Papers and Originals

Modern Application of Tracheostomy*

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The operation of tracheostomy is one of the oldest in surgery. Just how old and who first performed it is lost in antiquity. It was described as an anatomical exercise by some ancient writers, who never actually performed it on the living person. The immortal Galen himself, who lived from A.D. 131 to 200, was among this number.

About the middle of the sixteenth century Fabricius of Padua wrote a critical assessment of the procedure and its place in the field of therapy. He praised its dramatic benefit to patients with respiratory obstruction at the level of the larynx, but condemned it as actually dangerous in diseases of the lower respiratory tract.

Antonio Musa Brasavola, in 1546, is credited with the first clear account of a successful tracheostomy. It was on a patient *in extremis* with laryngeal obstruction from what was probably Ludwig's angina. Even after the publication of many reports of successful tracheostomies, there were some who still opposed it as both a dangerous and a useless procedure.

A Surgical Heresy

Those who had some faith in the value of opening the "wind-pipe" in obstructive disease of the larynx mostly advocated its use as a late attempt to save life in a grave emergency. How long this surgical heresy persisted! To Chevalier Jackson, more than to anybody, belongs the credit for destroying this false surgical teaching. I can hear him now, in my memories of him, saying to the class: "Tracheostomy is one of the operations which we mostly carry out too late, despite our admonitions to perform it early."

One can sympathize with some of the earlier surgeons who were loath to carry out tracheostomies except in a grave emergency. They had not the benefit of the knowledge we possess of the upsets in blood chemistry resulting from prolonged oxygen want and carbon dioxide retention; nor were they to know that these blood changes affected the whole of the tissues of the body. Perhaps most of all, it was not realized that many of the failures to preserve life were not due to any intrinsic weakness of the operation but to the inevitably fatal nature of the disease which had precipitated the respiratory crisis.

The function of the lower airway, and by this I mean the larynx, trachea, bronchi, and, ultimately, the lung alveoli, is to ensure that an adequate amount of oxygen-containing air is supplied to the blood in the alveolar vessels. Equally so, the carbon dioxide needs to be collected and exhaled. The inspired air is suitably filtered, warmed, and moistened by the nasal mucosa, making it acceptable to the delicate lining of the lower airway. Any changed circumstance which prevents this inward passage of air to the alveoli we know as respiratory obstruction.

Mechanical obstruction of the larynx or its neighbourhood has long been recognized, and the failure of ventilation of the lungs as a result of it has constituted, in the past, the commonest indication for tracheostomy.

In its simple, original form the operation of tracheostomy was only a means of re-routing the inspired air normally taken into the body via the nose, in order to by-pass an obstruction at or about the level of the larynx. Nothing more ambitious than this was claimed for it, though no doubt the value of reducing the "dead space" was recognized by some.

Indications for the Operation

The classical indications for the operation as conceived and taught by Chevalier Jackson were laryngeal stridor associated with (1) sucking in of the intercostal spaces, (2) the suprasternal notch, and (3) the retraction of the abdominal musculature immediately below the sternum. All these signs are indicative of the load placed on the accessory muscles of respiration. Cyanosis should be regarded as a sign of approaching death and not an indication for operation. The need for tracheostomy should be recognized before this.

The dangerous effects of prolonged oxygen want and carbon dioxide retention have already been mentioned. The gradual building up of a high carbon dioxide concentration in the blood over a long period of mechanical ventilatory obstruction conditions the respiratory centres to react to such a high concentration. The sudden saturation of the blood-stream with oxygen after a tracheostomy may result in complete and fatal apnoea because the reduced amount of carbon dioxide in the blood fails to excite the respiratory centre.

This unfortunate happening could have prejudiced people against the operation. It is now known that it is sometimes necessary to carry out artificial respiration after opening the trachea, and to let the patient breathe some carbon dioxide for a few breaths. By this means the dangers of the apnoea may be avoided. The measures described here enable the blood level of carbon dioxide to readjust itself.

