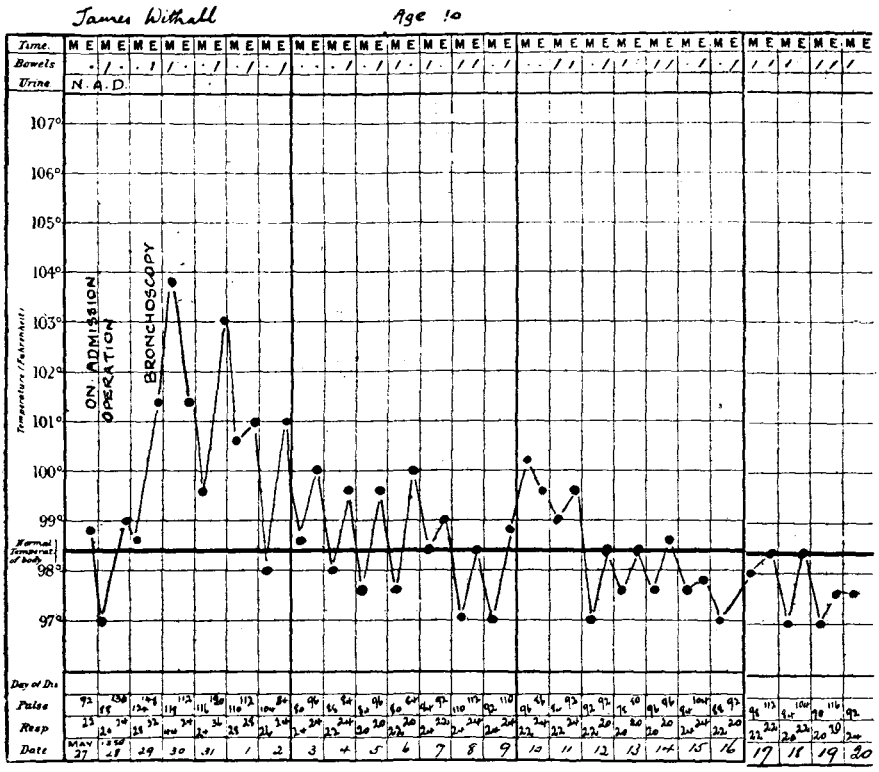


FIG. 3.

tissue and then to the hilum of the lung. 2. Air obtaining entrance to mediastinum through a tracheotomy wound, or wound at base of neck. 3. Through pleura during induction of artificial pneumothorax, due to too great a pressure being used and causing a fissure in the pleura leading to the mediastinum, or causing separation of mediastinal adhesions, and air entering the mediastinum at that site. (Ehrenburg.)

Intrinsic. 1. Infectious diseases, measles with bronchitis, diphtheria and most frequently whooping cough. 2. Anæsthesia during induction by the closed method and also during an intratracheal administration when pressure was raised to 60 mgs. of mercury. (Bauer reported by Ehrenburg.) 3. Violent efforts at parturition and severe paroxyms of asthma. (Sewell.) 4. Foreign bodies causing bronchial obstruction of the valvular type only. Owing to the rise of pressure in one lung or lobe, an alveolus may burst either into the pleural cavity causing

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pneumothorax, or into the interstitial tissues, to result in mediastinal emphysema (McCrae.)

As regards the surgical pathology of the mediastinum with relation to emphysema, a number of interesting facts have been discovered by various workers after artificial pneumothorax. In view of their importance in connection with endoscopy, it has been thought desirable to incorporate them with the report of the case.

Nitsch (reported by Ehrenburg) was the first to announce that the mediastinum as a septum between the two halves of the thorax presented two weak areas. 1. Anteriorly at the level of the second and third cartilages. Here two thin pleural sheets may sometimes be found fused together, but in any case, there is very little support in the anterior mediastinum from the upper margin of the manubrium to the region of the third and fourth ribs. This is the previous site of the thymus, and is occupied only by loose connective tissue. 2. Posteriorly between the spine and aorta at the back and the œsophagus and heart in front. With regard to emphysema, these are two sites where distension of the mediastinum may occur, and this is well shown in the first X-ray picture, especially just above the diaphragm. Vinson and Moersch note the appearance in one of their cases, as if there were air in the pericardial cavity, but it seems more likely that one of these weak areas was distended with air.

Ehrenburg has described also two septa which are situated in the mediastinum and which form in the adults, a tight membrane. Herzog (reported by Ehrenburg) states that in childhood these septa contain less elastic tissue and are more easily injured, especially in whooping cough. Here with perhaps plugs of mucus more in one lung than the other, pressure during coughing may not be equal in the two halves of the thorax.

