POST-OPERATIVE CARE

The first dressing after the operation is done at the end of twenty-four hours, the plan of packing the original dressing being resorted to if needed. There is a good deal of shock with the first dressing, and an ounce of neat brandy is always given ten minutes after the dressing has been completed.

The patient is allowed to assume whatever position he finds comfortable, and this is one of the advantages that are claimed for the omission of the catheter after the operation. At Guy's, the practice in my hands is to allow the bladder to fall back into its usual position, as an anatomically correct bladder is much more likely to work naturally and physiologically than if it be anchored to the abdominal wall.

An important point (an anatomical one), to which my attention was first called by Dr. Le Vieux of Mauritius, is that across the very centre of the suprapubic wound there runs a deepish furrow that is really a line of abdominal flexion, and this groove tends to open up the wound. Therefore, if it be desired that the wound should close as soon as possible, it is essential that the patient should lie flat upon his back at the end of fourteen days with a catheter *in situ*, so as to get rid of the groove and its tendency to open up the wound. A catheter is thus sometimes used whilst the final process of closing of the wound is taking place.

If bleeding should occur a little time after the operation, as it sometimes does, a good position for the patient is that in which the buttocks are raised and the legs and body depressed. This position causes the prostatic region to be much higher as far as gravity is concerned than it is usually, and thus the bleeding may diminish or cease.

After the operation careful attention must be paid to getting the bowels to open properly. For this purpose the laxative that the patient is accustomed to is tried first, but if this fails to act castor oil is given, and if this also does not act then a turpentine enema. Ileus must be prevented. It is very dangerous in itself, and also dangerous as indicating that the patient is weaker than may have been supposed, and that other organs besides the bowels are failing. Therefore it must be treated assiduously.

The lungs must be watched. There is too great a tendency for the medical attendant to wait for signs of pneumonia to show themselves. Various symptoms arise after such an operation. By some people various alkaloids are ordered, one for each separate symptom. This is a bad method of treating such cases. Far better with some old and tried medicine to anticipate symptoms, and prevent worse ones occurring.

Since the employment of boric crystals, which are used to fill up the wound, there has not been a case in Guy's Hospital genito-urinary department of sloughing of the wound, but if it does occur the sloughs should never be forcibly removed. Such a procedure will only lead to further infection of the wound, and perhaps to the death of the patient. It is possible that this sloughing may follow the use of india-rubber drainage tubes, for such tubes contain free sulphur, which has its uses in certain septic urinary cases, but is not wanted after prostatectomy. The second point to remember is that sloughing may indicate that the patient is dying, and in these circumstances there may be actual gangrene of the wound.

Lastly, stress may be laid upon two additional details: (1) in a certain number of cases it is important that the wife should be kept away from the patient for two or three days after the operation; (2) as soon as the patient is to be allowed up a carefully fitted suspensory bandage should be properly applied, as it is not an unknown experience for orchitis to occur some time after the operation, and even when the patient has gone home.

CO₂ IN PROPHYLAXIS AND CURE OF POST-ANAESTHETIC RESPIRATORY COMPLICATIONS *

BY

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These notes are based on an experience of 5,000 cases in which carbon dioxide was administered in combination with general anaesthesia. Among the advantages which accrue to the surgical patient three stand out prominently:

1. The prophylactic action of carbon dioxide against the onset of respiratory complications, irrespective of the anaesthetic agent.
2. The protection afforded to patients who come up for operation with concomitant respiratory disability.
3. The curative action of carbon dioxide when post-anaesthetic respiratory complications have occurred.

For purposes of observation I arranged these cases in four groups. In the first and largest group carbon dioxide to the extent that appeared advantageous to the patient was administered in the theatre, during the induction, the maintenance, and the recovery stages of gas, oxygen, and ether anaesthesia. In the second group carbon dioxide was used in the induction and recovery stages of deep ether anaesthesia. In the third group carbon dioxide was used as a prophylactic against respiratory complications during the recovery stage of anaesthesia in the theatre and in the ward after the operation. In the fourth group carbon dioxide was administered as a therapeutic agent in cases of post-anaesthetic respiratory complications. The tendency has been for the first three groups to merge into one, and recently, as far as it has been possible, my cases have had carbon dioxide during the induction of and recovery from anaesthesia, in the theatre and in the ward, at regular intervals throughout the first twenty-four to thirty-six hours after the operation.

