peritoneum. They are often congested, and during the premenstrual period they ache and become hypersensitive. A somewhat similar tenderness is produced in cases of varicocele, and here we find a definite referred pain, which is most marked half-way along the line joining the umbilicus to the mid-point between the symphysis pubis and anterior superior spine. This varicocele is an analogous condition to that found in the male which produces a testicular ache. It occurs in the pampiniform plexus, and shows itself as a markedly dilated and varicose condition of the ovarian veins running from the broad ligament through the infundibulo-pelvic ligament. I have noticed it a number of times at operations for chronic retroflexion, and I have seen it relieved by the Gilliam operation, which not only lifts up the uterus but also shortens the broad ligament and so relieves the kink. Pain is also produced in prolapsed ovaries not accompanied by retrodisplacement of the uterus, and this is best relieved by an operation designed to replace the ovary in as nearly normal a position as possible. This can be obtained by stitching a suitable point of the infundibulo-pelvic ligament to the side wall of the pelvis near the interior abdominal ring. One authority reports seventy-six such cases with 88 per cent. of cures.

Endometriomatous growths in the ovaries may cause pain, and ovarian dysmenorrhoea is common in such conditions. These growths tend to come on after the age of 30, and should be suspected in women complaining of dysmenorrhoea and lower abdominal pain starting at this age. Interstitial haemorrhage in the ovary will also produce pain. I have noted these conditions at operation for pelvic pain, but they are not common.

I have little faith in the idea that the small cystic ovary occasions pain, and the so-called cirrhotic ovary is not in my opinion a pathological entity. Adhesions in the region of the infundibulo-pelvic ligament involving or catching up the fibres of the ovarian plexus may result in chronic ovarian pain and dysmenorrhoea. Such a condition has been described by Lupan following removal of appendix; a complete cure was obtained in his case by division of the plexus in the infundibulo-pelvic ligament. Peritoneal bands or adhesions to the ovary can produce pain; I had one such case following an appendicectomy when an omental band had caused internal pain in the rectum for a long period. Division of the band gave complete relief. Large tumours of the ovary, whether malignant or benign, do not as a rule give rise to pain unless the pedicle becomes twisted, causing congestion or formation of adhesions.

It is probable that the ovary itself is fairly insensitive, as otherwise the recurrent follicle ripening, with associated increase of tension, would produce pain. We must recognize, however, that at times the ovaries become more sensitive, for example, just before menstruation, or if there is any marked pelvic congestion; also in cases of repeated unsatisfied sexual stimulation there will develop a hypersensitiveness of the ovary. This is evident by the dyspareunia which sometimes develops in such women.

Apart from organic disease of the ovary we, as gynaecologists, are confronted with three conditions which have been, and will continue to be, dubbed ovarian pain: (a) reflected pain, (b) neurasthenic pain, and (c) hysterical pain. Abnormal conditions of the female genitals affect the lower dorsal and upper lumbar segments of the cord. This causes a hyperaesthesia of the cutaneous areas supplied by these segments, and consequently tenderness and pain on pressure over a fairly wide area situated between the umbilicus and the anterior superior spine. A diagnosis of oöphoritis is often made, although the ovary may be completely free from blame.

In neurasthenia we have a condition in which the resistance of the nervous system is decreased, and consequently the threshold for pain is lowered. This may be produced

by anaemia, chronic disease, long-continued suffering, or mental worry. The patient will complain of pain in the region of the ovary where no ovarian pathology exists. Lastly, in cases of hysteria the patient often fixes her attention on her ovaries, though the ovary is absolutely normal.

The lesson to be learnt from these considerations is that we must be extremely careful when a patient comes to us complaining of pain which she has been told is due to her ovaries. If on examination we find definite physical signs of pathology in her genitalia then we can with confidence recommend operative treatment. If we find the uterus and cervix healthy and normal in position, and we are not sure of the condition of the tubes and ovaries with regard to adhesions, possible endometriomata, displacements, etc., then we should explain the position carefully to the patient and advise an examination under an anaesthetic, and at the same time carry out a Rubin's test. This examination should put us in the position of knowing whether it is necessary to open the abdomen or not. It will also be of value from its suggestion effect on the patient.

Finally, if we are certain in our own minds that there is no pathological condition present we must tell the patient so firmly, and assure her that operative treatment will not improve her condition, and that if she has patience and adopts the measures necessary to improve her general health she will gradually get rid of her pain.

