A Review OF THE PRESENT POSITION OF KNOWLEDGE AS TO PROSTATIC ENLARGEMENT.

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BY

SIR CUTHBERT WALLACE, K.C.M.G., C.B., F.R.C.S.,
SURGEON TO ST. THOMAS'S HOSPITAL.*

FUNCTION AND FORM.

RECENT years have added little to our knowledge of the function of the prostate. It is not apparent that it has any internal secretion, or that it exercises any influence on metabolism; it is a secondary sexual gland.

The glands that make up the prostate spring apparently from all sides of the urethra, but the anterior group ultimately atrophy. The gland mass that lies below the ejaculatory ducts is seldom the seat of changes and usually retains its spongy nature.

Long before birth the prostate has assumed its adult form and the gland tubules the distribution that pertains throughout life. There is no indication of any division into lobes or lobules. The tubules run out from the side or posterior walls of the urethra, tending to bend forward as the distance from the urethra increases. In front there is very little if any gland matter. This glandless area represents an atrophy of tubules, not a fusion of constituent lobules. None of the tubules of the gland reach the surface, thus leaving another non-glandular portion. Lastly, there is always a considerable thickness of non-glandular tissue surrounding the urethral canal.

HISTORICAL.

[The history of prostatectomy was then reviewed, beginning with the early work of McGill of Leeds (1887).]

From 1886 until the close of the century the operative treatment of enlarged prostate was undergoing a slow and painful evolution. In 1888 Harrison of Liverpool was advocating perineal section and prostatotomy, more especially in those cases of foul urine and degenerated kidneys, and in this way seems to have laid the foundation of the present two-stage operation; but the general feeling of the profession can be gauged by the eagerness with which the so-called sexual operations were taken up. In the late nineties the operation of prostatectomy was again making headway, and the sexual operations, having been found wanting, were declining. In 1900, while the treatment of enlarged prostate was still chaotic, Freyer published his series of successful cases, which, anyhow in this country, re-established prostatectomy as an operation of choice.

Since this time the suprapubic operation has found favour with most surgeons, and the technique of its performance has remained in the main unaltered. The perineal operation has, however, found some formidable advocates, and appears at the present time to be gaining ground.

THE SEXUAL OPERATIONS.

In 1775 John Hunter made the classical observation on the want of development of the prostate that resulted from castration in youth or infancy. Castration as a remedy for prostatic enlargement was suggested to White of Philadelphia by the shrinking of uterine fibroids after ovariectomy, the uterus being considered a homologue of the prostate. It was found by experiment that castration of adult dogs was quickly followed by atrophy of the prostate. In 1889 Griffiths had reported to the same effect.

Treatment by castration, although put forward aca-

demically, was taken up with a rush, and, like many new treatments, was at first apparently efficacious. Even unilateral orchidectomy was reported to be efficient. The literature of the period, however, shows that castration could not be relied upon to cause an atrophy of the enlarged prostate.

Vasectomy was next proposed as a slighter operation, but one warranted to produce the same effect. It had a vogue, but gradually it also lost favour, and with it the sexual operations ended. Mr. Shattock and I did some experiments to test this matter; we found that, while cutting off the blood supply caused an atrophy of the testicle, division of the duct left the testicle entirely intact. While in the midst of these experiments we discovered that John Hunter had made the observation in the human subject that the testicle developed and contained spermatozoa although there was no connexion between the testicle and its excretory canal. In vasectomy, as practised for the relief of prostatic enlargement, we have an example of how careful one must be to verify the facts before applying them.

CAUSATION AND NATURE OF THE ENLARGEMENT.