I recall that in my early years in the specialty a tracheostomy operation was a rare event in the ear, nose, and throat department of a general hospital, and the handful I remember being performed were done for acute inflammation of the larynx, including diphtheria, for bilateral fixation of the vocal cords due to rheumatic ankylosis of the crico-arytenoid joints, and one case of laryngeal papillomatosis of childhood.

A number of tracheostomies were carried out as the first stage in major surgical operations on the head and neck. This was in the days before endotracheal anaesthesia had become so widely and efficiently practised. There are some of us who still claim that before many operations on the head and neck are carried out a preliminary tracheostomy is a wise safeguard. The advantage of carrying out a tracheostomy in such condi-

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tions enables the surgeon, when working in the mouth or pharynx or even on the jaws, to do so unencumbered by the presence of an endotracheal tube, and at the same time the lower airway can be isolated by means of a cuffed tracheostomy tube. I believe this opinion is shared by Dr. Hayes Martin, of the Memorial Hospital in New York.

Some twelve months or so ago the members of my staff at the Manchester Royal Infirmary carried out 14 tracheostomies in one week in the various departments of the hospital and none of these was done for the relief of laryngeal obstruction, but for such general diseases as tetanus, severe head injuries including facial injuries, severe injuries to the chest, myasthenia gravis, and cor pulmonale associated with an acute exacerbation of chronic bronchitis with emphysema. This simple fact demonstrated very clearly, I think, the widening and changing application of tracheostomy as a therapeutic procedure.

Pattern of Lung Clearance

Traffic movement in the lower respiratory tract is not, however, always towards the alveoli and the lower reaches of the bronchial tree. There is movement in the opposite direction in the form of expired air and the normal secretions of the mucous glands of the trachea and bronchi. This latter fluid, when in normal quantities, is carried towards the larynx by the action of the cilia, or, when excessive, the bronchioles and alveoli are cleared by the "tussive" squeeze of the lung tissue. This squeezing is brought into play by the contraction of unstriated muscles and elastic tissue in the alveoli and bronchial walls. The final expulsion through the larynx is carried out by coughing, which is sometimes called the "bechic blast." Both mechanisms are brought into play as a result of vagal-originating afferent impulses exciting the respiratory centres in the medulla and the pneumotaxic centre in the pons.

When the fluid content grossly increases in amount or its physical properties change, particularly where the viscosity is increased, this normal pattern of lung clearance may fail. Equally, if the neuromuscular mechanism fails, stagnation of secretion takes place in the lower airways, producing a disturbance of lung ventilation. This disturbance brings in its train failure of the proper interchange of carbon dioxide and oxygen with the blood-stream: the gaseous exchange is so obviously necessary for the maintenance of the normal body economy and even for survival.

The problems created by mechanical ventilatory obstruction pale before those aroused by secretory ventilatory obstruction, and it is the varying aetiology of this that accounts for the ever-widening application of tracheostomy and its use in association with artificial respiration and aspiration of the bronchial tree.

A Better Understanding

Perhaps the first hint of a better understanding of the more recent application of the operation can be recognized from the writings of Montgomery in 1885. It was he who developed suction clearance of the lower airway through the tracheal opening, and it would seem, too, that he realized that it was something more than oxygen depletion in the circulating blood, something more toxic in behaviour, that was responsible for the mischief associated with failure of ventilation of the lower airway.

The first contribution of major importance in the management and significance of non-mechanical ventilatory obstruction dates from 1943, when Galloway produced his report on the benefits of tracheostomy in poliomyelitis. Since that date tracheostomy has become well accepted for ventilatory distress from every conceivable cause.

Ventilatory failure produces hypoxia, or shortage of oxygen in the blood, and hypercapnia, or excessive concentration of

carbon dioxide in the blood, and, as a result of this latter, a form of acidosis. This composite group of changes produces the pathological state which we know as asphyxia. When hypoxia is present in the body, and in the lung particularly, capillary permeability is increased and pulmonary oedema results. Coexisting damage from a similar cause is produced in the nervous system and cardiac muscle. All these offer a serious threat to life.