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TOTAL THYROIDECTOMY IN THE TREATMENT OF PATIENTS WITH CONGESTIVE HEART FAILURE AND ANGINA PECTORIS

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Any measure which promises to prolong, in fair comfort, the lives of patients with both the congestive and the anginal forms of heart failure, in whom the efficacy of all other forms of treatment has been exhausted, must command serious attention, as, if the promise is fulfilled, the method will have a wide application. It is for this reason that the papers of Blumgart¹ and Levine,² and their associates, have excited such great interest. They claim that the removal of the whole thyroid gland in patients without thyrotoxicosis, incapacitated by congestive or anginal heart failure, is not only comparatively safe, but that it so greatly improves the patients' condition that many of them again become capable of work. Blumgart³ says that the operation has now been performed with gratifying success in over fifty cases.

Rationale

It is established that ordinarily the heart's output of blood per minute varies directly as the rate of metabolism. The more rapid the metabolism the more oxygen do the

tissues use, and the more oxygen-containing blood does the heart have to send them. In hyperthyroidism the heart's output is increased because the metabolic rate is raised; in myxoedema metabolism is slowed and the cardiac output is diminished. In the late stages of congestive heart failure the heart's output of blood per minute is diminished, in spite of the fact that the metabolic rate is normal or even increased, and no doubt this is largely responsible for the symptoms at this stage.

Blumgart's preliminary researches were concerned, not with the volume of blood expelled by the heart per minute, but with the linear velocity of blood flow, and this was done in the present series because the linear velocity is easy to estimate, while the estimation of the volume output presents great technical difficulties in patients with congestive heart failure. Blumgart found that in health the linear velocity of blood flow through the lungs was proportionate to the metabolic rate. In hyperthyroidism the velocity was increased. In heart failure, even in its early stages, it was diminished. In myxoedema the velocity was as low as in heart failure, but there were no circulatory symptoms. Blumgart therefore argued that heart failure is due to the heart being unable to maintain a sufficient volume and velocity of blood flow for the needs of the tissues. The damaged heart, on ordinary medical treatment, is pumping the greatest volume of blood at the greatest speed of which it is capable, but the needs of the tissues are unsatisfied. The only course left is to reduce the metabolic needs (by thyroidectomy) to a level at which they can be satisfied by the diminished output of which the heart is capable.

Two further arguments support this. First, the most severe heart failure in cases of hyperthyroidism is usually completely relieved by subtotal thyroidectomy. Most observers agree that thyrotoxic heart failure is not due to organic damage to the heart, but partly to the occurrence of auricular fibrillation and partly to the increased metabolism making excessive demands on the heart. Again, patients with myxoedema rarely have circulatory symptoms, but sometimes, when thyroid extract is given, anginal attacks or congestive failure occurs, and the attempt to cure the myxoedema has to be abandoned.

Levine and Blumgart's Observations

If the argument is correct, improvement might be expected in angina pectoris as well as in congestive failure. It is thought that angina is due to the coronary arteries being unable to transmit enough blood for the increased needs of the heart during exercise. Thyroidectomy diminishes the body's oxygen consumption, both at rest and on exertion. The heart's work is thus reduced, and a large blood supply to the heart becomes unnecessary. Levine and Blumgart⁴ therefore tried the effect of partial thyroidectomy in a number of cases. They found that, though the symptoms were temporarily relieved, the metabolic rate soon rose again and the symptoms recurred, presumably owing to the regeneration of the fragments of thyroid tissue left behind. They also found that irradiation by x rays or radium was useless, as doses which do not damage the other tissues have little effect on the normal thyroid. It was evident that nothing short of total thyroidectomy was likely to succeed, and this was done in another series of cases. They have described in detail² the results in twenty-two cases, including cases of rheumatic, arteriosclerotic, hypertensive, syphilitic, and pulmonary heart disease, with congestive failure, angina, or both. All were unable to work, and many were bed-ridden.

The results in the twenty-one cases in which sufficient time had elapsed since the operation, after varying periods up to six months, were as follows:

(a) There were two operative deaths.

(b) One patient with frequent attacks of cardiac asthma had no more attacks for three weeks after the operation, but then died in his first post-operative attack. Another, with mitral stenosis and auricular fibrillation, was not improved, and died after a subsequent operation for pericardial adhesions. A third, with syphilitic aortic incompetence, angina, and congestive failure, was not improved, and died a few days after discharge.

(c) Two patients with mitral stenosis, auricular fibrillation, and congestive failure (one of them with a complicating chronic nephritis) were not improved.

(d) Three patients with angina and congestive failure were relieved of their angina. The congestive symptoms were improved greatly in one, slightly in another, and not at all in the third. All three were much more comfortable than before the operation.

(e) One patient with only angina was completely relieved.