Two theories as to the nature of prostatic enlargement have alternately held the premier place—the infective and neoplastic. Nothing of interest in this connexion has come to light of recent years, except that Hugh Young, by a careful statistical inquiry, has shown that gonorrhoea, at all events, plays no part in the etiology. At present most people regard the enlargement as due to the growth of adenomata, and if this is accepted, the cause of prostatic enlargement is the same as that of other such growths. In this association it may be useful briefly to allude to certain facts:

1. The growths reproduce fairly faithfully the histological features of the parent, both as regards stroma and gland tissue.
2. Encapsulation is usually very complete, especially in old-standing cases.
3. Sometimes, however, the encapsulation is incomplete and recalls certain adenomata of the breast.
4. The growths are often compound, one adenoma comprising several small ones.
5. The time of appearance is late in life, and this may have some connexion with the proneness of the growths to become carcinomatous.

POINT OF ORIGIN OF THE ADENOMATA.

There is still some difference of opinion as to the exact place in the gland at which these masses arise. One school maintains that they are not true prostatic tumours, but arise in the subcervical glands or in those of Albarran, both of which are submucous; in far the greater number of cases, however, the point of origin lies well within the prostate proper. The adenomatous masses usually arise in connexion with the acini which enter the prostatic urethra above the mouths of the ejaculatory ducts; that portion of the gland which lies below seems little prone to this change and often retains its normal spongy texture after the rest has undergone a complete change.

CAUSATION OF SYMPTOMS.

The symptoms, which must be of local origin, since bladder function returns practically to normal when the obstruction has been removed, may now be discussed.

Frequent and precipitate micturition may be explained by thinning and then replacement of the contractile tissue about the internal meatus by the adenomatous growth.

Hesitant and interrupted micturition are more difficult of explanation. Hitherto they have been put down to the ball-valve action of the "third lobe." Now a growth behind the urethra that could act in this way is a rarity, and I would suggest that these symptoms are caused somewhat in the following way. The urethra is surrounded by an adenomatous mass which is under tension caused by its growth stretching the pathological capsule. The urethra is also bent at an angle so that it forms a kind of flap valve. For urine to pass, the pressure in the bladder has to be so adjusted that it can overcome the increased pressure within the urethra and at the same time be insufficient to shut the valve. Any departure from the

*The report has been slightly abridged by the omission of some introductory matter.

optimum bladder pressure will cause a cessation of the flow of urine. The distressing symptom of dribbling from the urethra after the act of micturition should have been finished may be accounted for by the elongation, stretching, and distortion of the canal by the adenomata which have replaced the normal contractile tissue or hindered its orderly action.

Residual urine is the most difficult symptom to explain—in fact, it never has been explained. The most ingenious solution is that which attributes it to the intravesical pressure on the varying cone-like projection of the prostate into the bladder. When the bladder is full the cone will project but little, but as the organ empties the cone will offer a greater surface that is subject to pressure, with the result that the urethra becomes occluded. Unfortunately for this explanation a vesical cone is not always present.

I would suggest that residual urine is really a case of bladder posture. Fullness of the bladder is a relative term. The usual act of micturition, when once the initial stimulus of distension has been given, is continuous. The bladder during the process of emptying will contain from time to time an amount of urine which in process of filling had produced no desire for micturition. If the act of emptying is slow or interrupted, as it is in prostatic trouble, it is possible to imagine that the impulse necessary to carry the act to completion becomes dormant or fails to be again initiated; to speak in homely terms, the bladder imagines itself to be empty.

THE FATE OF THE CAVITY LEFT BY OPERATION.

Even before the revival of prostatectomy it was asserted that the procedure consisted in the total removal of the prostate. This was given as an explanation of the success of the operation. It is, however, now, I think, generally admitted that the modern operation for prostatic hypertrophy consists in enucleation of adenomatous masses from within the expanded outer portion of the organ, and that there is no real solution of continuity between the bladder and the urethra. That fact accounts in part for the almost unbelievable fact that the operation is very seldom followed by stricture.