The toxic effect of the acidosis is further accentuated by the formation of lactic acid in the tissues through lack of oxygen. Hypercapnia in its clinical presentation gives rise to headache, restlessness, unresponsiveness to conversation, disorientation, and in the last stage of all to narcosis and, finally, to respiratory depression and circulatory collapse.

It is on the prompt recognition of these clinical manifestations and the institution of appropriate counter-measures that the patient's life will depend. Perhaps the most important single step in the treatment is the performance of a tracheostomy. This may not be sufficient in itself and may necessitate the institution at once of aspiration of the bronchial structures.

In 1952 Copenhagen suffered a severe scourge from an outbreak of poliomyelitis. This event was not only important for the severity of the epidemic but also because it was through it that a new understanding of the underlying causes of the high mortality in poliomyelitis was uncovered. These discoveries not only helped new principles for the treatment of deficient ventilation in poliomyelitis, particularly in the bulbar type, to be laid down, but made the application of these principles possible and necessary in a much wider variety of diseases.

As Professor Lassen of Copenhagen has pointed out, the belief that the fatal cases in poliomyelitis resulted from central damage from the virus by putting out of action the brain-stem and cerebellum is incorrect. Death results from the failure of oxygenation and the lack of proper elimination of carbon dioxide. It is ventilatory failure which offers the menace to life. This of course may be due to damage to the reflex mechanism which initiates and controls breathing, but the deciding factor of survival appears to depend upon adequate alveolar ventilation. It is accumulated secretions in the lower reaches of the airway which offer the greatest threat to efficient ventilation. Once this lesson had been learnt and intelligent measures to combat the factors controlling this ventilatory inadequacy were introduced, the mortality rate was reduced from 60–80% to 20–40%.

The most powerful weapons in combating inadequate alveolar ventilation had, without any doubt, been the increased use of the operation of tracheostomy and cleansing of the lower airway by direct suction with or without artificial respiration by artificial lungs or by intermittent positive pressure from some form of breathing machine.

Basic Facts of Respiration

Before we can hope to understand the application of tracheostomy in its widest sense, it is necessary to remind ourselves of the basic facts of respiration.

If we turn to the story of the development of the lower airway—and where better to find this than in the works of Sir Victor Negus—we can build from this point.

When some of the primitive types of fishes became wholly or partly terrestrial the gill mechanism, by which air dissolved in water could be absorbed and its life-maintaining oxygen utilized by the animal, became inadequate, and the substitution of a gaseous environment for a watery one called for a completely different oxygen-absorbing mechanism.

There appear now in the animal scale the lung fishes which spend some seasons in the water and others on dry land. They have developed a diverticulum from the pharynx. The ostium

of the diverticulum is surrounded by a sphincter which prevents water and other materials from entering it when using the gills in water. The diverticulum of the lung fishes is a primitive lung guarded by the sphincter muscle, which is a primitive larynx. They are now adapted, so far as their respiratory mechanism is concerned, to their amphibious life. The protective function of the larynx in relation to the lower airway is never lost and remains its most important duty despite the ultimate use of the larynx for vocalization. The failure of this mechanism in the human is fraught with grave risks to the lower airway. Without it even the nasal secretions, the saliva, vomitus, and any foreign body would invade the lower airway, disturbing the whole physiology of the alveoli.

In the human the flow of air into and out of the lungs results from the changes in the cubic capacity of the chest cavity. This variation in the capacity of the cavity results from the expansion or contraction of the boundaries of the cavity, but the direction of air movement in or out of the lung is governed by the pressure differences between the outside air and the air in the lungs. When the thoracic pressure is greater than the pressure of the surrounding atmospheric pressure expiration takes place. When the pressure in the thoracic cavity is less than atmospheric pressure inspiration results. The action is similar to that of bellows.

Increase in the cubic capacity of the cavity is brought about by the forward movement of the anterior chest wall, the posterior being mostly fixed as it is made up of the spinal column. The forward movement of the sternum is a secondary result of the lifting and rotation of the ribs, and this latter is one of the functions of the intercostal muscles.

