

A study of rupture of the bladder : with some experiments bearing upon the closure of the vesical wound / by Alex. W. Stein.

Contributors

Stein, Alexander W., 1841-1897.
Bryant, Thomas, 1828-1914
Royal College of Surgeons of England

Publication/Creation

Brooklyn, N.Y. : Annals of Anatomy and Surgery, 1882.

Persistent URL

<https://wellcomecollection.org/works/spewqfdb>

Provider

Royal College of Surgeons

License and attribution

This material has been provided by This material has been provided by The Royal College of Surgeons of England. The original may be consulted at The Royal College of Surgeons of England. where the originals may be consulted. This work has been identified as being free of known restrictions under copyright law, including all related and neighbouring rights and is being made available under the Creative Commons, Public Domain Mark.

You can copy, modify, distribute and perform the work, even for commercial purposes, without asking permission.



Wellcome Collection
183 Euston Road
London NW1 2BE UK
T +44 (0)20 7611 8722
E library@wellcomecollection.org
<https://wellcomecollection.org>

327
34

11

A STUDY OF

Rupture of the Bladder,

WITH SOME EXPERIMENTS BEARING UPON

THE CLOSURE OF THE VESICAL WOUND.

By ALEX. W. STEIN, M.D.,

OF NEW YORK,

SURGEON TO CHARITY HOSPITAL (GENITO-URINARY AND VENEREAL DIVISION);
PROFESSOR OF VISCERAL ANATOMY AND PHYSIOLOGY AT THE NEW
YORK COLLEGE OF DENTISTRY AND OF COMPARATIVE
PHYSIOLOGY IN THE AMERICAN VET-
ERINARY COLLEGE, ETC.

REPRINTED FROM THE ANNALS OF ANATOMY AND SURGERY, JULY AND AUGUST, 1882.

BROOKLYN, N. Y.

ANNALS OF ANATOMY AND SURGERY.

1882.



Digitized by the Internet Archive
in 2015

<https://archive.org/details/b22370481>

A STUDY OF RUPTURE OF THE BLADDER
WITH SOME EXPERIMENTS BEARING
UPON THE CLOSURE OF THE
VESICAL WOUND.

By ALEX. W. STEIN, M.D.,

OF NEW YORK,

SURGEON TO CHARITY HOSPITAL (GENITO-URINARY AND VENEREAL DIVISION); PROFESSOR OF VISCERAL ANATOMY AND PHYSIOLOGY AT THE NEW YORK COLLEGE OF DENTISTRY AND OF COMPARATIVE PHYSIOLOGY IN THE AMERICAN VETERINARY COLLEGE, ETC.

THE ruptures of the bladder may be divided into three classes—Intraperitoneal, Extraperitoneal and Subperitoneal—that is, the lesion may be situated within the limits of the peritoneal covering and involve that structure; it may be located at some point of the viscus not invested by peritoneum, or it may be that the lesion occurs within the limits of the serous tunic, but the rupture is incomplete, the mucous and muscular coats alone giving way, allowing an extravasation of urine beneath the peritoneal covering, which latter remains intact.

The relative frequency of these three classes of cases is shown in 195 of the 219 cases found in our bibliography, as follows: Intraperitoneal, 127; extraperitoneal, 56; subperitoneal, 12. The greater frequency of intraperitoneal ruptures finds an explanation in that when the bladder is fully distended and is subjected to violent or sudden compression, the peritoneum which is then the most tense and least yielding of the several tunics will split in advance of the subjacent coats and carry the latter with it in the laceration; whereas, in situations where the peritoneum is absent, the coats of the bladder are more elastic and yield considerably before they give way. Subperitoneal ruptures are certainly not common, yet it is quite probable that they have occurred somewhat oftener than is reported. In several reported cases of recovery there is every reason to believe that the extravasation was partial or subperitoneal, while the long duration and slow progress of some cases of intraperitoneal ruptures can be accounted for only in the supposition that at first the extravasation was subperitoneal, and that the peritoneum became subsequently involved by pressure or ulceration. Such a conclusion would seem inevitable, when, following a fall or an injury, symptoms of vesical rupture appear and continue for from several hours to several days without being very grave, until suddenly during a straining effort something is felt to snap or crack in the abdomen, after which rapid and fatal peritonitis ensues. This is the history given in several instances.

As regards the exact location of the lesion our histories are definite in only a limited number of cases. In the intraperitoneal variety we find the superior region of the bladder mentioned in seventy-nine cases. In fifty-nine the laceration is said to have been at the posterior wall, thirty-six times at the upper part, and nineteen times at the lower part. The extraperitoneal lacerations occurred anteriorly in twenty-five,

in seven at the side, and in six at the lower and posterior portion of the viscus. We thus find that the largest number of intraperitoneal ruptures occur at the upper and posterior part of the bladder, where the viscus is thinnest, and where, in the course of distention, it comes in relationship with the sacral promontory. In these cases there need be no bony lesion; the relationship of the bladder to the bony prominence behind is such that any external violence or pressure may cause the injury, and the reason for the more frequent location of intraperitoneal ruptures in the upper and posterior portions of the bladder is found in the force being directed upon the upper part of the viscus, which is thus compressed against the vertebro-sacral eminence. While intraperitoneal ruptures prevail posteriorly, extraperitoneal lacerations are found most commonly in front. The course of this is manifest in the fact that the anterior surface of the bladder being in immediate contact with the pelvic zone is most exposed to injury from lesions of bone. The large majority of ruptures situated anteriorly are complicated with fracture of the pelvic bones.

