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BILATERAL TENSION PNEUMOTHORAX OCCURRING DURING OPERATION

BY

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SUMMARY

In certain cases such as those with fractured ribs with and without surgical emphysema, when there has been damage to the oesophagus and also in other types of injury, operation or procedure, it is wise for the anaesthetist to keep in mind the possibility of tension pneumothorax occurring during anaesthesia and surgery. On the other hand, spontaneous pneumothorax occurring during anaesthesia in a previously fit patient, although recorded, is not so common. The following record shows that, although rare, this complication can arise especially when IPPV is being employed and there is in addition a previous history of chronic bronchitis and emphysema. Indeed the lesion may be bilateral.

"All that wheezes is not bronchospasm" (Hamilton and Moyers, 1966). The truth of that statement was borne out recently when a patient developed bilateral tension pneumothorax during operation and bronchospasm was first thought of as a possible cause of the resultant respiratory difficulty.

The occurrence of bilateral tension pneumothorax is of sufficient rarity, certainly drama, to merit our recording this case.

CASE REPORT

In 1958 an adult female attended a mass miniature radiography unit as a result of which she was asked to report at a chest clinic for further investigation of a suspicious pulmonary lesion in the right mid-zone area.

Investigation for tuberculosis was repeatedly negative and the condition was diagnosed as "inflammatory fibrosis, chronic bronchitis and asthma".

Reviews over the next 2 years were satisfactory. However, in October 1960 it was noted that there were cystic changes in the mid- and lower zones of the right lung. Further reviews over the next 7 years were, however, still satisfactory. The asthmatic attacks were mild and infrequent, and well controlled with ephedrine initially and at a later date with Franol (ephedrine, aminophylline and phenobarbitone). At annual review in March 1970 she complained of having lost weight and of menorrhagia. On examination she was found to have an enlarged uterus due to multiple fibromyomata. This diagnosis was confirmed and laparotomy advised.

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Pre-operative examination was negative apart from the pulmonary condition which seemed quiescent, and asthma was certainly not an obvious feature.

Premedication consisted of papaveretum 20 mg and hyoscine 0.4 mg. Anaesthesia was induced with thiopentone 350 mg, and intubation facilitated with suxamethonium 30 mg. Anaesthesia was maintained using nitrous oxide, oxygen and halothane 0.5 per cent. Dilatation and curettage was then performed, by the end of which time spontaneous respiration had returned. The patient was now put into a slight Trendelenburg position and the laparotomy commenced. At this time tubocurarine 30 mg was given and artificial ventilation commenced by hand. Up to this point the conduct of the case had seemed to be proceeding smoothly. The colour was good, and the systolic pressure was 120 mm Hg. The abdomen had been opened and the hysterectomy started.

Shortly afterwards it was noticed that the left radial pulse had become much softer and that the blood pressure had fallen. Her skin colour, however, was still good and ventilation by hand seemed adequate. The low blood pressure was thought to be due to the effect of the muscle relaxant combined with halothane and no undue significance was attached to this finding.

When a Howell ventilator was used to ventilate the lungs it immediately "blew off". The patient's colour was still good and it was thought that the endotracheal tube had kinked. Rather than waste time, another tube was immediately inserted but, despite this, ventilation with the Howell ventilator remained grossly inadequate. Now the patient's colour was definitely deteriorating and both left and right radial pulses were difficult to obtain.

On reversion to manual ventilation it was noted that there was very little movement of the chest wall and bronchospasm was immediately suspected. The neuromuscular block was therefore reversed using atropine 1.2 mg and neostigmine 2.5 mg in the hope that spontaneous respiration might succeed where manual ventilation had failed; even with 100 per cent oxygen she was slightly cyanosed and the systolic pressure had fallen to 40 mm Hg.

Fortunately at this stage the possibility of tension pneumothorax was considered and in view of her previous history it was thought that it would affect the right side.

The diagnosis was confirmed by aspiration of air through a wide-bore needle which had been inserted in the second right intercostal space anteriorly. She improved slightly following this. The improvement was, however, not maintained and her condition deteriorated again and it was thought that she had had a cardiac arrest. It was now suspected that the pneumothorax was not only unilateral but bilateral. This suspicion was again quickly confirmed by aspiration of air through the second left intercostal space. Her condition then gradually improved as the air slowly escaped through both intrapleural needles. As soon as larger catheters were inserted she improved very quickly.