ABNORMAL RESPIRATORY FUNCTION DURING AND AFTER ANAESTHESIA

The function of respiration is ultimately dependent on the integrity of the respiratory centre which lies in the floor of the fourth ventricle. Near to it the nuclei of the vagus nerves take their origin, and a proper appreciation of the close relation of these nuclei to the centre is of considerable importance in anaesthesia. The vagi distribute fibres to the pharynx, the larynx, the pulmonary and cardiac plexuses, and the abdominal viscera. Afferent stimuli¹ from these systems, excited either by the anaesthetic agent or by surgical trauma, profoundly disturb the respiratory function. In one case the clinical result is hyperpnoea followed by apnoea, while in another the effect is expressed in slow, shallow, and irregular respiration. Unilateral or bilateral inhibition of the diaphragm frequently occurs in abdominal operations, as a result of reflexes through one or both phrenic nerves. The volume of the pulmonary ventilation is chemically controlled by the percentage of carbon dioxide in the alveolar air, the blood, and the tissues. Normally, any increase or decrease of this percentage will increase or decrease the volume of the respiration to such an extent as will maintain the carbon dioxide in the alveolar air at about 5 to 5.5 per cent. Acapnia is a condition in which the percentage² of carbon dioxide in the blood and in the alveolar air is subnormal, and apnoea supervenes when the carbon dioxide tension in the respiratory centre falls³ below the

* Read in the Section of Anaesthetics at the Annual Meeting of the British Medical Association, Eastbourne, 1931.

point required for stimulation, provided always that the oxygen tension is sufficient to prevent stimulation of the respiratory centre by anoxaemia. If the oxygen pressure in the inspired air continues below 13 per cent. of an atmosphere, the respiratory centre becomes excited and its function stimulated. Every degree of acapnia is possible in the surgical patient. Such factors as fear, pain, morphine, purgation, vomiting, starvation, anaesthetic agent, and surgical trauma militate against the normal carbon dioxide content of the blood and tissues.

The pulmonary alveoli at the base and periphery⁴ of the lung are larger than those at the root and apex. On inspiration the lower and peripheral parts of the lung expand and function more readily than do the central and upper parts. The inflation of the lower and peripheral alveoli is almost entirely dependent on the action of the diaphragm. Any interference, therefore, with the mobility of the diaphragm, such as may occur from exposing the abdominal cavity to atmospheric pressure,⁵ or from manipulation of the abdominal viscera, will result in defective expansion of the lungs, particularly of the bases and periphery. When apnoea supervenes on a period of deep breathing, it is observed that the respiratory function⁶ finally comes to rest at the end of an expiration, and therefore in the position of deflation. During and after deep ether anaesthesia, in post-anaesthetic sleep, and as the result of prolonged surgical trauma or post-operative pain, the respiration is frequently maintained at a minimum excursion. In this type of respiration expiration is more active than inspiration, and the residual air of the respiratory system is gradually expelled, with collapse of the pulmonary alveoli. It has been demonstrated⁷ that the normal pulmonary vital capacity is reduced 60 per cent. in upper abdominal and 40 per cent. in lower abdominal operations. In similar cases it is found that the normal expansion of the chest may be reduced by 75 per cent., and the descent of the diaphragm by 50 per cent.

Inadequate pulmonary ventilation is the primary aetiological factor in post-operative respiratory complications. It is the precursor⁸ to the accumulation of viscid and tenacious exudates which partially or completely obstruct the bronchi or the bronchioles. The absorption of the alveolar air, and the collapse of the pulmonary alveoli or the infection of the obstructing exudate by pathogenic organisms, results in the cases of atelectasis or of cellulitis of lung tissue¹² which follow on surgical procedures.

PROPHYLACTIC AND CURATIVE VALUE OF CO₂

If the intrapulmonary movements are observed with the fluoroscopic screen after lipiodol has been passed through the trachea into the bronchi, it will be seen that the bronchi and the bronchioles expand and lengthen during the act of inspiration, and contract and shorten during expiration. This stretching and recoiling of the elastic tissue, and this relaxation and contraction of the muscular tissue of the respiratory system, are particularly well seen in cases of bronchiectasis. It will also be observed that during hyperventilation with carbon dioxide the inspiratory phase is more active and prolonged than the expiratory phase. This activity of the inspiration is less obvious during normal respiration, and is definitely reversed to a short inspiratory phase and a prolonged expiratory phase during hypoventilation. If these observations are carried out during deep ether anaesthesia, or after prolonged surgical trauma, or in post-anaesthetic sleep, the mobility of the diaphragm will frequently be found to be reduced to as little as 25 per cent. of the normal. As a direct result of hyperventilation with carbon dioxide, the respiratory system is continuously in the position of inspiration with the bronchioles expanded and the air sacs inflated, and there is evidence that the activity of

the respiratory cilia⁹ and bronchial peristalsis is much increased by the same factor.