The rent may be perpendicular, transverse, or oblique. It is usually linear. It seldom presents as a gaping wound or hole. When such exists it varies in size, from a minute opening to one admitting the passage of several fingers. The rent is generally ragged and its edges everted. Its length varies from 1 to 12 cm. Extraperitoneal lacerations have, as far as we know, not exceeded 5 cm. in length; nor is the rent larger in the greater number of intraperitoneal ruptures, but in several of these the tear was said to be from 5 to 12 cm. in length. The coats may not be torn equally. In intraperitoneal rupture especially the serous investment is apt to tear more than the other coats. In one such case the rupture in the bladder is said to have been 3

cm., while that in the peritoneal covering was 15 cm. in length. This is, no doubt, owing to the fact already mentioned, that the peritoneum is the least yielding of the vesical coats, and, being upon the stretch, splits first and most. As a rule, there is but one rent; exceptionally two or three points have given way simultaneously. In two or three cases the edges of the rent were found so overlapped as to form a kind of valvular closure, which prevented the further escape of urine from the bladder.

CAUSES.

The causes of rupture of the bladder may be divided into predisposing and determining.

The first and most prominent predisposing cause is distention of the bladder, the danger of rupture being proportionate to the degree of fixation and elevation of the viscus above the true pelvis and in front of the projecting lumbosacral angle. While it would appear that distention is not a *conditio sine qua non* to rupture, a more or less replete state of the bladder no doubt exists in nearly all cases previous to the accident. In the majority of cases the injury occurs while under the influence of alcohol. The ætiological influence of alcoholism is manifest—(1) in the diuretic action of the drug, rapidly increasing the accumulation of urine in the bladder; (2) in the obtunding of sensibility, vesical as well as general, whereby this undue accumulation is disregarded, and (3) in the diminished tone and elasticity of the abdominal walls. Other predisposing causes of rupture are atony, fatty degeneration, sacculation and ulceration of the vesical walls. In the majority of cases the autopsy showed the coats of the bladder were healthy at the time of the accident, but the conditions of the bladder just mentioned render it very liable to rupture, even under circumstances of moderate distention, and from comparatively trivial causes.

It is probable that in rupture primarily depending upon some long existing mechanical obstacle to the escape of urine, such as urethral stricture or prostatic hypertrophy, some physical or pathological changes have existed in some cases prior to the rupture of the viscus, but in many cases no such changes were found. One would suppose that a degree of thickness or hypertrophy of the vesical walls would be a safeguard against rupture, but this condition of the bladder is specially noted in several cases. A specimen in my possession shows an extensive laceration through a contracted bladder, whose walls in some places are three-fourths of an inch thick. This man had long suffered with stricture of the urethra, and had received a kick in the abdomen, causing the laceration.

RUPTURE FROM EXTERNAL VIOLENCE.

The most common determining cause of rupture of the bladder is some external violence applied over the region of the viscus, a sudden kick or blow over the hypogastrium, a simple tumble or a fall from some point of elevation, the falling or kneeling of one individual upon the abdomen of another; these are most frequent causes, and produce the injury by compressing the distended bladder against the promontory of the sacrum, and are generally incident to drunken brawls. In one case the bladder was ruptured by the impact of a fragment of shell (*M. H. Larrey*). In another class of cases the injury is occasioned by the falling of a beam, the caving in of a wall or of an embankment, the passage of a wagon over the abdomen, etc.; these are frequently complicated with fracture of the pelvic bones, and it is difficult often to determine during life whether the injury to the bladder is the direct consequence of the compression, or to the laceration of its coats by spicula of bone penetrating its cavity.

In the empty state the bladder is so deeply situated in the pelvic cavity that it is in a great measure protected from external violence, and, as a rule, can only be injured by such force as will separate the pubic symphysis or fracture the pelvic bones. Rupture by *contre-coup*, as in falling from an elevation upon the feet or buttocks, has occurred even when the bladder was comparatively empty. A man, æt. 51, fell from a considerable height, and in consequence of the concussion, sustained a rupture of the bladder. The man had passed his water only half an hour before the accident and had taken no spirituous drinks of any kind. There was a fracture of the horizontal ramus of the pubis, but this did not occasion the rupture, as this latter was situated at the posterior wall of the viscus. (*Wernher.*)

The cause of rupture may emanate from the individual himself, as occasioned by violent straining in micturition defæcation, and in lifting heavy weights. Rupture of the bladder depending upon stricture of the urethra as a primary cause is not common, for the reason that in stricture of the urethra the canal behind the obstruction having become dilated and attenuated by the constant pressure made upon it during urination, will yield in preference to the bladder, which organ, under these circumstances, is often rather hypertrophied than atonied. Nevertheless, not a few instances of vesical rupture from straining to overcome an obstructed urethra have occurred, and as this element in the causation of our lesion has recently been ignored by some prominent writers, the source of our information may be given.

RUPTURE FROM STRICTURE.

HOME, æt. 44. Stricture for twenty-three years; retention several times; the last time after continuing twenty-four hours, man felt a "rush from the upper part of the bladder." Symptoms: extravasation; death; rupture both intra- and extraperitoneal.

HOME. Stricture ten or twelve years; after application of caustic to stricture, had strangury; on third day patient was conscious of "something having given way internally;" died on ninth day; a rent two inches long midway between fundus and prostate.