(f) Ten patients with congestive failure were much improved. Patients previously orthopnoeic and bed-ridden were able to lie flat, and to be up and about without distress, and some were able to return to light work.

(g) Signs of slight hypothyroidism often developed, and small doses of thyroid extract had to be given continuously to five patients, and for a short period to two others. The mental slowness and heaviness of myxoedema rarely appeared, and most of the patients said they were mentally quicker than before the operation, no doubt owing to the improved cerebral circulation. Slight signs of tetany appeared for a few days in some cases, but were easily controlled by calcium and vitamin D.

Present Series

Such successful results in patients hopelessly ill indicated that the method was worthy of further trial, and this paper gives the initial results in a small series of six cases. They had all been observed for months or years by one of us in the out-patient department, Queen's Hospital, Birmingham. They were all incapacitated by their cardiac symptoms, which were slowly progressing in spite of treatment, including, in four cases, one or more periods of in-patient treatment. So far as could be forecast, they had not more than a few months or years of increasingly miserable existence before them. Cases in which the cardiac lesions were rapidly progressing—for example, cases of active rheumatic or syphilitic disease—were excluded. None had clinical evidence of hyperthyroidism, though in some, as is common in heart failure, the basal metabolic rate was raised.

Preliminary Investigations.—In order to diminish subjective errors a number of objective measurements were made before operation for comparison with the post-operative findings, and although the changes in the patients' symptoms were often greater than indicated by the measurements, it may be of interest to record the results in the accompanying table. Radiographs of the heart and electrocardiograms were taken. The venous blood pressure was measured by the direct method, since a rise in the venous blood pressure is a fairly early sign of congestive failure, and a fall usually occurs with improvement. The velocity of the circulation through the lungs was measured by the cyanide method of Weiss and Robb.⁵

About 7 minims of a 2 per cent. solution of sodium cyanide is injected into a vein at the elbow; this travels to the heart, through the lungs (which takes most of the time), and out into the systemic arteries. When it reaches the carotid sinus, at the bifurcation of the common carotid artery, it suddenly stimulates a great transient increase in the rate and depth of respiration. The time between the injection and the first deep inspiration is taken with a stop-watch.

The vital capacity of the lungs was measured by means of a spirometer. It is thought that a vital capacity diminished by the encroachment of distended pulmonary capillaries on the air space, or by the congested capillaries making the lung more rigid, is more closely related

Table Showing the Results of Special Examinations Before and After Operation

Case	Time in Relation to Operation	Venous Blood Pressure in cm. Saline	Pulmonary Circulation Time in Seconds	Vital Capacity in c.cm.	Basal Metabolic Rate (per cent.)	X-Ray Findings	Electrocardiogram
I	Before	7.0 to 12.5	12.5 to 19.6	1,700 to 2,330	- 2 to 0	Heart enlarged to left	Left ventricular preponderance. Depressed S-T I and II
	After	8.0 to 10.0	10.0 to 17.6	2,000 to 2,300	- 8	Increase in enlargement to left and right	Deeply inverted T I
II	Before	9.3	13.2	2,300	+ 4 to + 15	Heart enlarged to left	Left ventricular preponderance. Diphasic T I and II
	After	0.5 to 3.2	18.6 to 19.6	2,300	- 9	Unchanged	Unchanged
III	Before	17.0 to 22.5	25 to 26	2,300	+ 12	General enlargement of heart	Bundle-branch block of the unusual variety
	After	19.0 to 21.0	29 to 30	2,400	- 5	Slight increase in enlargement	Unchanged
IV	Before	6.0 to 15.2	12.2 to 16.4	1,900	+ 16 to + 20	General enlargement of the heart	Left ventricular preponderance. Diphasic T I and II
	After	8.0	16.3 to 18.0	2,100	0 to + 2	Unchanged	Unchanged
V	Before	2.2 to 3.2	21.6	2,300	+ 19 to + 20	Heart normal in size and shape	Intraventricular block
	After	2.5 to 5.0	21.6	2,500	- 7	Slightly enlarged	Diminished voltage of QRS waves and flattened T waves
VI	Before	4.0 to 10.2	10.2 to 15.4	1,400	+ 28 to + 31	Heart enlarged to left	Left ventricular preponderance. Negative T I
	After	6.0	15.6	1,700	+ 21	Unchanged	Unchanged

to the occurrence of cardiac dyspnoea than is any other factor.