Hyperventilation appears to be a highly efficient method of stimulating drainage of the pulmonary system, and is essential for the successful expulsion¹⁰ of exudates from the respiratory tubes.

Chart of 400 Abdominal Operations

Number of cases	100	100	100	100
Age	18-40 years	20-40 years	20-50 years	19-50 years
Sex	Male	Male	Male	Male
Season	Nov.-Feb.	Nov.-Feb.	Nov.-March	Nov.-March
Anaesthetic agents	N ₂ O + O ₂ + E	N ₂ O + O ₂ + E	E or ethyl chloride and ether	E or ethyl chloride and ether
Operation ...	Exploratory laparotomy	Exploratory laparotomy	Exploratory laparotomy	Exploratory laparotomy
Prophylactic CO ₂	Used in theatre and ward	Not used	Used in theatre and ward	Not used
Respiratory sequelae	Four cases	Ten cases (four serious)	Eight cases	Twelve cases (five serious)
Therapeutic CO ₂	Used for 24 hours	Not used	Used for 24 hours	Not used
Result	All rapidly recovered	1 atelectasis 3 pneumonia 1 died	All rapidly recovered	1 massive collapse 4 pneumonia 2 died 5 days
Average illness	36 hours	4 days	48 hours	
Mortality ...	0 per cent.	1 per cent.	0 per cent.	2 per cent.

Note.—The term "exploratory laparotomy" included cases of partial gastrectomy, gastro-enterostomy, appendicectomy, cholecystectomy, and excision of duodenal ulcer. The respiratory complications appeared within thirty-six hours of the operation, and the diagnosis was confirmed, in the serious cases, by radiology, and in the post-mortem room.

The records of a series of consecutive abdominal operations have demonstrated the extreme rarity of serious respiratory sequelae, provided the pulmonary system is kept patent during the surgical procedure and for twenty-four hours afterwards, and provided that free egress is assured for any secretions that may have accumulated during and for twenty-four hours after the operation. Such respiratory complications as have occurred have been treated by hyperventilation, and have invariably cleared up rapidly with the expulsion of liquefied secretion. Included in this series are patients who came up for urgent operation, and had acute or chronic respiratory conditions. In my experience the chest condition was not aggravated by a nitrous oxide, oxygen, carbon dioxide, and ether anaesthesia, and frequently, on subsequent visits, information was volunteered by the patient that the chest condition appeared to have actually improved since the anaesthetic was administered. Carbon dioxide is slightly less powerful as a curative than as a prophylactic agent. To be rapidly effective as a therapeutic agent, the administration must commence on the earliest evidence of respiratory sequelae. It is not contended that carbon dioxide will prevent post-anaesthetic cough and temperature and pain if catarrh and pathogenic organisms are present in the respiratory tract before operation, but it is maintained that carbon dioxide will minimize the untoward effects of the operation and the anaesthetic agent by stimulating the liquefaction and the expulsion of the viscid secretion.

TECHNIQUE OF ADMINISTRATION

The following procedure has been evolved:

- (a) Pulmonary ventilation is controlled and regulated to the normal during the induction and maintenance of anaesthesia.
- (b) During the closing stages of the operation hyperventilation and de-etherization is carried out until the patient leaves the operation theatre.
- (c) In the ward the administration consists of the inhalation of carbon dioxide and oxygen for five-minute periods. These periods are continued at four- to six-

hourly intervals throughout the first twenty-four to thirty-six hours after the operation.

(d) This periodical administration is continued if there is any evidence of respiratory complications.

The percentage of carbon dioxide, the duration of the period, and frequency of administration should be regulated according to the toleration of the individual patient. The apparatus used in the ward consists of a small platform on castors to carry one cylinder of carbon dioxide and one cylinder of oxygen, with a central standard to carry a sight feed bottle. It has proved eminently simple and satisfactory. The freedom from pain in abdominal wounds during hyperventilation with carbon dioxide as compared with the pain and distress which the patient endures in voluntary deep breathing is a marked feature of the administration. Adult patients readily volunteer their appreciation of the relief the administrations give, and children rarely object to it.