GARRY, æt. 32. Stricture; went to stool, when, without any previous pain, he felt something "as it were jump up suddenly in his belly," and from that moment was unable to pass water; died in a few hours; bladder hypertrophied and contracted; could not hold more than four or five ounces of fluid; rupture at the posterior wall; here bladder was thin, but there was no sign of ulceration.

WARD, æt. 38. Stricture and retention with overflow; one night experienced a severe pain in the region of the bladder, which was followed by prostration of vital powers; extensive extraperitoneal extravasation occurred, with communication of the bladder with rectum two and one-half inches above the anus; constant use of catheter; recovery.

KEAL. Symptoms of urethral stricture—horse fell on lower part of patient's abdomen—followed by retention of urine; two days after, while straining, he felt a crack, accompanied by a sensation of cold in the pubic region; recovery. This although not an unequivocal case, yet from the great retentive power of the bladder after the external violence, it would seem to deserve a place in this class of cases.

WILLIAMS, æt. 32. Stricture and retention; while making a violent effort to relieve his bladder, he "felt a snap, as if something had given way in his belly." Extravasation above pubes; incision; flow of urine through wounds; recovery.

CRUSE, æt. 36. Stricture; while straining felt something give way and experienced severe pain all over abdomen; died on the forty-fifth day; rupture on the anterior wall of bladder.

CRUSE. Patient came into hospital with retention, laceration of urethra, and extravasation of urine. A rupture of bladder was occasioned by violent contractions of the abdominal muscles during the patient's struggles while undergoing etherization; intraperitoneal rupture half an inch long

at summit. *Warning not to administer anæsthetics while the bladder is in a condition of great distention.*

BANGS. Impermeable stricture; straining to urinate, felt something give way in his bowels; died in ten hours; coats of bladder hypertrophied; ulcerated; rupture intraperitoneal.

CALL, æt. 50-60. Stricture over twenty years; frequent attacks of complete retention. One afternoon patient was found walking about the room with his bladder enormously distended and in great pain. Not having a catheter, the doctor was obliged to go for one. He was not absent more than a quarter of an hour, but when he returned the man was in bed, entirely free from pain, and the floor of the room swimming with water. The patient said that while walking about the water, suddenly and without the slightest warning, came in one great gush through the anus. There was no infiltration of the areolar tissue, and recovery occurred most rapidly by use of sounds.

PADLEY. Very close stricture; admitting only a filiform, bougie; extensive extraperitoneal extravasation; incisions through which urine escaped; extensive sloughs detached; recovery.

SPASM OF THE URETHRA.

HARRISON, R., mentions the case of a man who had been suffering from retention for days, and while straining to relieve himself the bladder was ruptured. There was no sensible diminution of the calibre of the urethra, and he concludes that the obstacle was occasioned by spasm.

ENLARGED PROSTATE.

The following are instances in which the accident was primarily dependent upon prostatic enlargement, and in all the cases the rupture was intraperitoneal.

STOLL, retention; on the second day, while straining at stool, felt something burst in the abdomen; peritonitis; died in two days. Prostate swollen, inflamed and gangrenous. Rupture intraperitoneal.

SASIE, æt. 75, catarrh of bladder, distention, symptoms of rupture. Death on fifth day, prostate double normal size with centric hypertrophy. Intraperitoneal rupture; another incomplete rupture near by.

TANCHON, æt. 70, retention thirty-six hours, peritonitis; death in four days. Prostate hard, as large as a hen's egg; behind vesical neck two small polypi. Intraperitoneal rupture.

MERCIER, hypertrophied prostate, ulceration of bladder, rupture intraperitoneal.

FIELD, æt. 72, retention and dribbling. Prostate enlarged three or four times normal size. Intraperitoneal rupture.

WARREN, æt. 67. Had for years attacks of retention depending on enlarged prostate. Last attack existed for days. Symptoms of peritonitis. Death. Prostate very much hypertrophied. Intraperitoneal rupture.

AMUSSAT is said to have had a case in which the accident arose from enlarged prostate.

PARTURITION.

The bladder has been ruptured in consequence of parturition with and without instrumental delivery, a fact to be remembered in always keeping the bladder empty during the progress of labor.

HEY, æt. 38. First confinement, delivered of a dead child after rather a protracted labor. Symptoms before and after confinement were those of retention with overflow. On the fourth day after delivery as she was raising herself up she felt something crack at her naval, and the pain became immediately severe about that part. Died on the fourth day after the accident. Rupture at fundus, bladder sound.

BEDINGFIELD, æt. 36. Delivered of seventh child after an easy and natural labor of about two hours; twelve hours after delivery her symptoms commenced. Died on the fourth day after delivery. Intra- and extra-peritoneal rupture at fundus.

RAMSBOTHAM, very protracted labor. Died two hours after delivery. Intraperitoneal rupture. Slight projection of sacrum which impeded the ready passage of head.

RAMSBOTHAM, æt. 36. First child. Labor slow but progressive from Monday to Wednesday, when she felt swelling giving way within her, after which labor pains began to decline. She had not voluntarily passed urine since Monday, but had dribbled during all the labor. Child removed with forceps. Died Friday. Intraperitoneal rupture at fundus.

FAYE, æt. 24. First pregnancy; rather difficult labor. Turning and extraction. Symptoms commenced day after delivery. Died sixth day after delivery. Intraperitoneal rupture of bladder and uterus.

RETROVERTED GRAVID UTERUS.

Two interesting cases of rupture are also recorded as having occurred from retention of urine caused by a retroverted gravid uterus, one by Hunter, of Lynn, the other more recently by Schwarz.

