as regards tumour formation. Physiological stimulation, on the other hand, would appear to be free from such dangers.

There is much evidence to show that compounds of the sulphhydryl (-SH) group tend to stimulate growth by mitosis.

Some clinical applications of sulphhydryl therapy have been mentioned, and a plea is made for their wider trial at the present time.

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THE RESPIRATOR AS AN OXYGEN APPARATUS

BY

H. L. MARRIOTT, M.D., F.R.C.P.

Major, R.A.M.C.; Assistant Physician, Middlesex Hospital
 (From the Army Blood Transfusion Service)

The importance of oxygen therapy in regard to war casualties is becoming increasingly appreciated. It is well recognized as being the most essential measure of treatment for gross anoxia, evidenced by cyanosis, resulting from injury to the respiratory apparatus from wounds, blast (Zuckerman, 1940; Falla, 1940), or gassing. It is also of considerable value as a supplementary measure of treatment in cases of shock from wounds or burns, though not of as great importance as transfusion of adequate quantities of blood or plasma. In shock the peripheral circulatory stagnation causes the blood to give up a very high proportion of its oxygen to the tissues and to return to the lungs abnormally depleted of oxygen. Inhalation of pure oxygen, as compared with air, significantly increases the amount of oxygen available to the tissues (Boothby, Mayo, and Lovelace, 1939; Wood, Mason, and Blalock, 1940).

If pure oxygen is to be given it is necessary to employ a face-piece apparatus. The B.L.B. mask (Boothby, Lovelace, and Bulbulian, 1938; Card, Forest Smith, Griffiths, McSwiney, and Savage, 1940) is probably the best. The nasal catheter method, even when used under conditions of maximal working efficiency (Marriott and Robson, 1936), is not capable of producing concentrations of oxygen much exceeding 50% in the inspired air, and is therefore not in general suitable for the acute oxygen lack of war casualties, though it has its place in the treatment of other conditions.

Converting the Respirator

When casualties occur in large numbers in a locality it is probable that there will not be enough efficient oxygen face-pieces available. The purpose of this note is to describe how the ordinary civilian or civilian duty types of respirator may be converted into makeshift oxygen masks permitting the administration of pure oxygen, the only piece of apparatus necessary to effect the conversion being an ordinary rubber football bladder (Association bladders,

size 4 or 5, will do). All civilians have such respirators, and practically all hospitals have stocks of spare ones.

Rubber football bladders are plentiful and cheap. The conversion from respirator to oxygen face-piece can be achieved within a minute, and involves no meddling with the construction of the respirator. The Service respirator is not so suitable for the method of adaptation to be suggested because its inlet valve is situated in the canister instead of in the face-piece, and an attempt at conversion would necessitate detachment of the wired-on rubber hosing.

A hole is made in the pole of the football bladder remote from the inlet by simply cutting off the terminal inch of the deflated folded bladder. This hole is then stretched and slipped over the canister (see illustration)

for a distance of three-quarters of an inch—if the hole is of the right size it should result in the canister being firmly gripped by the bladder. The gas-tightness of the junction should be reinforced by moving forward the rubber band which secures the face-piece to the canister (this junction can take care of itself as a rule) or else by using another rubber band. The presence of a "context" attachment does not matter; it should be regarded as part of the canister.

The Apparatus in Use

The inlet tube of the football bladder should be connected direct to tubing from the oxygen cylinder. It is not necessary to interpose a flowmeter or a humidifier. The oxygen should be turned on before the face-piece is put on the patient. When it has been put on the flow should be regulated so that the bladder is moderately generally distended during expiration, and does not empty completely even at the end of inspiration—it should be half collapsed at this point. To keep it distended both during inspiration and expiration necessitates an extravagant flow; to allow it to collapse completely during or at the end of inspiration is to be giving an inadequate flow and to make the patient suffocate. When the flow is nicely adjusted in accordance with the above instructions it is likely with a man at rest to be about 6 to 8 litres per minute. With a patient making respiratory efforts it may need to be more. If the patient cannot be kept under constant observation it is desirable that the adjustment of flow should err on the side of liberality and that the bag should only collapse slightly towards the end of inspiration. No unconscious patient or one too weak to remove the mask himself should ever be left unobserved when receiving oxygen by a face-piece which covers both nose and mouth. To this rule the converted respirator is no exception.

The valve in the face-piece prevents rebreathing into the bladder. The bladder performs four important functions: (1) It provides a simple method of connecting the oxygen supply to the face-piece. (2) Because of its collapsible nature it forms an indicator for the adjustment of the rate of flow as described above. (3) It economizes oxygen by allowing it to accumulate during the expiratory phase of respiration, which occupies about two-thirds of

the cycle, instead of running to waste. If the flow is adjusted as described, the pressure within the bladder during expiration should be less than within the face-piece, the valve of which will therefore be kept shut, and consequently no oxygen will pass into the mask. (4) During inspiration the bladder acts as a reservoir of supply. If there were no such reservoir the patient would be dependent solely on the oxygen flowing through the tubing at the time. Unless the flow was very extravagant he would quickly empty the tubing and feel suffocated.