It is stated that the only effect on the organism¹¹ as the result of the inhalation of 6 per cent. carbon dioxide during a period of two hours was diuresis and increased acidity of the urine.

CONCLUSIONS

1. Carbon dioxide gas should be available in every operation theatre and in every surgical ward.

2. This gas, used with discrimination, is a valuable adjunct to general anaesthesia.

3. The maintenance of a patent and inflated respiratory tract protects the patient against serious post-operative respiratory complications.

4. The therapeutic application of carbon dioxide in respiratory disease rapidly drains the pulmonary system.

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Memoranda

MEDICAL, SURGICAL, OBSTETRICAL

A METHOD OF RECORDING MAXIMUM ARTERIAL PRESSURE

It is generally recognized that the methods now employed of taking blood pressures may, under certain circumstances, give misleading readings. At present it is quite impossible to determine how far diseased arterial vessels—for example, those due to sclerosis—may affect blood-pressure readings. The following accurate method of recording maximum blood pressures actually measures the internal pressure in the vessels. It is based on the simple consideration that if the flow of blood in the veins of a limb is obstructed the pressure in the veins will rapidly rise till it equals the pressure of the arteries supplying the limb. It is only necessary then to insert a needle into a vein and connect it with a manometer.

A sphygmomanometer is attached to the arm, and at the same time a needle with a very large bore is inserted in the

basilic vein; the needle is connected with a manometer containing a solution of potassium citrate and salt. The pressure is gradually raised in the armlet; *pari passu* there is a rise in the water manometer. Soon the fluid in the manometer reaches a certain level, and then, momentarily, there is a slight but definite fall; this coincides with the closure of the arterial vessels owing to compression of the armlet. The highest level attained in the water manometer records the maximum arterial pressure. The record of the mercury sphygmomanometer at the moment when the slight fall in pressure in the water manometer has taken place measures the external force necessary to occlude the vessel wall and to overcome the internal pressure of the arteries. These two readings are practically identical in some cases, and not quite so close in others.

In order to study the events which take place in the distal portion of the extremity after the occlusion of the veins, the limb is enclosed in a plethysmograph (made of tyre rubber connected with a water manometer); this part of the procedure, however, is not essential for ascertaining the maximum pressure. It is necessary to raise the pressure in the armlet slowly, so that the veins may have time to fill properly. A sample reading is as follows: systolic pressure by the auditory method, 135 mm. mercury; sphygmomanometer reading at the time of closure of the arteries, 120 mm.; record of water manometer in terms of mercury, 115 (water is lighter, of course, by 13.6 than mercury).

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HERPES ZOSTER INVOLVING THE URINARY BLADDER

The following case of what can undoubtedly be regarded as herpes zoster involving both the skin and the vesical mucous membrane is of considerable interest, not merely from the rarity of records of such a condition, but because it is probable that cases are frequently overlooked.

In May, 1931, I was called to see an English lady, aged 64, who complained of intolerable irritation and frequency of micturition (every half to one hour night and day). The onset had been sudden, and I saw her on the second day. Suspecting pyelitis I examined the urine, and was surprised to find only very scanty pus cells and erythrocytes. Later in the day she confessed to a rash just below the left buttock, which on examination proved to be typical herpes zoster affecting areas innervated by the second and third sacral roots. When questioned she admitted feeling irritation on the ball of the left foot, and between the hallux and second toe, although no cutaneous lesions were visible. An alkaline diuretic mixture, together with hyoscyamus, was prescribed, and calamine lotion applied to the vesicles; the condition cleared up in four days. Cystoscopy was not available.

About one year previously I had treated her husband for herpes zoster on the right side of the penis (not glans) which was associated some weeks later with an epidemic of chicken-pox among the young (black) staff of the household. There was also an epidemic of chicken-pox on the station at the time of the case here recorded. The patient had not been taking arsenic.

Discussion

Herpes zoster of the urethra has frequently been recorded, and its association with herpes progenitalis noted, but I have only been able to find references to three cases of herpes of the bladder.

Dubois¹ reports the case of a man, aged 40, who, together with cutaneous lesions of the left buttock, complained of frequency, dysuria, and eventually of retention; cystoscopy revealed typical vesicles on the left side of the base and left lateral wall of the bladder; symptoms lasted ten days. Dubois also quotes Wolbart as figuring in his translation of Long's treatise on cystoscopy and urethroscopy an illustration of herpes of the ureteric orifice.