CASES OCCURRING WITHOUT ANY MECHANICAL IMPEDIMENT TO URINATION.

HAUFF mentions the case of a man who, having indulged freely in sweet wine, felt, while sitting at the table, a severe pain in the abdomen, which rendered all movement insupportable. A small quantity of urine escaped by the penis. The symptoms which followed were those of intense peritonitis, and he died on the fourth day. Autopsy revealed intraperitoneal rupture.

JOHNSTONE. In this case rupture seems to have been occasioned by retention and extreme distention of the bladder continuing for a long period, patient refusing to be catheterised. No history of injury whatever. A circular hole one and one-half inches on left side of bladder, communicating with a cavity filled with large quantity of urine.

FIX BY SMITH, female, æt. 20; retention. Inability to urinate; peritonitis. Death; intraperitoneal rupture.

BARTLET, man, æt. 53. Stooped down to take up from the ground a bar of iron, the downward and forward move-

ment of the body being very suddenly and rapidly performed. Just as the act of bending was completed he experienced a severe pain at the lower part of the abdomen, which led him to desist, and he did not attempt to raise the metal. He died within eight days. Autopsy, bladder somewhat thickened; hole, $\frac{1}{2}$ by $\frac{3}{8}$ of an inch; exactly corresponding to this hole was an ulcer which bore an exact resemblance to a chronic gastric ulcer. Vesical mucous membrane generally, swollen and patchy red.

In the following cases reported by Assmuth the rupture seems to have been caused solely from pressure of the abdominal muscles upon the distended bladder. There seems to have been no obstacle to the escape of urine, and apparently no diseased condition of the bladder walls.

Man, æt. 32, while removing a heavy sack of flour from a railway platform to a cart, was seized with a violent pain in the hypogastrium. Trying, some time after, to make water, he only passed a few drops of blood. Peritonitis developed, and he died on the sixth day after the accident. Intraperitoneal rupture at the upper and posterior wall.

Man, æt. 40. While endeavoring to raise a very heavy burthen was seized with a violent pain in the hypogastrium. Died on the sixth day after the accident. Peritonitis, rupture 3 cm. in length; right side, posterior wall about 2 cm. from apex.

SEX AND AGE.

Rupture of the bladder occurs much more frequently among men than among women, in the proportion of ten to one. This comparative exemption of the female from this injury is due to the fact that women, from the nature of their occupations, associations and habits of life are less exposed to the dangers of such an accident; while the greater width of the pelvis and the interposition of the uterus and its appendages between the bladder and sacral promontory tends to mitigate and break the force of the concussion or compression exerted upon the viscus.

The lesion may occur at any period of life. King (*Guy's Hospital Report*, 1837,) records a case of intra-uterine rupture of the bladder in a foetus, with imperforate urethra, and somewhat similar cases are cited by Robert Lee, Cock and Malgaigne. In children this is a rare accident, remarkable as this is in view of their numerous knocks and falls. This may probably be ascribed to the fact that owing to the greater sensibility of the bladder in the young, micturition is more frequent, and the viscus is rarely suffered to become greatly distended. The structures are more yielding and elastic, and the sacro-vertebral angle is less prominent than in later life. In the adult the injury occurs most frequently between the ages of 30 and 40, and between 20 and 30; that is, at that period of life when man, by reason of his occupation, is most exposed to injuries, and when, too, he is inclined to indulge most freely in intoxicating drink.

SYMPTOMS AND DIAGNOSIS.

The symptoms of rupture of the bladder are usually as follows: In consequence of fracture of pelvic bones, or perhaps simply from shock, patient is unable to walk or even to rise from the place where he has fallen. Pain severe over hypogastrium. Desire to micturate incessant with an inability to void the smallest quantity of urine, or possibly but a few drops mixed with blood. Constitutional symptoms indicative of great prostration rapidly ensue; countenance is pallid and anxious, pulse feeble and fluttering, perspiration clammy, voice weak and husky, abdomen becomes distended, temperature rises, delirium, coma or convulsions supervene, and death comes to the relief generally in a few hours, or, at the farthest, a few days, the prostration being greater and the fatal result occurring sooner in intraperitoneal than in extraperitoneal ruptures. If the patient ral-

lies from this shock or collapse his life may be next imperilled by the development of peritonitis or septicæmia. The infiltration of urine is often remarkably extensive, detaching the pelvic organs from their annexes, descending into the perineum, through the inguinal canal and obturator foramen into the scrotum and thighs, and ascending the abdomen and back, reaching at times as high as the shoulder.

Perhaps in the majority of cases the symptoms are sufficiently expressive to enable the surgeon to arrive at a prompt diagnosis. Of great diagnostic value is the statement so often made by the patient that after a blow over the hypogastrium, or while in the act of straining he "felt something give way within the abdomen," and sometimes adds, "experienced a sudden relief from the discomfort occasioned by the previously distended bladder." The evidence, furnished by catheterization, is of special value when it is positively known that the individual had not micturated for several hours previous to the accident. Under these circumstances an empty bladder, or one containing but a small quantity of sanguinolent urine, is strongly confirmatory of laceration of the bladder. But the evidence pointing to rupture is by no means always unequivocal; often the signs and symptoms upon which we would most depend are absent—those that are present are dangerously misleading, and the case is shrouded in uncertainty and doubt. Especially is this the case in the beginning when a long interval of time may elapse between the receipt of injury and the development of characteristic symptoms. Let me here urge the importance of watching closely a patient on whom the suspicion of rupture of the bladder rests, for, though the symptoms may be for a time latent, once manifest, they are rapidly progressive, and everything depends upon a timely and, perhaps, bold surgical interference. Not only may the first symptoms be delayed, or be insufficiently

