ANAESTHESIA IN STOKES-ADAMS DISEASE*

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STOKES-ADAMS attacks have been recognized for over 100 years and originally were noticed to consist of attacks of syncope occurring in patients with an abnormally slow pulse. Over the past 10 years or so, considerable improvement in our knowledge of the mechanism of these attacks has evolved, together with the development of new methods of treatment for the attacks and for the underlying disease. One form of treatment involves operation and the insertion of an artificial pacemaker. Consequently, in the last 2½ years, 26 anaesthetics have been administered at the Royal Victoria Hospital to 14 patients with Stokes-Adams disease. Moreover, most of these patients belong to an older age group, and with an increased life expectancy, they are likely to be presented for operation unrelated to their primary disease, e.g. bowel obstruction. It is the purpose of this paper, therefore, to discuss certain aspects of the disease of significance to anaesthetists, and to record some of our experience with these 14 cases.

THE DISEASE

Characteristically the disease is manifested by periodic attacks of loss of consciousness recurring at varying intervals of time, and caused by a cardiac arrhythmia.

A sufficient number of cases have now been monitored during an attack, both at this hospital and elsewhere,¹ to classify the types of arrhythmia which cause syncope. Most attacks are due to paroxysmal ventricular asystole, but a smaller proportion of attacks are due to paroxysmal ventricular fibrillation or to ventricular tachycardia. Most patients appear to develop one type of arrhythmia and adhere to it, but, occasionally, a patient will manifest all three arrhythmias at different times, and there is one such case in our series.

The type of rhythm occurring between attacks is interesting. Portal's group from London, England,¹ report 19 cases in which 10 had complete heart block and 9 had varying degrees of atrioventricular dissociation, 16 of their patients had right bundle branch block. Of the 14 patients treated here, at least 5 were in sinus rhythm at the time the attacks were occurring, while 8 were in complete heart block. Three of the cases normally in sinus rhythm were found to have bouts of complete block occurring spontaneously. From the anaesthetist's standpoint, the presence of sinus rhythm does not preclude the possibility that Stokes-Adams attacks may occur at a subsequent time.

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TREATMENT

In the long-term management of these cases the cardiologist's aim is to keep the heart rate up, for it has been found that by so doing, one can prevent attacks of asystole, ventricular fibrillation, or tachycardia from occurring.² Of the various drugs which have been used to achieve this aim, isopropylnoradrenaline and adrenaline have had the most success. They are by no means successful in all cases, or completely reliable in those cases which do respond. This moderate degree of success often requires the administration of the drugs by intravenous drip, which is not a suitable means for prolonged administration.^{3, 4}

For this reason, various electrical methods of maintaining the heart rate at a reasonable level have been devised. The electrical stimuli can be applied to the skin of the chest wall,⁵ but voltages required tend to be high, skin burns are produced, the patient often complains of pain, and each stimulus causes contraction of the pectoral muscles. Percutaneous electrodes⁶ may be passed through the chest wall to stimulate the myocardium, but this method carries the danger of blind myocardial puncture, producing haemopericardium. Furman *et al*⁷ overcame this difficulty by introducing an electrode catheter through either the right external jugular vein or the right brachial vein into the right ventricle, under fluoroscopic control. They found it possible to pace the heart with very low voltages and could even maintain the system for several months. The disadvantages of this method include the necessity of passing a wire through the skin with the associated problem of the occurrence of infection. Chardack⁸ and others^{1, 9} have developed a compact transistorized pacemaker unit with a battery life of 5 years, which can be implanted in the subcutaneous tissues of the anterior abdominal wall and connected by wires to two electrodes sewn into the anterior wall of the ventricles. In this way all the apparatus is contained within the body. Thoractomy is necessary to insert the electrodes, and if the apparatus needs repair, surgery is necessary to effect this.

It is at this point that we need to examine the problems which may be encountered in administering an anaesthetic to these patients.