After the enucleation the urethra and bladder are joined by a ragged cavity, which may be at that moment of very considerable dimensions. Very soon after the removal of the adenomata, or rather at the very moment of their removal, the cavity contracts centripetally, so that not only are the sides of the cavity approximated, but the bladder is at the same time approximated to the urethra. This contraction is brought about by the resilience of the remaining part of the prostate, and it may be remembered that it is this resilience pressing on the central adenomatous mass which is in part the cause of the urinary difficulties. This contraction at the time of operation is a very real thing, and gives rise to considerable difficulty if the surgeon wishes visually to explore the cavity. After the operation the cavity continues to retract, so that in some cases within a few weeks a skiagram of the bladder shows no sign of its existence. Sometimes, however, a distinct cavity remains for a considerable period, though micturition is perfectly normal. It might be argued that the existence of this cavity shows that the internal sphincter is out of action. There is, however, another explanation: it is possible that, in those cases in which a cavity persists, the growth has been largely intravesical, and that the top of the cavity corresponds, not to the internal sphincter; but to the level to which the mucous membrane of the bladder has been raised.

When an opportunity occurs of inspecting and digitally examining a bladder after prostatectomy, it is remarkable how little abnormality is to be made out; perhaps there is a small dimple at the internal meatus, or the meatus is not so dilatible as it normally is, and reminds one of the state of affairs in carcinoma or in the so-called "Mercier's bar." Again, it is almost impossible to be sure by rectal examination whether the prostate has been removed or not.

The two-stage operation was introduced quite early in the history of prostatectomy to rest the patient who was worn down by sepsis and want of sleep. The indications

for its performance were at first almost entirely clinical. The discovery and perfection of tests of urinary efficiency have extended and rendered more accurate the indications for the performance of this operation.

It entails, however, certain disadvantages. The first is that there are two anaesthetic administrations and two periods of anxiety and discomfort. The second is that the enucleation is made more difficult by the shrinking of the bladder, the hardening and contraction of the prostate, and the induration of the abdominal wall. In addition, the wound may become foul and phosphatic deposit give trouble.

If the two-stage operation is decided upon, the relative merits of catheter and suprapubic drainage are to be considered. The catheter has been with many surgeons very successful; it avoids two operations, but it may give rise to a urethritis which is troublesome, and in some cases to a definite rise in the blood urea. Suprapubic cystostomy has the great advantage that the condition of the prostate can be accurately determined by the only certain way—namely, that of bimanual examination.

I have nothing to say about after-treatment, except to express the opinion that, whatever is the means favoured to carry off the urine after prostatectomy, the less the prostatic couch is interfered with the better. I have been very free from secondary haemorrhage, and I attribute this to only washing the bladder out in exceptional circumstances.

URINARY EFFICIENCY.

There are, of course, discrepancies between the various tests or parts of the same test, but in the main a fairly just estimate as to the efficiency of the kidneys can be formed.

Mention must here be made of what is, to me at all events, a difficult problem. When is the surgeon justified in refusing to proceed to a second stage prostatectomy? There are a certain number of patients on whom a drainage cystostomy has been performed, and whose urinary efficiency, as judged by the usual tests, has never fallen to a figure that would, in the first instance, have warranted a single stage prostatectomy, although in other ways they seem to be in good health.

The question to be decided is this: What percentage of urinary efficiency is to be taken as justifying completion of the operation after a period of drainage?

The mechanism whereby the loss of efficiency of the kidney is brought about is still unsolved. It is doubtful what effect the obstruction to outflow has on the constituents of the urine and what is the ultimate fate of a kidney whose duct has been completely occluded for varying periods.

The rapid improvement that takes place in some cases after drainage of the bladder is mysterious. Perhaps the easiest explanation is that which attributes recoverable damage to vascular compression and not to histological change.

BACK PRESSURE.

It is usual to attribute the troubles of the kidney simply to "back pressure," but when the subject is examined more carefully it is not so easy to understand how the kidney is subjected to an obstruction lasting over a long period. It is not very obvious why we speak of back pressure in connexion with the kidney and do not use the term when we talk of obstruction in connexion with other ducts and the intestinal tube. It is an unfortunate expression, because it sometimes leads to the belief that the pressure which injures the kidney originates in the bladder as the result of tension or of muscular contraction.