In view of the bronchospasm which was very evident at the end of operation and of her restlessness, and the large volumes of air which were still escaping from both pleural spaces, tracheostomy was performed. (This was primarily done to minimize any sudden rise of intrapulmonary pressure, caused by bronchospasm, coughing or straining in the immediate postoperative period, but also because the subsequent course of the patient's condition seemed quite uncertain to us at that time.)

In fact she made an uninterrupted recovery, the left chest drain being removed on the fourth postoperative day, and the right on the fifth. The tracheostomy tube was also removed on the same day.

Apart from prophylactic treatment with ampicillin (500 mg 6-hourly) and orciprenaline for the bronchial spasm which was present intermittently, no other drug was given either for pain or sleeplessness, apart from nitrazepam, 1 tablet, on the second postoperative night.

Throughout her convalescence she never complained of any pain or discomfort whatsoever. Convalescence was entirely uneventful and the patient was discharged fit 11 days later.

DISCUSSION

Tension pneumothorax occurring during anaesthesia and surgery has been recorded previously (e.g., Temple, 1949; Dundee, 1955; Fairley, 1955; Martin, 1961).

In some cases the condition was suspected and anticipated because of previous or coincident damage to the lungs, air passages, chest wall, or oesophagus resulting from trauma, endoscopy, nerve block, high airway pressures or operation, in the neck or on or near the pleura. In one case (Gleave and Monty, 1963) the diagnosis became evident only when thoracotomy was performed for the resultant cardiac arrest. An excellent paper by Martin and Patrick (1960) reviews the many and varied causes of pneumothorax complicating anaesthesia and surgery.

In this case we were fortunate in that pneumothorax was suspected and diagnosed immediately after simple procedures had failed to improve the patient's condition. As to the exact causation it can only be surmised that the lungs were ruptured separately and directly into the respective pleural cavities by a high airway pressure occurring during manual ventilation of the lungs.

It is well known that when lungs are ruptured, both experimentally and in clinical practice, interstitial emphysema is first produced. The escaping gases then spread up the pulmonary vascular sheaths into the mediastinum, subsequent rupture of the pleura and the occurrence of a pneumothorax being a secondary event. That such a pattern of events did not occur here is suggested by the fact that radiological examination of the chest did not reveal mediastinal emphysema and certainly there was no evidence during the performance of the tracheostomy that gases were present under tension in the deeper planes of the neck.

The right pneumothorax was diagnosed first but it is thought that the condition started on the left side. Our evidence for this is that at a time when the right radial pulse was quite easily felt the left radial pulse had been very difficult to palpate. In retrospect this seems to suggest that the tension was already building up on the left side. This finding, however, was forgotten in the excitement of the moment. Whether there was a separate lesion in the left lung or whether the pneumothorax was simply an extension from the right side will never be known. There certainly was a lesion in the right lung because after the left drain was removed a further 24 hours elapsed before the drain in the right could be removed.

"The possibility of damage to the lungs is considered remote in properly conducted controlled respiration unless a condition such as bullous emphysema is present and rupture even then is probably no more likely to occur during controlled respiration with properly limited positive pressure than during normal life" (Mushin et al., 1969).

It is well known that the pressure required to rupture the exposed and unsupported lungs of various mammals is 40–60 cm H_2O but that when the lungs are supported the pressure required is 80–140 cm H_2O. The maximum safe intrapulmonary pressure is stated to be 70 cm H_2O. Unfortunately the only recorded pressure in this case was 50 cm H_2O. This is the pressure at which

the safety valve on the Howell ventilator "blows off". This happened immediately the patient was connected to the ventilator but, of course, by this time the damage had been done. Pulmonary compliance was decreasing and pulmonary resistance increasing due to the build-up of tension in the pneumothoraces.

It is well known also that the pressure developed by squeezing the thin rubber reservoir bag can, with difficulty, be made to exceed 40–60 cm H_2O. Considering the relative rarity of spontaneous pneumothorax during anaesthesia, manual compression of the reservoir bag must be considered a relatively safe procedure. However, with tight expiratory valves and large gas flows these pressures—40–60 cm H_2O—can easily be exceeded. If, in addition, there is abnormal lung pathology, then the chance of a pneumothorax occurring is obviously increased.

In the present case, before the general condition deteriorated the anaesthesia and the operation had appeared to be proceeding smoothly. Undue pressure had not been exerted on the reservoir bag during the initial period of manual ventilation. There was not a period of coughing or straining during induction, both of which are well known to produce high intrapulmonary pressures. At no time was the reservoir bag allowed to become overdistended. It is thought, therefore, that the pressures used for manual ventilation must have been enough to rupture abnormal lung tissue, such as a bulla, in each lung, directly into the respective pleural cavity.