These tests have been done repeatedly on all the patients during the time they were being watched in the out-patient department. In addition, photographs were taken so that any subsequent change in their appearance due to myxoedema might be more readily appreciated. Finally, their exercise tolerance was carefully estimated. Five patients walked up and down the ward until compelled to stop by pain or dyspnoea, and the number of times they walked the length of the ward and the time taken to do so were observed. The sixth patient was able to walk slowly on the flat almost indefinitely, and she was made to walk up a flight of stairs until compelled to stop. In each case the test was repeated several times on different days, and the best result taken for comparison with the post-operative findings.

The Anaesthetic.—Local anaesthesia was not used for several reasons. We thought it desirable to minimize mental stress in patients subject to angina pectoris. The added adrenaline is also liable to bring on anginal attacks. It was thought possible that a cervical block might paralyse the phrenics, with disastrous results in patients already dyspnoeic. Finally, orthopnoeic patients, if conscious, would be unable to lie in the "thyroid position." Avertin-gas-oxygen anaesthesia was ultimately decided upon. Avertin ensures quick induction and avoids pulmonary irritation, but it depresses the circulation and respiration and reduces the blood pressure. Gas and oxygen is non-toxic and non-irritant, and it tends to stimulate the circulation and respiration and to raise the blood pressure, thus counteracting the undesirable effects of the avertin. Glucose was given in large quantities for several days before the operation in order to protect the liver (already damaged by chronic venous congestion) against the toxic action of the avertin. Atropine 1/75 grain was given an hour before the operation. The avertin (0.1 gram per kilo of body weight in 2½ per cent. solution) was given with the patient lying on his left side with his head propped up on pillows, and he remained in that position till narcosis was produced. The patients may, however, be moved to the theatre and placed in the thyroid position on the operating table without undue anxiety. The gas and oxygen was given by Magill's mask and the Clausen harness method. An airway was inserted as soon as possible, and a high percentage of oxygen was necessary in order to maintain a good colour.

The operation must be approached with great circumspection, and the procedure must be delayed if anything occurs which might further handicap the patient tem-

porarily. Berlin's technique⁶ was that essentially followed.

The whole thyroid gland, with the pyramidal lobe and any near-by nodules of aberrant thyroid tissue, was removed. The chief dangers are that the recurrent laryngeal nerves may be cut and that the parathyroids may be removed. The recurrent laryngeal nerve is best sought for after the upper pole has been freed, and while the lateral lobe is being drawn towards the mid-line. It is a comfort to see that the nerve is safely left behind, but if a careful search shows that it is not running through the terminal branches of the inferior thyroid artery it can be accepted that it is safe. The total removal of the parathyroids can be avoided by observing the following:⁷ (a) the parathyroids, unlike aberrant thyroids, are not rounded, but elongated, flattish, and soft; (b) they are usually wrapped in a little fat; and (c) one or more are usually well away from the thyroid, at least 1 cm. from the lower pole of the gland.

The operation, *pace* those who scoff at the dissecting surgeon, is a *dissection*, to be done deliberately. Haste is more dangerous to the patient than a little extra anaesthesia. After the operation the patient should be kept lying flat until consciousness returns, when he is propped up. Cyanosis should be prevented, while the patient is lying flat, by the use of oxygen.

Records of Six Cases

CASE I

History.—Mrs. K. P., aged 49, hypertension, with coronary sclerosis and ? occlusion. Angina pectoris and congestive heart failure. Under observation since February, 1931. Since 1928 stiffness of left hip, and much pain in the back. Since 1929 severe headaches and retrosternal pain, spreading down left arm to the wrist on exertion. In March and September, 1932, and February, 1933, complained of attacks resembling coronary occlusions—severe cramp-like epigastric pain, coming on while at rest, spreading to the chest, not relieved by amyl nitrite, lasting several hours. Since the first of the attacks ankles began to swell, she became very dyspnoeic and orthopnoeic, and, though just able to get about, was unable to do her housework. In spite of treatment, including two periods in hospital, she continued to go downhill. In addition to her cardiac symptoms she was troubled at intervals by severe pain in the back, associated with osteoarthritis of the spine.

Examination.—She was of the hypersthenic, plethoric type. The left hip showed great limitation of movement. She was orthopnoeic. The liver was large and tender. There was slight oedema of the ankles. The apex beat, which was forcible and heaving, was just outside the mid-clavicular line. The aortic second sound was very accentuated. The blood

pressure ranged from 220/130 to 290/160. The electrocardiogram showed left ventricular preponderance, and a depressed S-T interval in Leads I and II.

Operation.—Total thyroidectomy (January 10th, 1934). Thyroid of average size and appearance, and normal histologically. Her condition caused no anxiety during or after the operation, though for three days her blood pressure fell to 126/76. There was slight pyrexia for three days, and a little cough for a further few days.

