On the *right side* there was no "azygos line" in the lower part of the abdomen. The venous blood from the pelvis and lower limb had to find a new route to circumvent the obstructed common iliac vein. Fresh anastomotic channels were opened up in the direction of the deep circumflex iliac and ilio-lumbar veins (Fig. 2, f). Many large veins belonging to this group were found in the lateral and posterior parts of the abdominal wall, and these united to form the beginning of the right subcostal vein. The latter part of the collateral circulation had been more difficult to establish, as evidenced by the dilated superficial veins in the right groin and lower limb.

Discussion

In the absence of a clinical history we must assume that the man had a severe illness of unknown aetiology many years ago. There was no record of any serious disturbance in health during the last eleven years of his life, while an inmate of the Capetown Infirmary. If the deposit of calcium salts can be looked upon as a remote or terminal result of the fibrous organization of a thrombus one may argue that the original lesion in the inferior vena cava began at a level just above the entrance of the two renal veins. It was in the nature of a spreading thrombosis and could not have caused a total blockage of both renal veins at once, as this would have been incompatible with life. The extreme resiliency of the venous system in compensating for the obstruction would perhaps justify a further assumption—namely, that the original illness occurred when the patient was a young man or perhaps even in childhood: only young tissues could have shown this wonderful adaptability. The kidneys, both of normal size, had recovered completely from their extraordinary handicap, and the man lived to the ripe age of 71.

It is an interesting point whether the condition could have been diagnosed during life. The varicosities on the right side pointed in the direction of a venous thrombosis. A collateral circulation which had caused an enlargement of the deeply situated azygos system of veins cannot be discovered clinically. A normal urine, once compensation was established, would hardly have allowed one to suspect a complete blockage of both renal veins. A radiograph of the posterior abdominal wall was taken in the department, but the inferior vena cava outline could hardly be seen. Evidently the condensation of calcium salts in the fibrosed vein was not dense enough to show up with any distinctness against the shadow of the vertebral column.

BEARING ON DECAPSULATION OF THE KIDNEYS

The most remarkable feature of the collateral circulation was the enlargement of the veins in the perinephric fatty capsule of the kidneys. These formed large bunches of veins surrounding the kidney and piercing its fibrous capsule. The perinephric fat belongs to the extra-peritoneal tissue, and one of the functions of this important layer is "to establish, through its vascular plexus, communications between the parietal vessels and those distributed to the abdominal viscera" (Cunningham, 1937). This function could not have been illustrated in a more striking manner.

The operation of decapsulation of the kidneys was originally proposed by Edebohl (1901). It was thought that the thickened fibrous capsule of the kidney prevented the establishment of a collateral circulation. More recent literature on the subject shows that the original theory finds few supporters. When the renal veins are free the anastomotic channels do not establish themselves easily, and the fibrous capsule which forms after the operation is often thicker and firmer than the first one. The operation is still recommended in chronic Bright's disease and in certain forms of acute nephritis, but the

most striking successes occur in puerperal eclampsia (Thomson-Walker, 1936). It has been suggested that the success of the operation is not connected with the collateral circulation at all, but has to do with the removal of the sympathetic renal plexuses which ramify in the capsule (Sen, 1936). It is stated that the blood flow through the kidney substance improves because the vasoconstricting influence of the sympathetic is removed.

After seeing the extraordinary development of the venous circulation in the perinephric fat and through the fibrous capsule of the kidney in the present case it is clear that there is a strong anatomical justification for operations planned to establish new blood channels. It suggests that the original explanation of the successes claimed for decapsulation of the kidney—i.e., one based on collateral circulation—remains the correct one.

Summary

A short account is given of the anatomy of a case that demonstrates the remarkable potentialities of the body for establishing circulatory anastomoses.

From this case it appears to be possible to establish a complete collateral circulation for the drainage of both kidneys.

These findings may prove to be important clinically.

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IMPERFECT STERILIZATION OF DRESSINGS AS A PROBABLE CAUSE OF POST-OPERATIVE TETANUS

BY

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When recording the results of experiments on the sterilization of dressings (Hayes, 1937) I ventured to express the opinion that imperfect sterilization could be the cause of unexplained post-operative tetanus. The present paper is concerned with experiments conducted to indicate the viability of tetanus spores inserted in the centre of dressings and sterilized under certain conditions. Unfortunately, owing to the onset of war, it was not possible to complete the full range of experiments desired.