marked to attract attention, but the vesical rupture may be complicated with other injuries whose symptoms may for the time obscure the more dangerous lesion within. As indicating the difficulties sometimes encountered in arriving at a diagnosis, we find that there is rarely any external sign or mark of injury to be found over the abdomen, even where a wagon has passed over the body. We depend much upon the history given as to the nature of the accident, the condition of the bladder at the time of injury, etc.; but if the patient is unconscious or is drunk, as is so often the case, no information can be obtained, or what may be given cannot be relied on. If we will take a lesson from some of the cases before us relative to the constancy and reliability of the most characteristic symptoms, we shall find that standing, or even walking, is not inconsistent with the existence of laceration of the bladder; neither is the difficulty or inability to micturate a uniform symptom. The patient may have no difficulty in voiding urine, and indeed may pass a considerable quantity of water. In some cases it occurred that after the first catheterization the patient regained the power of voluntary micturition.

Two remarkable cases, illustrating the absence for weeks of symptoms proper to laceration, are given by Bennett and Mason respectively. In the first, autopsy revealed an extensive extraperitoneal extravasation in the pelvis, communicating with the rectum; in the second, there was some pelvic peritonitis, and Douglas' cul-de-sac was bridged over and filled with urine. Harrison also mentions the following instructive case: A man, engaged in a scuffle on a Saturday night, had his bladder ruptured by his opponent falling across the lower part of his abdomen. On Sunday he ate his breakfast, walked into town a distance of three miles, had his urine drawn by a surgeon, and returned in the evening. On Monday morning he arose at his usual hour, went

to work, and had a catheter again introduced in the course of the afternoon. Tuesday morning he felt somewhat better, passed urine at frequent intervals and walked about part of the day, and it was only on Wednesday that decided symptoms of peritonitis had manifested themselves, and that the nature of the injury was discovered. The patient expired on the eighth day, and on the posterior surface of the bladder was discovered a fissure one and a half inches in length.

The absence of difficulty in voiding urine is met with in both extraperitoneal and intraperitoneal ruptures. Stone's patient, for example, with an extraperitoneal rupture one inch long and half an inch wide communicating with an abscess half full of urine and pus, "passed his urine for three days after the injury as naturally as ever." This man lived thirty-two days. While Gruber's patient, with an intraperitoneal rupture one and a half inches long at the summit of the bladder, "was able to pass water without any difficulty." He died eighty hours after the injury.

The marvelous retentive power of the bladder noted in some other cases would seem explicable only on the supposition that at first the rupture was incomplete, while in others this was accounted for in the closure of the vesical wound by "valvular protrusions" and adhesions, which prevented the escape of urine. An instance is cited of a man who was injured in a fall, and manifested symptoms which led to the diagnosis of laceration of intestine. The catheter evacuated a *large quantity of perfectly clear urine*. In twenty-four hours the man died, and the autopsy revealed a large tear in the bladder, into which a coil of intestine had slipped and become engaged. The intestinal tract was found uninjured. There were signs of general peritonitis, and a large quantity of bloody urinous fluid was found in the cavity of the peritoneum. Many

cases might be cited to show that the presence of clear urine in the bladder cannot be accepted as an evidence of the absence of injury to the viscus. The following are cases in point, and are also interesting: the first, on account of the prolonged absence of symptoms; the second, on account of the accumulation of a large quantity of blood outside the bladder.

Boy, æt. 7. Run over by a wagon. Half a pint of healthy looking urine was removed after the accident, and subsequently the urine was drawn morning and evening and no trace of blood was seen. On the sixth and seventh day the bladder acted voluntarily. On the evening of the seventh day symptoms of prostration suddenly set in, and on the eighth day he died. He never had any marked symptoms of peritonitis or other abdominal distress, although numerous fractures were found in the pelvis. An extraperitoneal perforation on the right side of the bladder and directly opposite another laceration involving only the mucous and muscular coats were found.—(*Fleming.*)

Man, æt. 60. Crushed by falling off a wall. Catheter gave exit to about 4 oz. of urine, perfectly free from any tinge of blood. Died in 48 hours. Autopsy: separation of symphysis pubis; extraperitoneal rent on the anterior wall of bladder, $\frac{1}{4}$ inch long; the edges of the rent were lying so closely applied to each other that it was only discoverable by the escape of bubbles of air from within the cavity of the bladder when it was compressed. The bladder contained from two to three ounces of urine untinged with blood, but around it and towards the rectum there was a great amount of blood effused external to the peritoneum.—(*Fleming.*)

Similar cases are mentioned by Scott, Cussack, Ellis, Hamilton, Peacock, Gillespie and others.

On the other hand the following case shows that the sudden advent of blood in the urine is nothing more than a presumptive evidence, strong though it may be, of this lesion. The urine may be tinged with blood from simple contusion of the bladder without laceration.

A man, æt. 60. Was stamped upon and thrown down a pair of stairs; brought to the hospital in a state of profound collapse. There were marked signs of injury over the abdomen, the least motion of the body caused him to groan and cry out with pain. After he had made several ineffectual attempts to urinate, a catheter was passed and withdrew a quantity of *dark bloody* urine. The entire appearance of the case led to the diagnosis of rupture of the bladder, but in 10 hours the man died, and the autopsy revealed a laceration of the ilium and *no injury* to the bladder. Mr. Fleming mentions a very similar case.