Inspiration is very definitely an active process. Expiration is mostly passive, except under special circumstances, most typically in the forced expiration in coughing.

There are three centres in the brain related to respiration; the inspiratory centre, which is situated in the medulla, is the most active and controls the functions of the chest muscles. The expiratory centre, also situated in the medulla, when stimulated produces forced expiration and acts as an inhibitor of the inspiratory centre. The pneumotaxic centre is in the pons and is concerned with expiration, sending its impulses to the expiratory centre in the medulla. The function of the expiratory centres therefore is largely to inhibit the inspiratory centre. There are also inhibitory nerve stimuli resulting from a stretching of the lung, which are sent along the vagus nerve to the inspiratory centre. The stimulus produced by stretching of the lung and its effect upon the respiratory centre is sometimes described as the Hering-Breuer reflex.

The respiratory centres are sensitive to the pH and the carbon dioxide blood tensions. Structures like the chemoreceptors located in the carotid and aortic bodies are for the most part sensitive to the oxygen tensions. From this it follows that any circumstances which prevent the proper diffusion of these two gases in the alveolar air can produce gross disturbances of the depth and rate of breathing or, by secondary disturbance of the body chemistry, produce failure of the respiratory centres.

Reference has already been made to the necessity of keeping the lower airway free of accumulated secretions, whether these be the normal products of lung metabolism or the foreign material which enters the lower airway through an incompetent laryngeal sphincter mechanism. The task of clearing the airway may be hampered by a paralysis of the respiratory muscles. The natural protective value of a cough may be lost owing to the inability of a patient to execute a sufficiently powerful cough, as occurs in painful and gross injuries to the chest wall, where the patient is loath to cough or where the chest wall is so damaged that the essential stability of the thoracic cage is lost. It is in the event of any of these failings that the tracheostomy, combined with suction clearance of the airway, can contribute so much to the survival of the patient.

The Operation

While it is not intended that this paper should enter very deeply into the realms of operative surgery, a few observations on tracheostomy of a fairly general nature would not be out of place at this stage. Whenever possible the tracheostomy should be a planned procedure. It can be carried out under local anaesthesia, and if there is serious depression in breathing this is the best way to proceed. What should be kept in mind is the danger to a badly hypo-oxygenated patient if respiration should be suspended for any appreciable time during operation. This further load in patients with marginal respiratory efficiency may sway the balance against the patient's survival or result in permanent damage to the brain.

The decision whether to introduce an endotracheal tube before doing the operation may call for fine surgical judgment, and this may, in practice, depend upon the surgeon's knowledge and confidence in his anaesthetist. Most surgeons would agree that the tracheal stoma should be made as high as possible, certainly no lower than the second and third rings, but taking care to avoid the cricoid cartilage. This will in most cases leave the tracheostomy tube, whatever its type, well clear of the suprasternal notch. It also diminishes the risk of the tube passing to or beyond the carina and hindering its efficiency. Windows must be made in the anterior segments in two of the tracheal rings. A tracheostomy tube should be chosen so that if fitted with an inner tube this latter should be of such a calibre that it will allow the passage through it of catheters at least size 4 of the English gauge. A smaller size would be necessary for children. This is to make it possible to carry out, if so required, suction aspiration of the lower branches of the bronchial tree. This latter manoeuvre must be performed without risking the dangers of too high a negative pulmonary pressure, which may produce pulmonary oedema, one of the very conditions against which one's labours are being directed.

The choice of a tracheostomy tube is mostly a matter of individual fancy. If for any reason there is a risk of aspiration of foreign material, including blood, vomitus, or nasal secretions, the cuffed tracheostomy tube must be used to isolate and protect the lower airway. The "cuff" should be designed so that, when inflated, its contact with the tracheal wall should be fairly diffuse and not of a small type that produces points of high pressure. The localized pressure points are apt to produce focal necrosis of the wall.