Nosworthy (1941) indicated that the experienced anaesthetist could appreciate the state of the lung at any particular time and that he (the anaesthetist) was in complete control of respiration. This control and ability to adapt to change was summed up in the term "the educated hand" (Cullen et al., 1954). Mushin and co-authors (1969), however, state that they are dubious and anxious about this supposed attribute. Dubiety had previously been voiced by Egbert and Bisno (1967) and by Robinson (1968). In an experimental study Robinson (1968) found that, irrespective of the experience of the anaesthetist, changes in compliance were difficult to recognize but changes in resistance were more easily appreciated.

We think that in this case high airway pressures were not produced but, of course, there is no proof of this. The pressures that were used must have been great enough to rupture lung tissue.

This experience indicates that the anaesthetist must always be aware that he can produce high airway pressures unknowingly and although in most cases no harm results pneumothorax can occur. Further, if there is a suspicion of abnormal lung pathology airway pressures that might be considered to be within normal limits can well cause the same complication.

In certain operative procedures and in association with certain injuries, the possibility of a pneumothorax being already present or occurring under anaesthesia is well known, but in other cases and in other situations this complication may not be immediately suspected. Consequently treatment may be delayed unnecessarily.

As the success of treatment depends on the speed of recognition the following comment is most apposite. "Pneumothorax must always be considered as a cause of an otherwise unexplained circulatory depression" (Christian, Munson and Hamilton, 1969). Diagnosis can be made so very easily and quickly by inserting a needle through the second anterior intercostal space. Air, if present, will certainly reveal its presence.

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PNEUMOTHORAX BILATERAL PAR PRESSION SURVENANT DURANT L'OPERATION

SOMMAIRE

Il est conseillé à l'anesthésiste de tenir compte de la possibilité d'un pneumothorax par pression survenant durant l'anesthésie et l'opération, dans certains cas tels que ceux avec fracture de côtes avec ou sans emphysème chirurgical, lorsqu'il y a eu un endommagement de l'oesophage et également dans d'autres types de traumatisme, opération ou procédure. Le pneumothorax spontané d'autre part, survenant durant l'anesthésie chez le patient précédement bien portant, a été décrit mais n'est pas fréquent. Le cas décrit montre que cette complication, quoique rare, peut survenir spécialement lors de l'emploi d'une ventilation à pression positive intermittente et lorsqu'il y a une anamnèse de bronchite chronique et emphysème. La lésion peut en effet être bilatérale.

ENTSTEHUNG EINES BILATERALEN SPANNUNGSPNEUMOTHORAX WÄHREND DER OPERATION

ZUSAMMENFASSUNG

Bei bestimmten Fällen, wie etwa solchen mit Rippenbrüchen mit oder ohne operationsbedingtem Emphysem, bei Verletzungen des Oesophagus wie auch bei anderen Verletzungen, Operationen oder Eingriffen tut der Anaesthesist gut daran, an die Möglichkeit eines während der Narkose und intraoperativ entstandenen Spannungspneumothorax zu denken. Andererseits ist ein Spontanpneumothorax, der während der Narkose bei einem bislang gesunden Patienten auftritt, zwar bekannt, aber nicht sehr häufig. Der folgende Bericht zeigt, daß diese Komplikation, obwohl sie selten ist, doch vor allem bei Anwendung einer Intermittierenden Positiven Druck-Beatmung einmal auftreten kann, insbesondere, wenn zusätzlich anamnestisch eine chronische Bronchitis und ein Lungenemphysem bestehen. Die Läsion kann sogar bilateral auftreten.

NEUMOTORAX BILATERAL HIPERTENSIVO DURANTE LA OPERACION

RESUMEN

En ciertos casos, como cuando hay fracturas costales con o sin enfisema quirúrgico, cuando hay lesión del esófago y también en otros tipos de traumatismos, operaciones o procedimentos, conviene que el anestesista tenga en cuenta la posibilidad de que puede ocurrir un neumotórax hipertensivo durante la anestesia y operación. Por otra parte, no es tan frecuente, aunque ha sido registrado, que ocurra un neumotórax espontáneo durante la anestesia en un paciente previamente en buen estado. La comunicación siguiente muestra que, aunque rara, esta complicación puede surgir especialmente cuando se emplea IPPV y hay además una anamnesis de bronquitis crónica y enfisema. La lesión puede incluso ser bilateral.

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