Important as it is to establish the diagnosis early in all cases, it is even more important to ascertain whether the rupture is intra- or extra-peritoneal. In the early stage of the case when exact knowledge would be most serviceable, such a differential diagnosis is most difficult, often impossible. In seven or eight instances, the diagnosis of rupture was established by the accidental passage of the catheter through the vesical rent into the abdominal cavity. If, after entering the bladder and removing perhaps a few drops of urine, the catheter is suddenly felt to slip into a secondary cavity, in which its beak is freely movable, and from which a considerable quantity of sanguinolent urine escapes, it is certain that the laceration extends into the peritoneal cavity, or that the instrument has entered either a subperitoneal pouch, or if it is situated inferiorly, has passed into an extraperitoneal circumscribed collection of urine. In some cases it was noted that warm water injected through the catheter was felt by the patient in the groin and abdomen, and the escape of the fluid ebbed and flowed with the respiratory movements. As to the significance of peritonitis as an element in diagnosis between intra- and extra-peritoneal ruptures, it is nothing more than strongly suggestive of the former. The development of peritonitis in a given case does not necessarily denote a laceration of the peritoneum, as inflammation of this structure occurs in extraperitoneal

ruptures, not at all infrequently, either as the direct result of traumatism independent of the injury to the bladder, or as the consequence of the propagation of inflammation from subjacent parts. A further important sign is in the appearance of the urinary infiltration which in extraperitoneal ruptures is apt to present as a localized or circumscribed swelling, limited, perhaps to one side of the body, while in intraperitoneal ruptures the tumefaction is more general and uniformly globular over the abdomen. Last but not least, comes digital exploration of the interior of the bladder. In the female this is accomplished readily enough through the short urethra. In the male it is effected through a small median perineal incision made on a staff in front of the prostate. The practicability of this procedure has been verified, its execution is both simple and safe, and as a means of diagnosis it is without doubt the most efficient and reliable at our command.

PROGNOSIS.

The prognosis, though always grave, will depend upon the situation of the rent, that is, whether it is intra- or extraperitoneal, whether at the upper or lower portion of the viscus, upon the size and character of the laceration, and upon the quantity and extent of the urinary infiltration. Out of 219 cases, collected in our bibliography only 23 recovered; of these four are supposed to have been intraperitoneal, namely, those of Chaldicott, Thorp, Walters and Mason. Walters' case, however, is the only undoubted instance of recovery from intraperitoneal rupture on record; here laparotomy demonstrated such a rupture two inches long. That the other three cases were intraperitoneal is merely a supposition, based mainly on two facts: first, (Thorp's case,) that the beak of the catheter passed through the rent beyond the bladder and removed urine; and second, the occurrence in all the cases of peritonitis. With re-

gard to Thorp's case, a reasonable doubt may be expressed as to whether the catheter, in passing through the rent, did actually enter the cavity of the peritoneum, and not into one of those pouches which not infrequently form external to or beneath the peritoneum. Nor can the existence of peritonitis be regarded as a conclusive evidence of the involvement of the peritoneum in the laceration. Peritoneal inflammation, associated with extraperitoneal ruptures, are not at all uncommon, and when the extravasation is subperitoneal this complication is rather to be expected than otherwise. There is hardly anything in the history of Chaldicott's case other than the existence of peritonitis that would lead to the belief that it was a case of intraperitoneal rupture; nor is there anything more conclusive in Mason's case. On the contrary, there are several facts mentioned in this history that point strongly to the belief that it was extraperitoneal: (1.) Symptoms of peritonitis did not develop until fifty-one hours after the injury, a rather long time for urine and blood to remain inert in the peritoneal cavity. (2.) The statement that, posterior to the prostate and to the left a decided tumor was felt, which communicated the sense of fluctuation and which disappeared with the escape of a large quantity of bloody urine as soon as the bladder was laid open as in lateral lithotomy. (3.) The appearance of a dark-brown discoloration over the inguinal, hypogastric and perineal region and down the thighs, which places afterwards became hard and indurated, but which gradually disappeared. About one-half the cases of intraperitoneal ruptures terminate fatally within three days. Few survive the first week. In extraperitoneal lacerations the fatal result is rarely deferred beyond the second week.

TREATMENT.

The indications to be fulfilled in the treatment of rupture of the bladder are: (1.) To remove, as soon as possible, the

extravasated urine. (2.) To prevent further escape of urine into surrounding areolar tissue or peritoneal sac. (3.) To meet such symptoms of shock, peritoneal inflammation or urinary infiltration as may appear.

Speaking first of extraperitoneal ruptures, the first indication is met by free and deep incision into the infiltrated tissues. Decided evidences of extravasation of urine was manifest in only eight of the cases that recovered, in six of which, deep incisions were made above the pubes; in one the trocar and aspirator were successfully used to remove the accumulated urine; in another, spontaneous evacuation occurred by sloughing of the parts around the rectum.

CATHERIZATION.