Progress.—Her condition greatly improved for two months after the operation. Before operation she had to be propped up in bed with a bed-rest and three or four pillows, and could only walk five times the length of the ward in two and a half minutes before having to stop because of pain and dyspnoea. After the operation she dispensed with the bed-rest and used only three pillows, and she walked six times the length of the ward in two minutes without discomfort, and then stopped only because of the jocular comments of the other patients. After returning home, she found she could walk to hospital and up the stairs to the ward without discomfort, though previously she had to stop many times on her way to hospital. Angina occurred only after excessive exertion, such as walking up three flights of stairs to the laboratory immediately after walking to hospital. Her dyspnoea was also much less, and she was able to use only two pillows without a bed-rest. Her oedema has disappeared. During the next three months, however, she had a return of the pain in the back due to arthritis of the dorsal spine, and her activities were much reduced by this. Her dyspnoea is now greater than in the two months after her operation, though less than before the operation, and she has had no angina at all for the last three months. She feels that but for the pain in the back she is better than she has been for years. She has developed slight hypothyroidism, with puffiness of the eyelids and roughening of the skin, but there is no perceptible slowing of the mental processes, and she herself thinks she is brighter and mentally clearer than before.

CASE II

History and Examination.—Mr. H. P., aged 53. Hypertension, ? coronary disease, and angina pectoris. Under observation since August, 1933. Severe anginal pain, stopping him after walking thirty yards slowly on the level. Unable to do even light work. Unimproved by treatment, including a period in hospital, and prophylactic nitroglycerin. Apex beat one inch outside mid-clavicular line. Accentuated aortic second sound. Thickened arteries. Blood pressure 164/106 to 206/118. Electrocardiogram showed left ventricular preponderance, diphasic T I and II.

Operation.—Total thyroidectomy February 19th, 1934. Gland of average size and appearance, and normal histologically. His condition during and after the operation caused no anxiety, but he developed painful red swellings of the joints of the hands after operation, which troubled him for several weeks. (He had been subject to "rheumatism" for years.)

Progress.—Before operation he developed some pain after walking four times the length of the ward, and was forced to stop after walking eight times in three and a half minutes. After operation he walked ten times the length of the ward in four and a half minutes without pain, though he was slightly dyspnoeic. Since leaving hospital he finds he can walk much further on the flat without pain, but he still gets pain on walking uphill. No evidence of hypothyroidism has developed, though he has put on a little weight.

CASE III

History and Examination.—Mrs. G. W., aged 48. Hypertension, ? coronary disease, congestive failure, and angina. Under observation since November, 1932. Since 1929 increasing dyspnoea on exertion. Unable to walk up flight of eleven steps at home without resting: for same period angina on exertion. Oedema of ankle since April, 1932, and swollen abdomen (ascites) since October, 1932. The ascites disappeared under treatment with mercurial diuretics in hospital, but the other symptoms became slowly more marked. She was unable to do any housework. Marked cyanosis and orthopnoea (bolster and three pillows). Marked oedema of

legs, and, when first seen, great ascites, recurring slightly from time to time while under observation. Large tender liver. Apex beat in sixth space two and a half inches outside mid-clavicular line, and dullness one inch to the right of the sternum. Loud systolic murmur in tricuspid area. Pulmonary and aortic second sounds much accentuated. Blood pressure 220/138 to 236/142. Electrocardiogram showed bundle-branch block of the unusual type.

Operation.—Total thyroidectomy, March 28th, 1934. Gland of average size and appearance, except that there was a long pyramidal lobe which was traced to the region of the hyoid, where it tore away. Histologically gland showed some fibrosis, and a parathyroid was seen in its substance. Her condition caused no anxiety during or after the operation.

Progress.—Two weeks after operation she dispensed with one of her pillows, and then, after returning home, with another. Before operation she was stopped by pain and dyspnoea after walking four times the length of the ward in two and a half minutes, and at home had to rest while going up a flight of eleven steps. Two weeks after operation she stopped because of slight dyspnoea, without pain, after walking eight times the length of the ward in three and three-quarter minutes, and she walked twice up and down a flight of twenty-seven steps with no discomfort at all. Since returning home she walks to hospital and up the stairs to the ward without discomfort, whereas previously she had to rest several times on her way to hospital. She has not yet begun to do any housework, though she feels well enough to do so. Her cyanosis is less, she has oedema only of the right leg, which has thrombosed varicose veins, and the liver is not tender, though still large. Her blood pressure is 196/120. There is no evidence of hypothyroidism.