PREOPERATIVE PREPARATION

The first problem is that Stokes-Adams attacks may occur during the course of anaesthesia. Vandam and McLemore¹⁰ studied 21 patients who had complete heart block at the time of operation, 12 of these cases had Stokes-Adams attacks prior to operation, and, of these 12, 5 suffered circulatory arrest during the course of their anaesthetics. There was only 1 case of circulatory arrest in the group which had not had Stokes-Adams attacks prior to operation, and this was probably a toxic reaction to caudally administered local anaesthetic. In 3 of the 5 cases of circulatory arrest, the attacks occurred more than once during the operation. At least 2 of these cases were in sinus rhythm at the start of anaesthesia. Hodges¹¹ reports on an 80-year-old man who was operated upon for intestinal obstruction. He had a six-year history of complete heart block, and during the course of anaesthesia, there were very many attacks of asystole, one

was even thought to have been precipitated by inflation with oxygen. Two attacks of asystole occurring in an 80-year-old man under anaesthesia for treatment of burns probably sustained in a fall during a Stokes-Adams attack are reported by Ross¹² Zoll¹³ and Howat¹⁴ remark upon the frequency of Stokes-Adams attacks occurring in patients undergoing operation for the insertion of an implantable subcutaneous pacemaker, when these patients are not being electrically paced prior to induction of anaesthesia. The author has personally witnessed an episode of asystole occurring after intubation in these circumstances.

The second problem associated with these patients is the fact that the majority of them are in an older age group and are likely to have some degree of myocardial disease, in fact it is very likely that their Stokes-Adams attacks are due to the disease invading the conducting mechanism of the heart. If these patients are in complete heart block, the combination of a poor myocardium and a slow rate may be sufficient to precipitate congestive cardiac failure. Indeed, control of the congestive failure may not be possible until the heart rate is raised. This is due to the fact that the diseased myocardium cannot increase its stroke volume sufficiently to maintain cardiac output at the slower rate. Johnson *et al*¹⁵ have shown how a patient with a complete heart block in cardiac failure raised cardiac output in response to increasing the rate of an electrical pacemaker.

In order to avoid Stokes-Adams attacks during the course of anaesthesia in patients with complete heart block, and in order to improve cardiac output in a patient with myocardial disease, it is essential to raise the heart rate to the order of 70 prior to the induction of anaesthesia, and to maintain it at this level. The unreliability of drugs in achieving this end has already been noted. The only way of ensuring a constant rate of this order throughout anaesthesia is to pace the heart electrically. It has therefore been the practice here (as in several other institutions^{1,16,17}) to insert an electrode catheter under fluoroscopic control through a vein into the right ventricle as previously described. Not only will this protect the patient from attacks of asystole, but it has been shown that pacing the heart at a rate of 60-90 is equally effective in protecting the patient from Stokes-Adams attacks due to paroxysmal ventricular fibrillation or tachycardia. Those patients with a history of Stokes-Adams attacks who come to operation in sinus rhythm need to be prepared in a similar manner. There are several of the patients in this series who are normally in sinus rhythm and who have had subcutaneous pacemakers implanted. Competition between the patient's own sinus pacemaker and the implanted electrical pacemaker does not seem to present any problems apart from causing an irregular pulse when the patient's sinus is functioning.

The short-term use of the electrode catheter now seems to be free from any great danger, with one exception. Many authors^{18,19,20} have drawn attention to the dangers of inducing ventricular fibrillation with faulty electrical equipment when an electrode is present in the ventricle. Small unsuspected electrical leaks from monitors or electrocardiographs will find their way to ground through the indifferent electrode of a bipolar electrode catheter, or through a unipolar electrode if this is connected to the indifferent (grounded) terminal of the pacemaker. The use of a common ground attached to all electrical equipment will help to eliminate the danger, as also will the use of a transistorized pacemaker.

free from mains or ground connections. The indifferent (grounded) electrode of a unipolar system should be connected to the skin, allowing any current leak to run to ground through this lead. A case of ventricular fibrillation which occurred when using an electric soldering iron to repair an electrode catheter *in situ* has been reported from this hospital,²¹ and this was due to a very small mains leak in the tool.