To meet the second indication, free and uninterrupted drainage of the bladder is necessary. This has been effected by catheterization and by cystotomy; of the twenty-three cases that recovered, of which we have special data, the catheter was depended on for this purpose in fifteen cases. In nine the instrumentation was repeated daily at short intervals; in six the catheter was retained. As regards the choice between these two methods, I would give the retention of the catheter preference to the repeated introduction of the instrument, for the reason that the bladder may thus always be kept in a condition of absolute rest, the urine allowed to trickle as it comes from the ureters, and the edges of the wound kept undisturbed during the process of healing. A soft flexible (Nelaton) velvet-eyed catheter, opened at the extreme end, should be introduced and secured so that the eye reaches just within the vesical orifice and no further, then to secure the withdrawal of the urine as quickly as it is received in the bladder, the method of aspiration suggested by Chiene, of Edinburgh, for the cure of obstinate perineal fistula may be advantageously adopted, viz.,

to the catheter an India-rubber tube is fixed of sufficient length to reach, without being strained, over the side of the bed to the floor. It then passes into a bottle. The bottle and tube are filled with carbolized water before attaching the apparatus to the catheter; care is taken that no air can get in at any of the joints. It is well to introduce a piece of glass tubing at a convenient point for observing the direction of the flow. In order to keep the India-rubber tube steady in the bottle, a piece of glass tubing is attached to its extremity. If the glass tube extends beyond the neck of the bottle, any folding of the India-rubber tube at this point will be prevented. A syphon action is in this way established with a suction power, the strength of which depends on the height of the column of water, and which will draw the urine into the eye of the catheter as it passes drop by drop from the opening of the ureters into the bladder, and a constant slow current of water will pass along the tube into the bottle. The bottle is allowed to overflow into a basin, which, as it fills, can be emptied without displacing the apparatus. Care must be taken not to have too great a fall, or the suction of a piece of mucous membrane will plug the eye of the catheter. The height of the hospital bed is generally sufficient, and, in some cases, even a less height is all that is required. It is also necessary to be constantly on the watch that the eye of the catheter does not become clogged with blood or muco-pus, and that the flow is uninterrupted. The instrument should be removed, washed and returned once daily for at least a week or ten days, after which, in the majority of cases, the frequent introduction of the instrument will suffice, but the patient must not micturate by his unaided efforts for at least another week, and then only if he can do so without difficulty or exertion.

That catheterization of the peritoneal cavity or subperitoneal pouch can be successfully accomplished through the

rent in the bladder is shown in a number of cases, notably in that of Thorp, who also, by repeated washings of said cavity, saved the life of his patient. Nevertheless, these manipulations are always more a matter of chance than of skillful manœuvre, and can only be justifiable when accomplished readily and without prolonged search. After cystotomy, or simply by perineal incision, such catheterization, with cleansing and disinfection of the extra-vesical cavity, could be accomplished with less danger of doing harm, but this, to do any good, should be done soon after the injury. Nature goes to work at repair as soon as the injury is inflicted, and the quantity of plastic material that is thrown out in the vicinity of the vesical wound, even within twenty-four hours, is sometimes remarkable. We learn this incidentally from post-mortem examinations, and it should teach us to be careful not to re-establish an opening perhaps already closed by these delicate adhesions. The thought presents itself here that abdominal decubitus on cushions might sometimes be found preferable to the dorsal position, especially when the rent is situated inferiorly. It would also favor the escape of urine from a deep bas fond, and, possibly, from a subperitoneal pouch at the posterior part of the bladder.

PERINEAL SECTION.

Perineal section was practiced in seven of our cases, but as this operation does nothing for the relief of the bladder we need not be surprised that but one (*Berner*) successful result is reported, and in this case the deep supra-pubic incisions which were made, undoubtedly did more for the patient than the perineal section.

CYSTOTOMY.

Lateral cystotomy has been practiced six times as follows:

1845. WALKER, W. I., æt. 23 ; complicated with fracture ; tumor of extravasated urine above pubes ; operation performed twenty-four hours after injury ; fracture united in twenty-five days, and in fifty-five days patient resumed his occupation.

1867. PARKER, WILLARD, æt. 30 ; injured April 29th. May 1, made deep incision above pubes nearly to bladder. Trocar introduced upwards into peritoneal cavity six ounces of serous fluid escaped. Same evening incision as in lateral lithotomy. Died May 4 ; autopsy : acute peritonitis ; considerable infiltration of urine into tissues of pelvis ; bladder ruptured $\frac{3}{4}$ of an inch on the right side, just posterior to prostate.

1872. MASON E., æt. 26 ; operated 62½ hours after accident ; recovery.

1874. MASON E., æt. 11 ; on account of the absence of symptoms characteristic of rupture, cystotomy was not performed until twenty days after injury ; lived fourteen days after the operation ; finally succumbed to an attack of diarrhœa ; a few hours before death he also had a good deal of cough and symptoms of pleurisy ; a large rupture was found in the lower and posterior portion of the bladder ; another in front of the neck of the bladder ; some pelvic peritonitis ; Douglas' cul-de-sac was bridged over and filled with urine.

MASON, E., æt. 32 ; died twelve hours after the operation, and on the fourth day from the commencement of the trouble ; rent, one and one-half inches long in posterior wall of the bladder ; considerable urine in peritoneal cavity ; peritonitis.

BRYANT, THOS., speaks of a boy æt. 13, who, becoming empaled on a railing-spike had the base of the bladder extensively lacerated ; also rectum ; free incision was made into bladder through prostate ; recovery.