The pressure that dilates the ureter and destroys the kidney is the secretion pressure of the kidney, and it may be of interest to consider what are the pressures in the bladder that hinder the ureter in propelling the urine into the bladder; so long as the ureter can get rid of the urine, the kidney will be shielded from any noxious pressure.

I am indebted to Mr. B. W. Williams for the observations incorporated in Table I. They show the pressure in the bladder of some cases of retention. They were taken by means of a water gauge and have been reduced to milli-

metres of mercury; as more readily appreciable. The pressures recorded are those found in the intervals between spasms of the bladder.

TABLE I.—Pressure in Bladder in Cases of Retention.

Case No.	Duration of Retention.	Bladder Pressure in mm. Mercury.	Amount of Urine.	Case No.	Duration of Retention.	Bladder Pressure in mm. Mercury.	Amount of Urine.
1	36 hrs.	8-10	35 oz.	6	12 hrs.	34	46 oz.
2	7 days	23-25	85 oz.	7	24 hrs.	27	50 oz.
3	48 hrs.	22-23	45 oz.	8	24 hrs.	16	50 oz.
4	overflow	19	20 oz.	9	22 hrs.	8-10	36 oz.
5	3 days	29	42 oz.	10	24 hrs.	24	40 oz.

It will be seen that the maximum pressure which the ureter has to overcome in a case of acute retention of urine is about 34 mm. of mercury. The pain occasioned at such a pressure is not to be endured; the individual is compelled to seek relief. From this it appears that any high pressure that may act injuriously on the kidney must be of very short duration.

In most patients, even in those with a considerable amount of residual urine, the pressure against which the ureter has to work must be very slight. In fact, it is difficult to see that the pressure in the bladder in most cases of residual urine can be greater than that which pertains in the ordinary course of filling of the bladder. It follows that there are three possibilities, which are: (1) that the kidney is extremely sensitive to any obstruction, or (2) that the damage done is in the nature of a sudden catastrophe (during an attack of retention), or (3) that we must seek some unknown cause of kidney deterioration.

THE SUPRAPUBIC AND PERINEAL OPERATIONS COMPARED.

While the suprapubic method of operating has been chosen by the great majority of surgeons, the perineal has been practised by surgeons of great repute and experience, one of whom has probably the lowest mortality of anyone. It is therefore useful to inquire whether there is any reason for the majority to change their methods. It is claimed that (1) the perineal is the more scientific, in that the enucleation is more deliberate and is performed under the eye; (2) the ejaculatory ducts can be saved, or ligated; (3) the urethral wall can be left intact; and (4) the loss of blood is less.

To take these points one by one.

1. Some surgeons might say that by using a large vesical incision the enucleation can be carried out as openly and as deliberately by the suprapubic as by the perineal route. Putting this contention aside for the moment, it may be considered whether the enucleation under the eye is a material advantage. Removal of the adenomata is not a matter of delicate and difficult dissection, but really consists in entering a line of cleavage already established and following it to its end. It therefore matters little whether this is done under the eye or not. An accurate judgement that all adenomata have been removed can be formed by bimanual examination when the suprapubic route has been used.

2. As regards the preservation of the ejaculatory ducts, if it could be shown that children had been born to patients who had undergone perineal prostatectomy, it would be a point in favour of that operation, as a restoration *ad integrum* is always desirable. I am unaware, however, that a man has ever begotten a child after a prostatectomy. As regards a man's virility, apart from power of procreation, we have already seen that section of the vas produces no effect. It is not very clear whether the occurrence of epididymitis is caused or prevented by rupture of the vas. If opening the canal can cause an infection to spread to the epididymis, it cannot be denied that infection can occur with an intact vas or one in which the lumen has been obliterated by ligature after rupture. In the matter of the vasa, therefore, it does not seem that

the perineal method has any advantage over the suprapubic operation.

3. My observations on many *post-mortem* and operative specimens have led me to doubt the possibility of leaving the urethral wall intact in any but a very small and insignificant number of cases, and I should not be influenced on this account in the choice of the operative route.