CASE IV

History and Examination.—Mrs. G. D., aged 54. Hypertension, coronary disease, angina, and congestive failure. Under observation since September, 1932. Headaches and increasing dyspnoea since 1929. Angina on effort since March, 1933. Occasional attacks of mild cardiac asthma, lasting up to two hours, since April, 1933. For six months before admission unable to do housework because of dyspnoea and pain. Stout, plethoric, and orthopnoic. Large tender liver. Apex beat in fifth space in mid-axillary line. Dullness one inch to right of sternum. Blood pressure 236/138 to 270/150. Electrocardiogram showed left ventricular preponderance, diphasic T II and III.

Operation and Progress.—Total thyroidectomy April 11th, 1934. Gland of average size and appearance, and histologically normal. Her condition caused no anxiety during or after the operation. Before operation, stopped because of pain and dyspnoea after walking six times length of ward in six minutes. Twelve days after operation she walked fourteen times the length of the ward in five minutes, and then stopped only because her legs were tired, not because of pain or dyspnoea. After resting fifteen minutes she walked twice up and down a flight of twenty-seven steps without distress. Improvement continued after returning home, and she is now doing all her housework except the heavy washing. The only sign of hypothyroidism is slight roughening of the skin.

CASE V

History and Examination.—Mr. W. N., aged 54. ? old coronary occlusion, angina. Under observation since January 11th, 1934. In October, 1933, while at rest, had severe precordial pain radiating down both arms lasting several hours (probably due to coronary occlusion). Since then anginal pain on slight exertion. Unable to do even light work. Emphysematous chest. Thickening of arteries. Heart of normal size. No murmurs. Blood pressure 152/98. Electrocardiogram showed intraventricular block.

Operation and Progress.—Total thyroidectomy April 11th, 1934. Gland of normal size and appearance, and normal histologically. Somewhat collapsed immediately after the operation, but had recovered the same evening, and after this was troubled only by a little cough, apart from local discomfort. Before operation had to stop, because of pain and dyspnoea, after walking six times length of ward in two and a quarter minutes. The pain was not relieved by prophylactic nitroglycerin, and was no better after three weeks in bed. Several attacks of pain while in bed. Only slight improve-

ment after operation, as the patient still got occasional slight attacks while at rest, and was forced by pain to stop after walking ten times length of ward in three and a quarter minutes. Before operation he had to stop at least six times on his way to hospital. Now has to stop only once, but is still incapable of work. No obvious hypothyroidism.

CASE VI

History and Examination.—Mrs. F. R., aged 58. Hypertension, congestive failure, cardiac asthma, and angina pectoris. Under observation since September, 1933. Since February, 1932, attacks of paroxysmal nocturnal dyspnoea, with precordial pain radiating down left arm. At end of attack brings up about half a pint of frothy sputum. Since onset, increasing dyspnoea and oppression in chest on exertion. Unable to do housework for six months before admission. Thin, nervous woman. Apex beat in sixth space one inch outside mid-clavicular line. Accentuated aortic second sound. Marked arteriosclerosis. Blood pressure 208/110 to 246/140. Electrocardiogram showed left ventricular preponderance, inverted T I.

Operation and Progress.—Total thyroidectomy April 21st, 1934. Gland of average size and appearance, except for cyst 1 cm. in diameter in right lower pole. Normal histologically. Her condition caused no anxiety during or after operation. Before operation was forced to stop after walking twice up a flight of twenty-seven stairs in five minutes. After operation walked three times up and down same stairs in four and three-quarter minutes without distress. She was able to get about much better after discharge, but six weeks after operation she suddenly became unconscious, was paralysed down the right side, and died the same day, after readmission to hospital. Post-mortem revealed a greatly enlarged heart, due to hypertrophy of the left ventricle. There was very little coronary atheroma. A large haemorrhage into the left cerebral hemisphere had burst into the lateral ventricle.

Discussion

It is striking that all six of these seriously ill patients stood the operation so well. One was a little collapsed for a few hours, but the others gave no anxiety. So far only two patients show signs of slight hypothyroidism, in spite of the removal of the whole thyroid gland. Blumgart and Levine also found that the signs of hypothyroidism by no means always appeared. Kocher in 1883 said that myxoedema almost always followed total thyroidectomy, but the collective investigation on myxoedema by the Clinical Society of London in 1888⁸ showed that in many cases myxoedema did not occur. The committee concluded that "the apparent immunity in many cases was probably due to the presence and subsequent development of accessory thyroid glands, or to accidentally incomplete removal, or to the insufficiently long observation of the patients after the operation." All the patients in the present series were middle-aged, and it is possible that the thyroid in middle and old age is less active and less essential than in youth. It is striking that one of the patients displaying the obvious physical signs of hypothyroidism does not show the characteristic mental slowness. This is probably due to the improvement in the cerebral circulation relative to the needs of the brain.