Operative Risks

A valuable weapon though tracheostomy may be in the surgeon's armoury, its use is not free from risk, nor does its successful performance mean an end to the surgeon's worries. The incision which opens the trachea may so open the fascial spaces in the neck that, as a result of forced inspiration, air may find its way more easily into the mediastinum than into the lungs. This state of affairs holds particularly when the tracheostomy tube is incapable of taking the full load of the inspired air, but most of all when the tube has slipped out of the trachea. Air finding its way into the mediastinum gives rise to a recognized if not well-known condition of "tension pneumothorax," commoner in children and, if unrecognized, fatal. Aspiration of the trapped air in the thorax is the correct treatment, with, of course, the proper positioning of a misplaced tube.

The advantage of performing a tracheostomy on patients suffering from apparently differing diseases should be assessed against the background of the following fundamental observations.

The operation in the first place enables gases to enter into the trachea by by-passing laryngeal and pharyngeal obstructions. Basically, it does not matter whether this by-passing takes place by natural or by artificial respiration. Moreover, aspiration of

the secretions from the lungs enables the very important diffusion of the respiratory gases to and from the pulmonary blood-vessels. The cuff tracheostomy tube will guard the lower airway from insults by injury from foreign materials when the natural protection of the lower airway is lost.

Points in Management

As has already been pointed out, the management of patients with brain injury or brain disease, or of patients suffering from coma from any source and those whose life is in danger from thoracic injuries, and even cases of tetanus, springs from the lessons learnt in the treatment of bulbar poliomyelitis. In the case of cerebral accidents, head injuries, or major neurosurgical procedures the chances of recovery may be considerably reduced by the rise in intracranial vascular pressure due to respiratory obstruction. Increases in intracranial pressure may produce an excessive pulmonary secretion; this further jeopardizes the patient's life by accentuating ventilatory insufficiency. Any increase in intracranial vascular pressure may also produce further bleeding in a damaged vessel, and, in the case of surgery, a reactionary haemorrhage. Following on this, the intracranial contents become more crowded and pressure may be produced on vital structures such as the respiratory and vasomotor centres. Tracheostomy and aspiration of the lower airway will help to check this dangerous vicious circle. In the case of tetanus, where the patient may be treated with large doses of curare plus other forms of sedation, tracheostomy, plus the use of a respirator, is just as essential as it is in bulbar poliomyelitis. Basically the problem of the patient's treatment is the same.

In patients who suffer from injuries to the chest or have major thoracic operations and suffer from post-operative disturbances of the respiratory physiology, there again will be an increase in the amount of lung secretion and, as pointed out earlier, the decreased ability to get rid of the secretions by natural means. There may also be bleeding into the bronchial tree, and this makes aspiration more than ever important. Increased use of the tracheostomy operation with suction in conditions like cor pulmonale from acute exacerbations of bronchitis with emphysema needs no elaboration, though some physicians still have their reservations about tracheostomy and suction in these cases.

When aspiration is to be used a proper selection of soft Jacques's rubber catheters should be at hand; additional perforations near the distal end of the catheter reduce the risk of tracheal mucosa being sucked into the catheter. This event would cause dangerous trauma to the lining mucosa.

The catheters should be sterile, and lubrication can be attained by the use of sterile water or non-greasy jelly. Crusting in the trachea or excessive viscosity of secretions can be dealt with by means of an aerosol mist sprayed in concentrated form over the tracheal stoma, softening with a saline solution, or use of detergents such as Alevaire. Trypsin is also used for softening the crusts: it liquefies inspissated secretions without irritating the mucosa, which is the case when streptokinase or streptodornase is used for this purpose. Further, more stubborn crusting will require a bronchoscopy and removal of the resistant crusts by direct attack.

Aspiration needs to be carried out gently and carefully, as trauma could excite more bleeding. This, again, would increase the ventilatory obstruction. Overenthusiastic aspiration at too high a pressure or for too long a period can be dangerous by lowering the oxygen concentration in the alveoli.