Catgut as a Cause of Post-operative Tetanus

Imperfectly sterilized catgut has for many years been considered to be the chief cause of post-operative tetanus. Evidence is, however, accumulating which indicates that it does not play the important part previously accepted. There is considerable disagreement amongst authorities as to whether catgut is the chief cause. Fildes (1929) believes that it is, but also states that positive evidence is meagre. Mackie (1928) and Mackie, McLachlan, and Anderson (1929), agreeing with Fildes, point out the "peculiar relationship of post-operative tetanus to abdominal and gynaecological operations." Bulloch (Bullock, Lampitt, and Bushill, 1929), on the other hand, in his classical work and with years of experience following his special study of the subject, after reviewing all evidence available, concludes: "There may be a suspicion against catgut. It remains for the present only a suspicion." Pulvertaft (1937), discussing catgut tetanus, says: "There are indeed

strong reasons to suppose that post-operative tetanus is due most often to other causes than catgut."

The preparation of catgut has for some years been carefully controlled. Kinloch (1929) states: "Now surgical catgut is scheduled under the Therapeutics Act the small but tragic group of post-operative deaths due to tetanus infection contracted from contaminated catgut will be in future prevented." Cases are, however, still reported, and many are not. I have notes of five cases which occurred in one hospital and which are as yet unrecorded.

While not denying that catgut may be a cause, it is reasonable to look elsewhere for probable causes, and, as the simplest method of infecting a wound is by direct infection, dressings that come into contact with wounds are open to suspicion. Pulvertaft (1937) points out that tetanus spores are everywhere: elaborating the work of Fildes, who isolated tetanus spores from cellulose wadding, he was able to demonstrate spores in sanitary towels made of cellulose-wool and cotton-wool. It would appear, for some as yet unexplained reason, that these types of dressing can contain tetanus spores. Cotton-wool is in constant use in surgical practice. It is usually cut from a roll into certain sizes, packed into a drum, and sterilized. Whether it is tightly packed or loosely packed depends upon the size of the sterilizer and the person who packs the drum. Usually when a small sterilizer is in use the drum is tightly packed. It is not generally known that if cotton-wool from a roll is placed in a warm place it will swell to three times its thickness. If, therefore, wool is cut and packed tightly into a drum it will swell when placed in the sterilizer and heated, and all spaces will be obliterated, preventing the easy penetration of steam. It will thus be seen that there is a considerable amount of evidence available to indicate causes for post-operative tetanus.

Sterilizers

For sterilization to be efficient a properly designed sterilizer is required. Perforated drums should be used, dressings should be carefully and loosely packed, and the temperature inside the drum must be controlled. It is essential that air be expelled from dressings and sterilizer. Hoyt, Chaney, and Cavell (1938) showed the following variations of temperature in an autoclave containing air:

	Part of Autoclave		
	Upper	Middle	Lower
10 lb. steam pressure, 115° C.; autoclave containing 25% air ..	114° C.	113° C.	108° C.
20 lb. steam pressure, 126° C.; autoclave containing 42% air ..	120° C.	119° C.	115° C.

Note.—42% air is present in an autoclave when no attempt has been made to evacuate air.

These experiments are of great importance for the appreciation of the principles on which efficient sterilization is based. When steam is admitted into a sterilizer containing air, the air, being approximately twice as heavy as steam, falls to the bottom and is heated slowly by conduction from the steam. If air is not removed the temperature of the steam will fall to a degree dependent on the position—the nearer the steam the lower the temperature—and if present in the dressings the penetrative efficiency of the steam will be reduced.

Underwood (1934) advocates a simple method of removing air from a sterilizer and dressings. A tap is fitted to the bottom of the sterilizer and is left slightly open whilst the steam pressure is being raised. The presence of air is indicated by a spluttering noise which ceases when all air has escaped, being replaced by a steady feathery escape of steam. The tap is so adjusted that a fine stream of steam escapes during the whole sterilizing process, so that

air which is driven from the dressings can also escape. Underwood advises that a thermometer be inserted proximal to the tap in order that the temperature of the exhausted steam may be measured: he points out that if the temperature of the exhaust steam is equal to that of the steam inside the sterilizer and corresponds to that indicated on the gauge no air can be present. This simple accessory should be attached to all sterilizers.