4. If excessive bleeding could be certainly and effectively diminished by the perineal route, that would be a very good argument in favour of its adoption.

5. As regards restoration of function, and absence of a persistent operative sinus, the suprapubic method leaves little to be desired.

Professor Hans Wildbolz, in a recent communication, has advocated the use of the perineal method and the suture of the neck of the bladder and the distal portion of the prostatic urethra. He also states that the mortality of the operation is less than that of the suprapubic method, that the former method leads to a smaller rise in the blood urea, that sepsis is practically abolished, and that union takes place *per primam*. If other surgeons can reach the same results it will be a great argument in favour of the perineal method.

BEST TIME FOR OPERATION.

It is fortunate that, although the adenomata may be multiple, they are usually all of an age, so that when they have necessitated operation their removal is not followed by the formation of others. It should be the aim of the surgeon to remove the obstruction before the urinary function is depressed.

If the prostate is large and resilient and the life of the patient is disturbed by his trouble, the decision to operate presents no difficulties. On the other hand, if the prostate presents no great departure from the normal and the patient is willing to put up with what discomfort he has, most surgeons would, I think, be willing to wait, provided the kidneys are efficient and the patient can be watched.

More difficult are those cases in which the life of the patient is being somewhat disturbed by urinary troubles and examination by the rectum reveals a prostate perhaps a little large but not much altered in shape or size. Such a case may prove to be one of simple prostate which has not greatly enlarged or not enlarged toward the rectum, a case of carcinoma, or "prostatic bar." I know of no sure way in which the matter can be settled except by opening the bladder and bimanual palpation.

It has been truly said that if an individual is destined to have trouble with his prostate, he is lucky if the organ, so to speak, ripens quickly about the age of 60. The kidneys will most probably be in good condition, a single-stage operation is possible, and there is a prospect of many years of health and enjoyment of life.

CARCINOMA.

Hitherto the treatment of carcinoma has not been satisfactory, either from the operative or radiation point of view.

Operative treatment involves the entire removal of the gland. This is a difficult and tedious procedure. It has been accomplished, however, in a limited number of cases by the perineal and by the transpubic routes, and the feasibility of a satisfactory union of the bladder and urethra demonstrated. If the mechanical difficulties of removal have been got over, it cannot be said that the difficulties of diagnosis sufficiently early to justify a serious operation, and offer a reasonable prospect of cure, have been surmounted. Herein, to my mind, lies the crux of the question. The diagnosis of carcinoma is usually made on the hardness, the nodularity, the fixation of the prostate as felt per rectum, and the inelasticity of the internal meatus as felt from the bladder. By the time that the signs of malignant disease are irrefutable, as judged by a rectal or cystoscopic examination, the time of successful intervention is probably past. The rigidity of the internal meatus, which is a useful sign, can only be ascertained after a suprapubic cystostomy; this is a distinct advantage if the prostate is to be excised by the perineal route.

Again, there is the difficulty of diagnosing carcinoma from that undifferentiated group of affections that may be classed under the term "post-urethral bar."

Adeno-carcinoma in its own way presents almost as great a difficulty. This condition may be diagnosed in the process of enucleation of a presumed adenomatous mass, or it may not be diagnosed until after a microscopical examination.

Here the surgeon has three courses open to him: (1) He can proceed forthwith to total extirpation of the prostate, removal of which will have been made all the more difficult by the already accomplished operation. (2) He can wait and put the matter before his patient. (3) He can allow the bladder to close, if it will, and establish a suprapubic drain when obstruction supervenes, which usually happens within six months.

RADIATION.

Radiation has been carried out from the urethra, from the rectum, and by means of needles introduced through the perineum or through the bladder; deep therapy has also been used.

Radiation in carcinoma of the prostate is in the same condition as radiation for carcinoma in other parts of the body. We are slowly and painfully groping our way towards a better knowledge. There are many groups of observers doing good and careful work throughout the country, but I cannot help wishing that someone who has the means would by his generosity render possible a more intensive study of the subject.