Points of Importance

There are three important points in regard to oxygen cylinders which apply to all methods of administration, the one described above included, but which are not yet universally known; they are therefore mentioned. First, effective giving of oxygen by any face apparatus necessitates oxygen flows of the order of 5 to 8 litres per minute, and consequently it is desirable to use large cylinders (that is, 100 cu. ft.). The ordinary small 20-cu. ft. cylinders, so frequently seen, contain only approximately 570 litres and consequently can last for little more than an hour. Secondly, in order to determine how much oxygen there is within a cylinder it is essential that a pressure gauge be attached, otherwise it is impossible to have any idea. Thirdly, oxygen cylinders should always be fitted with automatic pressure regulators, securing delivery at a constant low pressure (for example, 5 pounds); otherwise—as when an adjustment valve alone is fitted—the delivery pressure falls all the time as the cylinder empties, and must necessitate repeated opening up of the valve unless the flow is correspondingly to fall.

Summary

A simple method is described of converting the civilian respirator to an oxygen face-piece apparatus.

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CONTUSION OF THE MYOCARDIUM*

BY

HUGH BARBER, M.D., F.R.C.P.

Senior Physician, Derbyshire Royal Infirmary

A blow over the chest or compression of the thorax may give rise to a variety of traumatic heart lesions. Sudden death suggests ventricular fibrillation, which event has been recorded experimentally in dogs (Kissane, 1937). Any form of abnormal rhythm may result. Rupture of a valve may occur. In association with these clinical pictures there have sometimes been transient changes in the electrocardiogram, indicating myocardial injury in addition (Beck, 1935; Kissane, 1937; Warburg, 1938).

In considering traumatic lesions of the myocardium the following clinical problems arise: Symptomless cases with complete recovery; delayed rupture of the heart; clinical features of a disordered heart; haemopericardium; persistent myocardial weakness; heart-block; coronary thrombosis; myocardial injury in association with angina pectoris, auricular fibrillation, or valve rupture.

There is evidence that any part of the heart may be bruised or that any one of the chambers may be ruptured.

* Based on a communication to the Association of Physicians of Great Britain and Ireland on May 10, 1940.

The site of the lesion is not necessarily in relation to the situation of the blow. The anterior aspect of the right ventricle is injured most frequently, but Beck (1935) records the case of a man who fractured his sternum on the steering wheel of his car. When he died on the sixth day myocardial bruising was found on the posterior aspect of the heart. In many cases fractures of the bones of the thorax occur, and distress from this cause may mask the symptoms of heart disability. But there are many records of myocardial injury in the absence of fractures, and indeed without any signs of external bruising. Bilderbeck (1919) in an adult, and Hamilton (1934) in a child, have recorded traumatic rupture of the heart immediately fatal without external injury.

Symptomless Cases with Complete Recovery

During the past two years Dr. G. R. Osborn and I have been studying heart injuries in cases of fatal accident. These have been more frequent than we expected. We have paid particular regard to less serious lesions, compatible with recovery, in those who have died from causes apart from the heart. These have been sufficient in number to suggest that recovery from undiagnosed myocardial contusion is by no means rare. The following case is an example of a well-defined lesion:

A man aged 58 was admitted after being knocked down by a motor-bus. He died the next day from cerebral injuries. The heart had received no special consideration during life. Necropsy showed that the cerebral injuries would account for death. A contusion about an inch in diameter was present over the lower part of the right ventricle in front; it did not involve the endocardium and there was no fluid in the pericardium. Two ribs were fractured on the left side, but the bones were not displaced and the parietal pericardium was uninjured.

From this heart lesion recovery was possible, and perhaps without any symptoms to suggest a contusion. More probably after an interval there would have been some distress from involvement of the pericardium.

In another motor accident case, in which death was due to a fractured skull, bruising of both the anterior and the posterior aspect of the heart occurred, but the endocardium was not injured. The pulmonary artery was ruptured, but the myocardial bruises would not have been fatal.

Delayed Rupture of the Heart

The most convincing evidence that a blow over the chest may injure the myocardium comes from recorded cases which may be described as delayed rupture of the heart.

A recent example (Priest, 1939) is that of a young Sepoy struck over the front of the chest by a cricket ball. After a short interval he continued to play throughout that day, was all right that night, and played cricket throughout the second day. That evening he complained of pain in the chest and died shortly afterwards. At necropsy a rupture of the right ventricle was seen to have occurred, with haemorrhage into the pericardium. In effect this young man played cricket for two days with a symptomless myocardial contusion.

This rare occurrence has been recorded by others. Groom (1897) notes that in a boy of 16 years who died suddenly a month after a chest injury the myocardial rupture appeared to have developed from the endocardium outwards. In this connexion my colleague Dr. Osborn has shown me an interesting specimen from a fatal accident case in which the right ventricle was ruptured but in the left ventricle there was a rupture of the endocardium, with the outer part of the heart muscle and the pericardium intact. Presumably the lesion in the left ventricle alone would have given rise to no symptoms until fatal rupture took place, or perhaps a cardiac aneurysm