There are many small sterilizers in use from which the air is evacuated from the top. I was asked to test such a type. The drums were packed with dressings sufficient for one abdominal operation. At 15 lb. pressure (121° C.) for 30 minutes and 20 lb. pressure (126° C.) for 10 minutes a temperature of 103° C. was not reached inside the centre of the drums. Such a temperature is useless for the sterilization of spores. As air is heavier than steam and must sink to the bottom it is obviously unsound to design a sterilizer with the air exit at the top.

Experiments were conducted to show whether tetanus spores were killed under varying conditions of sterilization. We used a vertical type sterilizer (kindly supplied by Down Bros.) fitted with a vacuum apparatus and steam-and-air exhaust cock at the bottom of the sterilizer. It accommodated two small perforated drums (5 in. by 11 in.) and one large drum (11 in. by 11 in.). Blotting-paper was soaked in the medium containing tetanus spores and placed in small Petri dishes. The dishes were put in the centre of the dressings to be tested.

Group A Experiments

The drums were packed with cotton-wool to an average capacity. No air was evacuated from the sterilizer. The steam pressure was raised to the requisite height and maintained for the experimental period.

Exp. No.	Steam Pressure per sq. in.	Duration of Sterilization	Position of Spores in Sterilizer	Size of Drum	Result
1	10 lb. 115° C.	20 min.	Upper	Small	+
			Lower	"	+
2	" "	30 "	Upper	"	+
			Lower	"	+
3	15 lb. 121° C.	20 "	Upper	"	—
			Lower	"	+
4	" "	30 "	Upper	"	—
			Lower	"	+
5	20 lb. 126° C.	20 "	Upper	"	—
			Middle	Large	+
			Lower	Small	—
6	" "	30 "	Upper	"	—
			Middle	Large	+
			Lower	Small	—

These experiments show that when air is not evacuated from the sterilizer tetanus spores are not uniformly destroyed. Experiments 3 and 4 clearly show the effect of air and confirm those of Hoyt, Chaney, and Cavell. Experiments 5 and 6 show how air delays the penetration of steam. The increase in the amount of dressings was sufficient to impose a barrier to penetration.

Group B Experiments

Dressing containers are advertised and used which contain no perforations. During sterilization the lids are raised in order to allow the ingress of steam. It has previously been shown that steam penetrates the dressings of such drums with the greatest difficulty. These experiments, though few in number, confirm previous findings.

Exp. No.	Steam Pressure per sq. in.	Duration of Sterilization	Position of Spores in Sterilizer	Size of Drum	Result
1	15 lb. 121° C.	20 min.	Lower	Small	+
2	" "	30 "	Upper	"	+
			Lower	"	+
3	10 lb. 115° C.	20 "	"	Large	+
4	" "	30 "	"	"	+

In Experiments 3 and 4 air was extracted by a vacuum of 10 inches.

Previous experimental work has shown the unsuitability of unperforated drums (Hayes, 1937) as containers for sterile dressings even when conditions were favourable. The above experiments are too few to enable one to dogmatize, but, taken in conjunction with previous experiments, they indicate that an unperforated drum is dangerous.

Group C Experiments

These experiments were conducted under correct conditions—i.e., air was evacuated from the sterilizer by first creating a vacuum of 10 inches, after which the steam-and-air-escape cock situated at the bottom of the sterilizer was opened. Steam, plus air, escaped, and the pressure fell to zero. The cock was then closed and the pressure raised to that required for sterilization. The cock was now slightly opened so as to allow the discharge of a feathery stream of steam.

Exp. No.	Steam Pressure per sq. in.	Duration of Sterilization	Contents (Large Drum)	Position of Spores in Sterilizer	Result
1	10 lb. 115° C.	20 min.	Sheets	Upper	—
2			Cotton-wool	"	—
3	15 lb. 121° C.	"	Sheets	"	—
4			Cotton-wool	"	—
5	20 lb. 126° C.	"	Sheets	"	—
6	" "	"	Cotton-wool	"	—

In Group C experiments the drums were tightly packed and of the largest size. The sterilizer was worked on correct principles. Spores were killed at as low a pressure as 10 lb., maintained for twenty minutes.