Some improvement in the circulatory symptoms occurred in all cases. In Cases II and V it was slight, in Cases I and VI it was moderate, and in Cases III and IV fairly marked. Patient VI died of cerebral haemorrhage six weeks after the operation; it seems improbable that her death was hastened by it. No patient is free from symptoms, but all were capable of more exertion than before operation, and one has already taken up her housework again, after being unable to do it for more than six months. Some improvement occurred in both the congestive and the anginal symptoms, though previously the patients were going steadily downhill in spite of all treatment. It seems fair to attribute the improvement to the operation and not to rest in bed in hospital,

because all the patients were kept in bed for two or more weeks before the operation without improvement, while four had had one or more previous periods in hospital without benefit. Moreover, the patient was kept in bed for only five to twelve days after the operation.

It cannot yet be foretold how long the improvement will last. As the underlying cardiovascular disease is slowly progressive, it can only be a matter of time before the capacity of the heart is again lowered below the demands of the body, lowered though these are by thyroidectomy, so that sooner or later the symptoms will no doubt recur. The patients are being kept under observation, and it is hoped to make a further report on their condition in about twelve months' time.

The cause of the improvement is not yet entirely beyond doubt. It seems very probable that the main factor is the reduced metabolism. Although the heart can drive on no more blood than before, the small volume it can drive on is now sufficient for the diminished needs of the body. This statement needs modification in two particulars. First, if the needs of the body are reduced so much that the heart, instead of being "all out," is able to reduce its work without the tissues suffering, the heart is rested, and recovers some of its lost reserves, so that it becomes able, when necessary, to expel more blood than before the operation. Secondly, in myxoedema the heart is usually enlarged and less efficient than normal, though the inefficiency is masked by the diminished needs of the tissues. There are also characteristic electrocardiographic changes. Both the enlargement and the electrocardiographic changes usually recede under treatment, showing that they are due to the myxoedema, and not independent changes. In three of the present series the heart enlarged, and in two electrocardiographic changes occurred, after the operation (see table). Any impairment of the heart's efficiency due to myxoedematous changes would tend to counteract the benefits of the reduced metabolism.

Levine pointed out that improvement sometimes occurred at a time when there was no change in the metabolic rate, though the basal metabolic rate usually fell, with further improvement later. This was also true of some of the present series. But too much stress should not be placed on basal metabolic rate readings taken shortly after operation. Possibly apprehension may be responsible for unduly high readings at this stage. Levine suggests that some of the improvement, especially in cases with angina, is due not to the diminished work of the heart but to humoral changes, particularly an alteration of the reaction of the heart to adrenaline. This suggestion is based on his previous work,⁹ in which he stated that in patients subject to angina an attack can always be precipitated by an injection of adrenaline. He suggests that in the absence of thyroid secretion this perhaps may not occur. This seems to be purely speculative, and, moreover, other observers do not agree that angina can always be precipitated by a dose of adrenaline, so that there is no need to consider this hypothesis further at present.

Though the diminished need of the tissues for oxygen-containing blood after thyroidectomy is no doubt the chief factor in the improvement, Blumgart's observations on the velocity of the circulation must not be held to prove this. The linear velocity of blood flow depends not only on the output of blood by the heart per minute, but also on the cross-sectional area of the vessels through which the blood flows. If the volume of blood expelled by the heart per minute and the cross-sectional area of the vessels are both halved, the linear velocity of blood flow remains unaltered. In early congestive heart failure the velocity of blood flow through the lungs may be much slowed, though the output of the heart per minute is practically unaltered. This is

because the dilatation of the pulmonary capillaries increases the cross-sectional area of the vessels through which the linear velocity of flow is measured. The linear velocity of blood flow can therefore be taken as an index of the work done by the heart only if it can be shown that the cross-sectional area of the vessels remains unaltered. In the cases under consideration there is no absolute proof of this, though there is indirect evidence pointing in this direction. The vital capacity of the lungs gives an indication of the cross-sectional area of the pulmonary vessels, since if these are dilated the vital capacity is diminished as the air space is encroached upon. In Blumgart's cases, as in our own, the vital capacity was unaltered or slightly increased, showing that the pulmonary vessels were, if anything, less dilated than before. The velocity of circulation through the lungs after the operation is either unaltered or slowed (see table). These two facts together—namely, a lessened linear velocity through narrowed vessels—show that the volume of blood flowing through the lungs per minute is diminished. Since the output of the left ventricle must equal that of the right, this indicates that the heart as a whole is doing less work.