Professor Sidney Russ of the Middlesex Hospital has kindly prepared for me the accompanying table of the radium publicly owned in the countries named. The figures for the British Isles include the radium held by the London, Manchester, and Glasgow institutes.

TABLE II.—Estimates of Radium Publicly Owned (1927) for Medical Purposes.

Country.	Population (Millions).	Grams of Radium.	Grams per Million.
Australia	6.2	10	1.60
Denmark	3.3	2	0.59
Belgium	7.5	4	0.53
France	40	18	0.45
British Isles	45	11.5	0.25
Sweden	5.5	1	0.18
Germany	56	2	0.04

MORTALITY.

It is extremely difficult to arrive at a just estimate of the mortality of any operative measure. It is almost always better in private practice than in hospital, owing to the different social classes from which the patients are taken.

I may give, in the first place, a few instances of figures given by individuals. In 1893 White of Philadelphia gave the mortality of the perineal route as between 13 and 14 per cent., and that of the suprapubic as 20 to 25 per cent. In 1912 Freyer gave the mortality in 1,000 cases as 5½ per cent., and stated that in the last 100 cases it had fallen to 3 per cent. Hey Groves, commenting on these figures, said that he had taken the mortality for all the available large hospitals in the kingdom and found it to be 40 per cent. Hugh Lett in 1913 said he believed that the mortality of hospital patients was 20 per cent. Fullerton stated in the same year that his mortality in 55 cases was 7.2 per cent.

Hugh Young, in his *Practice of Urology* (1927), gives his mortality for the perineal operation as 3.4 per cent. in 1,049 cases, and Wildbolz just recently has stated that his mortality for the suprapubic method (105 cases) is 15 per cent., and for the perineal operation (305 cases) is 6.5 per cent. These figures show very real differences.

Through the courtesy of some surgeons I am able to show some figures from different London hospitals, which are a good guide, as showing the results in one class of patients.

TABLE III.—Statistics of Prostatic Enlargement and Prostatectomy from Four London Hospitals.

(The figures are the last available.)

	Total.	Died	Mortality.	Individual Mortality.
Enlarged prostate ...	831	131	15.8	13.1 — 13.5 — 17.8 — 20.1
Prostatectomy ...	621	88	14.2	12.9 — 14.5 — 17.5 — 20.8

An absolute mortality has a definite value, but a more satisfactory way is to contrast two sets of comparable statistics. This I can fortunately do. Mr. Max Page, in the *St. Thomas's Hospital Reports* for 1910, published the results of prostatectomy at St. Thomas's Hospital, and these can be compared with more recent figures (see Table IV).

It is at once apparent that the mortality from prostatic trouble has not materially fallen; that of prostatectomy has fallen from 20.2 per cent. to 14.5 per cent., but the total operative mortality has somewhat risen.

It will be seen that the surgeon has been more chary in performing the one-stage operation, and that the deaths that formerly would have been recorded under prostatectomy are now found under cystostomy. If hospital statistics are to be improved the patients must seek help earlier than hitherto.

A striking fact is the good results that follow the two-stage operation, in spite of certain disadvantages.

In conclusion, I think one may say that, whatever is the true mortality of prostatic enlargement, the outlook for the prostatic patient has improved out of recognition since 1886.

TABLE IV.—Simple Enlarged Prostate.

Treatment:	1905-'910. Total Cases 131. Died 28.				1922-1926. Total Cases 219. Died 44.					
	Suprapubic Prostatectomy.		Suprapubic Cystostomy.		Suprapubic Cystostomy.		Suprapubic Prostatectomy—Two-stage.		Suprapubic Prostatectomy—One-stage.	
	Total.	Died.	Total.	Died.	Total.	Died.	Total.	Died.	Total.	Died.
	69	14	20	4	41	21	77	9	68	12
Method mortality	20.2		20.0		51.2		11.7		17.6	
Prostatectomy mortality	20.2						14.5			
Total operative mortality	20.2						22.5			
Total mortality			21.7				20.1			