People with most experience of suction clearance of wet lungs are agreed that even untrained nursing staff can learn the knack of this technique. But, of course, this does not justify the neglect of skilled nursing or a careless and slap-happy approach to it.

The tank respirator, better known as the iron lung, was one of the first successful machines designed for carrying out

artificial respiration for a long period. As a machine it is very efficient, but it is big and rather cumbersome, and the pressure differential between the right atrium and the limbs is apt to impede the venous return to the right heart. Its best use is in cases of weakness of the respiratory muscles but where obstruction to the airway is minimal.

The cuirass and Tunncliffe breathing-jackets are smaller and more manœuvrable than the tank type, but have the disadvantage of being less efficient as a ventilating mechanism. The shape of the cuirass limits the lateral movements of the ribs which, with the forward movement of the manubrium sterni, form part of the normal respiration by increasing the cubic capacity of the thorax. The patient's breathing, where this restriction of the thoracic cage exists, is mostly diaphragmatic in type. With the breathing-jacket fixing and splinting of the chest is not so marked, and it is therefore capable of taking more air in than the cuirass breathing mechanism. Both these respirators are used for patients who can breathe unaided for long spells and find the need for supplementary breathing sometimes, particularly at night.

Paul Bragg's respirator differs from the other types in that pressure is used to provide inspiration; the other types promote expiration. This is brought about by inflating a rubber belt which fits round the lower chest and abdomen. Pressure on the abdomen forces the diaphragm into the chest. Inflation of the lung is brought about by a small electric pump. It is light, portable, and efficient. It helps damaged respiration but does not completely replace the respiratory act. The inspiratory phase is brought about by the diaphragm's descent either by its musculature or by gravity. It is best used in cases where the intercostal muscles are still functioning but where the diaphragm is not.

Conclusion

In my professional lifetime I have seen many changes and much progress in the treatment of the sick. In the realms of medicine I have seen the discovery and use of insulin for diabetes. The conquest of pernicious anaemia has been one of the landmarks in medical history. My own specialty has witnessed the spectacular development of micro-surgery of the ear.

In the preparation of this paper I have found the story of the development of the operation of tracheostomy a fascinating one. Only a small part of it I have been able to tell you. I am conscious of the fact that I may have oversimplified many of its associated problems. I hope I have not given the impression that its use is a kind of surgical magic. The voluminous literature on the subject of recent years is a measure of the interest aroused by every branch of medicine and surgery.

The thinking on its many applications as a means of treatment has in our specialty, in this country, been much influenced by J. M. Kodicek. Kodicek is the otorhinolaryngologist in our neighbouring city of Chester. His essay on tracheostomy in respiratory insufficiency, which won for him the Logan Turner Prize in 1960, is a classic. Among the many interesting practical facts, he tells us that in his personal survey of all the departments of the London teaching hospitals he found that the number of tracheostomies in 1955-9 had increased by five times the number performed in 1945-54.

If in this talk I have excited interest in the therapeutic values of this "old operation in a new guise," I shall feel that that is sufficient reward for my labour.

May I, in conclusion, acknowledge in general terms my thanks to the many sources of information upon which I have drawn for the material of this talk. Some I have mentioned, but I would add to these a special one, the monograph *Tracheostomy* by Major Thomas Nelson, of the U.S.A.R., and to the work of Dr. Spalding and Dr. Crampton Smith, of the United Oxford Hospitals. To Dr. Betsy Brown, my University

Lecturer, go my thanks for obtaining much of the literature on the subject. To Miss Shirley Moss for the typescript, and to my wife for her tolerance and patience during the paper's preparation goes my sincere gratitude.

Summary

A brief résumé of the early history of the operation of tracheostomy is given in which is pointed out the strong difference of opinion among the earlier physicians in regard to the value of the operation: tracheostomy being originally an operation conceived on a purely mechanical basis as a means of short-circuiting entry of air into the lower airway by bypassing the larynx. Reference is also made to the upset in blood chemistry from prolonged oxygen want and the risk of fatal apnoea after the successful performance of a tracheostomy in such cases.