Several authors^{10 11 12} have analysed the predisposing causes of Stokes-Adams attacks occurring under anaesthesia. The type of premedication, mode of induction, and the agents used for maintenance have all been examined. Intubation and intra-abdominal manipulation, in particular, appear to be stimuli likely to trigger an attack. It is, however, not possible to predict with any certainty what stimuli will, or will not, cause an attack. On the other hand, it is possible to predict with some certainty that attacks are not likely to occur when the patient has been presented for anaesthesia with an electrode catheter already in place driving the ventricles at a rate of about 70 per minute.

ANAESTHESIA

The series of cases operated upon at this hospital comprises 14 patients who have had 26 general anaesthetics. Implantable pacemakers were inserted into all of them and subsequent anaesthesia has been required to rectify faults of one sort or another occurring in the original unit. One patient had his pacemaker implanted under general anaesthesia and then required three more general anaesthetics to service the machine. Another patient had three general anaesthetics on account of his pacemaker and then had a bowel resection under epidural anaesthesia, followed by two more laparotomies under general anaesthesia. During these latter two procedures his implanted pacemaker kept him out of trouble from Stokes-Adams attacks. One patient had a Bartholin's cyst removed under local anaesthesia and another a bronchoscopy after they had had pacemakers implanted. Had the invitation been extended, a general anaesthetic would have been administered with little trepidation, since their implanted pacemakers were working well at that time.

In only three of these operations was an electrode catheter not inserted prior to operation. Unfortunately for the purposes of this paper, anaesthesia proceeded uneventfully in each of them. On a fourth occasion the electrode catheter was found to be unreliable because of position sensitivity. On another occasion the electrode catheter was in place but not switched on until sinus bradycardia and hypotension developed.

Anaesthetic techniques were those in common use for thoracotomy for other diseases. The method of induction chosen was usually oxygen followed by thiopentone, followed by succinylcholine and intubation, but there were variations on this theme down to complete exclusion of thiopentone in one case. Maintenance was usually nitrous oxide with *d*-tubocurarine used to provide muscle relaxation though fluothane was also used quite frequently. When indicated, reversal of the neuromuscular block with atropine and prostigmine was accomplished without event, as would be expected in a patient whose heart is being electrically paced.

Very few problems were encountered. Hypotension of a mild degree occurred in several cases. There was one death 10 days postoperatively, probably due to acute myocardial infarction.

SUMMARY

Fourteen patients with a history of Stokes-Adams disease have received in all 26 anaesthetics, mostly for the implantation of an artificial pacemaker. There is a considerable danger that Stokes-Adams attacks may occur during the course of anaesthesia and, therefore, it is considered important to pace the heart artificially with an intravenous electrode catheter prior to the induction of anaesthesia.

The main danger of the electrode catheter is that minor current leaks from other apparatus (such as an E.K.G. machine) may run to ground through the catheter and cause ventricular fibrillation.

The anaesthetic techniques employed in these cases were varied and were those in current use for other thoracotomies. Few problems were encountered during the course of these anaesthetics, and this is attributed to the fact that in most of the patients the heart rate was controlled prior to the induction of anaesthesia by means of an artificial pacemaker.

RÉSUMÉ

Quatorze malades, souffrant de la maladie de Stokes-Adams, ont subi en tout 26 anesthésies, la plupart pour l'implantation d'un appareil dont la fonction est d'assurer en automatisme artificiel. Étant donné qu'il existe un grand danger de provoquer des attaques de Stokes-Adams au cours de l'anesthésie, il s'impose, avant toute anesthésie, de pouvoir stimuler le cœur artificiellement par un cathéter électrode endoveineux.

Le principal danger du cathéter électrode est qu'une fraction du courant s'échappe d'un autre appareil (tel, un appareil à électrocardiogramme), se dirige vers la terre par le cathéter et provoque une fibrillation ventriculaire.

Chez ces malades, nous avons employé les mêmes techniques anesthésiques variées que nous employons pour les autres thoracotomies. Au cours de ces anesthésies, nous n'avons pas eu de problèmes et nous attribuons cela au fait que, chez la plupart des malades, le rythme cardiaque était sous contrôle avant l'induction de l'anesthésie grâce à l'appareil qui assure un automatisme artificiel.

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