There is one septum on the right side of the mediastinum applied to the upper part of the superior vena cava. The other is on the left side, running from the arch of the aorta to the left border of the upper part of the pericardium. This left septum limits the distension of the mediastinum in this region, and is shown in the first X-ray picture. Owing to the distension of the right lung, the right septum is situated behind the the sternum.

Once air has arrived in the mediastinum, it distends first the weak areas described by Nitsch, but is limited by the septa described by Ehrenburg and the mediastinal pleura. Then with every inspiration, air is pumped into the mediastinum, while some can get out with expiration. (Baskin.)

Closure of the glottis by cough, forces more air in from the blown-up lung. Having filled the mediastinum, air may spread downwards below the diaphragm along the course of the aorta, œsophagus, or inferior vena cava, causing emphysema retroperitoneally. More commonly it spreads upwards along the connective tissue sheaths of the branches of

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the aorta into the neck, axillæ, and in one case (Vinson and Moersch), into the forearm. It may also dissect a passage from the trachea to the floor of the mouth, extending under the base of the tongue which becomes raised. Sewell reports a case (Šercer and Peičič) where there was emphysema of the mediastinum anteriorly and posteriorly, and the lining of the trachea was distended by air. This was found at post-mortem and must have been due to air tracking up under the mucus membrane of the finer bronchi. Clerf notes also that the trachea was narrowed and retropharyngeal wall pushed forward in his two cases.

As regards the cause of the obstruction in this case, blood clot was aspirated to form a valvular obstruction. In one case (Vinson and Moersch) a paper clip must have caused an injury to the wall of the trachea or bronchus in such a way that a valvular flap was formed, opening in inspiration and closing in expiration. The other cases (9) were of foreign bodies of the vegetal type (Clerf). Baum also reported four cases of vegetal foreign bodies, two of which had mediastinal emphysema. These patients were also *in extremis*, cyanotic with pallor of the upper lip and pulse uncountable. One of Vinson and Moersch's cases was also in a critical condition. This case had surgical emphysema from the mediastinum to the forearm. In both these cases there was no possibility of taking X-ray films in inspiration or expiration so that in the picture shown there is not the contrast between the two lungs.

Baum who reported on cases of laryngo-tracheo-bronchitis, included two foreign body cases with mediastinal emphysema, and noted in the general symptoms of all his cases a peculiar type of cyanosis. They were all in a state of collapse, and were not so much blue as pale, and even in the infective cases had a low temperature. He stated this was due to lack of oxygen in the blood. Some of his cases required tracheotomy and further suction, or repeated bronchoscopy.

The remainder of the cases reported, do not appear to be in anything like this urgent condition, but besides subcutaneous emphysema showed frequent wheezing perhaps shortness of breath on exertion and no cyanosis. The other symptoms were due to the subcutaneous emphysema, slight pain beneath sternum and in neck, slight difficulty in swallowing, and crackling when swallowing or moving the jaw.

In the cases following the formation of an artificial pneumothorax, only local effects due to the subcutaneous emphysema were complained of (Parfitt and Crombie). One of Ehrenburg's cases complained of dyspnœa and another of dizziness. In this type of case all the symptoms disappeared in thirty-six hours.

The difference in the general condition of the patients, one type of patient collapsed and the other in good general condition, depends I think, not so much on the subcutaneous emphysema or mediastinal emphysema, but on the amount of displacement of the whole mediasti-

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num. In both my case and that of Vinson and Moersch, the right side of the arch of the aorta was distinctly visible in the skiagrams to the left of the sternum. This displacement therefore depends on the amount of ballooning of the lung. In none of the other cases reported, was the displacement as large as that, and in none of the others was the patient as ill.

Jessop has studied mediastinal emphysema following external injuries of the thorax, and states that the whole circulatory system is affected by compression of systemic veins causing a drop in blood pressure, and of pulmonary veins causing congestion of the lungs and pulmonary œdema. The arteries and trachea are not affected by the increased pressure. In one case only was the heart directly affected. It is to be expected in these cases where the mediastinum is excessively displaced, that the increased pressure on the systemic and pulmonary veins, would cause further circulatory difficulties. This is thought to be the cause of the cyanosis, collapse, and rapid respiration rate.

From the point of view of prognosis Imperatori's case seems to be most important. The patient two days after choking on a peanut, developed subcutaneous emphysema. Bronchoscopy was performed and the peanut removed. The subcutaneous emphysema diminished very little and the patient died ten days after bronchoscopy.