Starting with the observations of Montgomery in 1885 and reinforced by the work of Galloway in 1943, a better appreciation and wider application of tracheostomy begins to develop.

The work of Galloway is contained in his report on the "Benefits of Tracheostomy in Poliomyelitis." The recognition by Professor Lassen, of Copenhagen, that poliomyelitis deaths were due principally to deficient ventilation and ventilatory failure formed the real basis of the modern application of the use of tracheostomy in a wide variety of conditions.

The article then explains the basic factors of respiration and goes on to outline the applications of the principles, resulting from Professor Lassen's observations, in conditions varying from severe head injuries, severe injuries to the chest, and ventilatory failure resulting from diseases of the chest.

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Present Treatment of Schizophrenia— a Controlled Follow-up Study

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The treatment of schizophrenia has undergone revolutionary changes for the better during the past 30 years, largely because of the discovery of new physical methods of treatment. Before their introduction, Guttman, Mayer-Gross, and Slater (1939) investigated 188 specially selected schizophrenics who had had treatment at the Maudsley Hospital in 1934 and 1935. Only patients under 46 who were having their first breakdown and had an apparent history of less than one year's duration were considered. The average length of hospital stay, however, was still 4.6 months, and no less than 41% were in hospital when followed up three years later. Insulin coma (Sakel, 1935) and convulsive treatment (Meduna, 1935) were then introduced, and Hoenig, Leiberman, and Auerbach (1956), comparing the results of a group of schizophrenics treated with insulin coma and E.C.T. (1948–50) with a comparable group (1934–5) treated before their introduction, found that 68% of the "treated" group improved, compared with only 35% of the "control" group. To find out whether insulin was the specific therapeutic agent in the treatment of schizophrenia Ackner, Harris, and Oldham (1957) compared the results of insulin and of a deep barbiturate-induced coma on matched pairs of patients. They concluded that insulin was not the specific therapeutic agent, although the coma regimen might explain its value. In fact, prolonged sleep treatment has been extensively used in Russia, and the results, although not as spectacular, compare favourably with those of insulin coma (Ivanov-Smolenskii, 1939). It is interesting that Ackner's patients gained a lot of weight during treatment, as do insulin-treated and sleep-treated patients.

The introduction of phenothiazines was the next major advance in treatment. To find out the advantages of using chlorpromazine, E.C.T., and insulin subcoma, rather than full coma and E.C.T., Rohde and Sargent (1961) reported the results of two groups of schizophrenics treated at St. Thomas's Hospital, before and after the introduction of chlorpromazine

in 1956. They found that the length of stay in hospital had fallen from 10.7 to only 6.3 weeks, and that the "phenothiazine-treated" patients showed a significant advantage over the "insulin-coma-treated" patients, when followed up two years later. The change in prognosis seemed so great, amounting to a treatment revolution, especially in the earlier cases of this dreaded illness; and so we felt it most important to follow up a further similar group, to see if these favourable treatment results were confirmed by it or not.

Present Series

The present investigation is a follow-up study of 48 more patients suffering from schizophrenia who were treated in the psychiatric in-patient unit between 1960 and 1963. They were practically all diagnosed and selected by one of us (W.S.) as likely to benefit from intensive treatment, and were fully discussed at the weekly case conferences. Their average age was 29.6 years; 20 were male and 28 female. The average length of time since the onset of symptoms suggestive of schizophrenia was three years and four months, so by no means all were early patients; but most still seemed treatable. The average duration of the *present* attack was, however, only 12.1 months. Twenty (42%) had had previous in-patient treatment. Only patients who were admitted to our unit *for the first time* were included in this series, because those patients who had previously been admitted formed part of the earlier series (Rohde and Sargent, 1961).

Treatment 1960–3

The patients were treated in a pleasant general hospital psychiatric unit of 20 beds, mostly in single and double rooms. This is situated in the Royal Waterloo Hospital, which became part of St. Thomas's Hospital at the start of the National

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