Summary and Conclusions

The whole thyroid gland has been removed in six patients without hyperthyroidism, showing incapacitating congestive heart failure, angina pectoris, or both, in whom all previous treatment had been ineffectual. There were no operative deaths, though one patient with a very high blood pressure died of cerebral haemorrhage six weeks after the operation. All six patients showed slight to fairly marked improvement in their circulatory symptoms after the operation, and were capable of more exertion. One of them, who had done no housework for over six months, is now doing all her housework except the heavy washing. The cases are all too recent for the permanent effects to be judged, but it is hoped to report on their condition again in about twelve months' time. Slight signs of hypothyroidism appeared in two cases only. The rationale of this method of treatment is discussed.

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Juliette Harburger (*Thèse de Paris*, 1934, No. 284) states that during the last two years (1932-3) observations at the Hôpital Laennec, Paris, have shown that alcoholic cirrhosis is three times as frequent in women as in men, and that the disease is more fatal in women (0.73 per cent.) than in men (0.09 per cent.). The malignant hypertrophic forms of cirrhosis are those most frequently found in women, as is shown by the fact that out of twenty-three cases thirteen were hypertrophic and ten atrophic. During the same period 1932-3 alcoholic neuritis showed the same frequency, relative proportion, and characters as in the case of alcoholic cirrhosis, there being four female cases to one male. The inversion of the ordinary frequency of alcoholic symptoms in the two sexes appears to be due both to social conditions, such as the employment of women in factories, and the economic crisis, and to anatomico-physiological conditions, the women representing a new and therefore particularly susceptible soil for alcoholic intoxication.

TRAUMATIC RUPTURE OF THE LUNGS WITHOUT SIGNS OF TRAUMA IN THE CHEST WALL

BY

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As the title suggests, we are concerned in this note with traumatic rupture of the healthy lung. Pathological perforations due to tuberculosis, abscess, emphysema, empyema, neoplasm, etc., and pulmonary laceration by fractured ribs, stabs, and projectiles have been excluded in the cases mentioned, either by necropsy or by the circumstances, age, and history rendering the presence of any of the above conditions extremely improbable. From time to time during the past century these cases have been published. The increase in the number of deaths by violence will, no doubt, bring more to notice, and further emphasize the fact that extensive damage to internal organs—rupture of the lungs, liver, kidneys, spleen, bladder, and intestines, and, for example, extensive retroperitoneal haemorrhage—frequently occurs without any external evidence of trauma. Injury to the abdominal viscera would appear to be due to direct violence to the organs through the flaccid abdominal wall, as in the case of the passing of a cart wheel, or the wheel of any heavy vehicle, over the abdomen, or by blows or falls in which the abdomen is forced on to a projecting ledge.

Rupture of the lungs cannot be so simply explained. Traumatic rupture of the lungs without injury to the chest wall may be of three types, any of which may occur alone, or the lungs may present all types in varying degree.

Pneumothorax Type

The first condition is simple rupture of a few alveoli, leading to pneumothorax without evidence, such as haemoptysis or haemothorax, to suggest extensive damage to the parenchyma. These cases are not very infrequent, but as the vast majority recover completely they are not published.

Giovanni,¹ in 1861, recorded the case of a boy, aged 15, over whose chest the wheel of a carriage passed. He died on the tenth day. At necropsy no fracture of the ribs or sternum could be detected, but air escaped on opening the thorax. Another instance is the following. A healthy young woman, aged 19, slipped from the top of the household step-ladder, and felt something unusual in her right side. On x-ray examination a pneumothorax was found with complete collapse of the right lung. No fracture of the ribs or other injury to the chest wall could be found. She made an uneventful recovery. No evidence of any lung disease could be found at the time, and radiological examinations at intervals during the subsequent eighteen months failed to detect any signs of tuberculosis.

Parenchymal Rupture

In the second type rupture of the lung parenchyma occurs without laceration of the visceral pleura. On section the lungs present numerous haemorrhages, varying in size from a pea to a walnut, or larger. The haemorrhages completely disintegrate the lung tissue, giving the appearance of cavities filled with blood. In addition, there are ecchymoses throughout the lung fields. Neither pneumothorax nor haemothorax is present, but haemoptysis is constant, and may be the only sign.

Moore² published an example. A healthy young man fell off a horse and sprained the left wrist and bruised the left elbow. No bruise of the chest wall and no fracture of the ribs could be found. He had severe haemoptysis and died three days later. The following is another instance. In 1934 a healthy man, aged 42 years, received a blow on the chin and fell to the ground. He died in a few moments from haemorrhage into the fourth ventricle. No marks of violence