At the post-mortem a purulent pericarditis was found, and thick creamy pus in the superior mediastinum along the course of the great vessels and trachea. There seemed to be therefore a constant amount of air in the mediastinum supplying the subcutaneous emphysema. In the tissues of the neck this air is constantly being absorbed and therefore air or gas must have been supplied either by the bacteria in the mediastinum or from the leaking alveolus in the lung being kept open by infection. This latter, I think, is the more likely. For this reason therefore, if the subcutaneous emphysema continues for longer than 36 hours, the presence of mediastinal suppuration must be suspected.

In the case reported, the patient was very ill for four days afterwards, and his temperature did not settle for ten days. Forbes in his case states that after removal of a peanut the emphysema disappeared but a stormy ten days followed, resulting in recovery. Vinson and Moersch had one case which required tracheotomy after the bronchoscopy and was put in an oxygen tent afterwards. The case in which the air extended to the forearm was in a critical condition before bronchoscopy and was also put in an oxygen tent. This case, however, was kept in the Mayo Clinic for only four days, whereas my case remained in hospital for three weeks.

In traumatic cases Gatellier has suggested an operation to reduce the pressure inside the mediastinum. Formerly in the occurrence of mediastinal emphysema after an injury to the thorax, thoracotomy had been

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performed, also puncture of the chest by trocar or incisions below the clavicle. Tiegel's method was a four inch incision made in the suprasternal notch down to the trachea, and continuous suction over the wound by a glass bell for 5 days.

Gatellier now recommends opening up of the fascial planes in the neck in front of the trachea and on both sides of it, to behind the œsophagus. He thinks it applicable not only to traumatic cases, but also to this complication in children following whooping cough and bronchopneumonia. In these latter cases, however, there is usually some bronchial obstruction as the primary cause, and it would seem better to deal with that by bronchoscope and suction.

Besides the question of mediastinal emphysema, there remains the condition as a complication of removal of tonsils and adenoids, or rather, of removal of adenoids. Reactionary hæmorrhage had occurred from the nasopharynx, and it is likely that during the night the clot in the nasopharynx had been loosened and was aspirated. In the case of bronchial obstruction, especially of the check valve variety, there is a latent period or symptomless interval, and in this case, it is again possible that the blood clot was aspirated in the early afternoon, and yet did not cause symptoms until the next morning. It may be taken as definite that aspiration did not occur at the time of the operation.

The loosening of a clot in the nasopharynx is a process much less noticeable to the patient than if it had occurred from a tonsillar area. The patient's nasopharynx is already obstructed by blood-clot, and this can quite well be aspirated without the patient noticing it. I have found recently that reactionary hæmorrhage from the nasopharyngeal area is more common after using an adenotome than after an adenoid curette. The hæmorrhage has never been excessive, has never caused anxiety, and its occurrence in these few cases has been outweighed by the efficient clearance of the nasopharynx. I should like to suggest that aspiration of blood clot is more likely to occur from the nasopharynx than from the tonsillar area. From the latter area, blood is more easily swallowed. It follows therefore (I suggest this tentatively, from the observation of this one case) that aspiration of blood and lung abscess following removal of tonsils and adenoids might be due not to carelessness during the operation, but to aspiration from the nasopharynx during the post-operative period.

Cases of this type may be divided into three degrees, according to the amount aspirated and the degrees of obstruction. 1. Massive obstruction causing sudden asphyxia and death or urgent symptoms, as in this case, requiring immediate surgical attention. 2. Smaller amounts aspirated but causing obstruction of a branch bronchus and going on to lung abscess. These are the cases that have been reported in America in large numbers, and have been put down to several possible

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causes, sitting position of patient during operation and embolism from tonsillar area. Another minor factor which may be noted is that the adenotome is used more commonly in America than the curette, which is more widely used in this country. I have not, however, been able to obtain any information about post-operative hæmorrhage from adenoids.

3. Minor degrees of aspiration may lead not to lung abscess but to fibrosis of lungs or bronchiectasis. I have had this occur in one case which had a reactionary hæmorrhage from the nasopharynx. No aspiration was detected but the patient was ill for three weeks after the operation, and since then, the area causing liability to infection such as chills and colds, has been transferred from the throat and nasopharynx to the chest.

Summary

1. A case is described in which after removal of tonsils and adenoids, reactionary hæmorrhage occurred from the nasopharynx, followed in 24 hours by mediastinal emphysema.

2. This was found to be caused by a check-valve bronchial obstruction and relieved by bronchoscope and suction.

3. A short discussion of the pathology and symptoms is given, comparing this case with others reported.

4. Post-operative aspiration of blood from the nasopharynx is considered as a possible common cause for lung abscess following removal of tonsils and adenoids.

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