Although not exhaustive the experiments as a whole are striking and, it is hoped, will serve as a stimulus to others to work on similar lines and as a warning to those who use unsuitable types of sterilizers.

Summary

Experiments have been conducted to show that tetanus spores inserted into dressings are not killed when the technique of sterilization is imperfect.

As tetanus spores are present everywhere there is ample opportunity for dressings to become infected.

Many small sterilizers are not efficiently constructed, and from personal observation it can be stated that in many instances the methods used in preparing dressings for sterilization and the technique leave much to be desired.

Bacteriologists have shown that cotton-wool may contain tetanus spores.

It is reasonable to accept that post-operative tetanus may be caused through using dressings that are infected with tetanus spores and have been imperfectly sterilized.

My thanks are due to Prof. McIntosh, Bland-Sutton Institute of Pathology, Middlesex Hospital, for providing me with the materials and facilities for the experiments, and to Mr. Barker for his assistance.

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C. Petrillo (*J. Pediat.*, 1940, 17, 378) places on record the case of a female infant in whom a piece of wire was retained in the heart for at least twenty-nine months and in the lung for at least four more months, and then was coughed up in a blood clot. The symptoms were those of post-pneumonic myocarditis with cardiac failure and passive congestion. The portal of entry was probably the oesophagus.

LACTATION AND BREAST FEEDING*

BY

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Breast milk is the most suitable food for the infant, and natural feeding, from the viewpoint of both mother and child, is the best method of administration. The chief advantages of natural over artificial feeding depend upon the facts that human milk has a composition and a physical character which are best suited to the needs of the infant, it is easily digested, it contains vitamins and immune bodies, and, being taken direct from its source, it is practically sterile and at the proper temperature for drinking. The breast-fed child therefore thrives better, is less likely to have digestive upsets, and is more resistant and less often exposed to infection than the bottle-fed. Further, breast feeding is simpler and cheaper than feeding by substitutes, and, involution of the maternal pelvic organs being assisted by suckling and mammary function being normal, the mother may be expected to have a more straightforward period of convalescence from her confinement when she feeds her baby in the natural way.

In spite of the many advantages of breast feeding it is occasionally found to be inadvisable or impossible, as when any of the undermentioned conditions exist:

1. Severe maternal illness, as puerperal sepsis, active tuberculosis, or pneumonia, during lactation.
2. Breast infection, as mastitis or severely fissured nipple. In the latter case weaning should be temporary, the baby being put back to the breast as soon as the nipple recovers.
3. Puerperal insanity. As an insane woman may attempt to harm her child she cannot be trusted to nurse it.
4. Pregnancy starting during lactation.
5. Absence of milk, which precludes the possibility of breast feeding.

Mechanism of Lactation

In order that efforts to control lactation may be placed on a rational basis it is necessary that the more important factors concerned with breast development and function should be understood.

The ovarian hormone, oestrin, which passes into the blood stream in large quantities throughout pregnancy, is responsible for increased vascularity and hypertrophy of the breast, its milk ducts, and its glandular tissue. The corpus luteum hormone, progesterin, secreted during the same period, brings about further differentiation of the glandular structure, with acinar formation (Folley, Guthkelch, and Zuckerman, 1938). Both of these hormones, and more especially oestrin, have a powerful inhibitory effect on lactation, probably acting chiefly through the anterior pituitary gland (Wenner and Joël, 1939). Thus during pregnancy the breasts are hypertrophied and their specialized glandular tissue is developed, but milk is not secreted.

After the child and secundines have been expelled from the uterus oestrin and progesterin are withdrawn, the blood hormone level falls rapidly, and the inhibitory action of these hormones on the anterior pituitary gland and on the breasts is removed. Prolactin, the lactotrophic fraction of the anterior pituitary secretion, is now passed into the blood stream and the breasts are stimulated by this hormone to produce true milk. In this action it may be

* Being part of a clinical lecture delivered at the School of Medicine, Newcastle-upon-Tyne, on October 5, 1940.