We thus find cystotomy successful three times out of six. In all of these the rupture was probably extraperitoneal. Of course it cannot be said that either of these patients would have or would not have recovered had they been treated simply by catheterization with evacuation of accumulated urine, and I shall not enter into a further analysis of these cases, which speak for themselves, but it seems to

me that present experience scarcely justifies the dogmatic and unqualified assertion made in certain quarters that "for rupture of the bladder cystotomy is the thing to do." It has doubtless established its claim as an admirable surgical procedure to be adopted in selected cases, but that it is always more effectual than judicious catheterization as a means of drainage, or that it is more successful, experience has not yet demonstrated. It cannot accomplish anything towards the removal of urine and blood from the peritoneal cavity, while we cannot but be reminded of the fact that extravasation of urine is one of the very dangers that is apprehended when cystotomy is made for the removal of stone.

In the female, division of the vesico-vaginal septum is a simple, safe and effectual means of affording drainage for the bladder.

PARACENTESIS.

For intraperitoneal ruptures paracentesis of the recto-vesical cul-de-sac has been frequently recommended on the supposition that the extravasated urine will gravitate and accumulate at the most dependent parts of the peritoneal cavity, but in reality such is not the fact; the urine when it escapes is diffused over the entire abdominal cavity by the peristaltic movements of the intestine, and by the suction action of the diaphragm, and never accumulates at one point unless encapsuled by peritoneal agglutinations. When such is the case, and a distinct fluctuating tumor is recognized *per rectum*, it should be evacuated and the cavity washed out. Home, Harrison, Dupuytren, Hamilton, Cruise, Mason and others mention such collections of fluid. The latter especially speaks of fluctuating swellings in the vicinity of the prostate in three of his cases, in one of which it was afterwards found that the recto-vesical cul-de-sac was

bridged over and filled with urine. It does not appear that any attempt was made to puncture or aspirate these collections in any of the cases.

LAPAROTOMY.

This operation has been performed three times.

1859. A. G. WALTER. Ten hours after the injury, no urine passing by the catheter, the abdomen was opened in the linea alba by an incision beginning one inch below the umbilicus and terminating one inch above the pubes, to the extent of six inches. The intestines were found inflated, their peritoneal coat, as well as that lining the interior of the abdominal walls, already showing evident marks of congestion. A soft sponge was then cautiously introduced into the abdomen, with which the extravasated fluid, consisting of urine and blood, was carefully removed from the pelvis, and between the convolutions of the bowels amounting to nearly a pint. A rent was found at the fundus of the bladder, two inches in extent. The cavity of the abdomen being cleansed of the noxious agent, the wound of the bladder was left to itself, as no urine was seen to escape from it. The abdominal wound was closed by strong Carlsbad needles, secured by silver wire (only skin and fascia being stitched, while the peritoneum was left untouched); a flannel bandage encircled the whole abdomen. The patient, awakening from the anæsthetic sleep, felt relieved of pain and the desire to urinate, so distressing before the operation; vomiting did not return; opium in one grain doses was ordered; abstinence of drink and perfect quietude of body, with retention of the catheter, were strictly insisted upon. He soon began to doze, had a comfortable night, was free from pain the next morning, complaining only of soreness in the abdomen without tympanites, sickness or calls to urinate; thirst less urgent. The treatment being vigorously continued, for drinks, iced barley-water, water only in very small quantities with pieces of ice, being allowed. No unpleasant symptom followed; urine in small quantities, but free of the admixture of blood passing by the catheter. On the third day the intervals between the doses of opium were lengthened to two hours; on the fifth, to three, and thus gradually decreased, as all signs of inflammation had passed. At the end of a week the abdominal wound appeared to be

closed by first intention; the stitches, however, were not removed till a week later. The gum-elastic catheter was replaced by a new one every two days, and was not withdrawn for two weeks after the injury had been received, and then only for a short time. At the expiration of two weeks, with the absence of all pain and tenderness, opium was omitted. The intestines were relieved by warm water injections on the tenth day, when mild nourishment was ordered. Between the second and third week catheter was permanently withdrawn, and only introduced every four hours for the evacuation of urine. After the third week, patient left his bed. He has remained well, working at his trade, and feeling no impediment in his urinary organs.

1876. ALFRED WILLETT. An incision some five to six inches in length, from the umbilicus to the pubes, was made in the mesial line and carried through the parietes. All bleeding points having been secured, the peritoneum was opened, and at once several ounces of dull, brownish fluid, with strong, urinous odor escaped. The intestines were greatly distended and instantly bulged out through the wound. The peritoneum generally was highly injected, and adjacent surfaces were glued together. Passing my hand into the pelvis, I detected a laceration of the bladder. The coils of gut were only slightly more adherent here than in the abdomen proper; whilst I satisfied myself there was no protrusion of bowel into the lacerated bladder. The omentum was raised from off the intestines, and so much of the latter as lay in the pelvis were drawn up, laid upon the upper part of the patient's abdomen, and protected from harm and chill by flannels wrung out of moderately hot water. There was about half a pint of the bloody, urinous fluid in the pelvis, and when this had been sponged away, a rent of the bladder some three and one-half inches in extent was exposed; it extended diagonally across the fundus, having a direction from before backwards and from right to left. The appearance was that of a nearly straight tear through all the coats of the bladder, except at its most dependent parts, where it was jagged and uneven. The bladder was flaccid, but, of course, quite empty, and at the site of rupture its walls were fully half an inch in thickness. I brought the torn edges easily in apposition and united them by eight interrupted sutures of fine Chinese silk.

The sutures were placed at intervals of rather less than half an inch, and seemed to close the rent completely. Before returning the intestines, I cleaned out the abdomen as thoroughly as I was able ; but the mesentery of the gut lying outside the abdomen acted as a transverse diaphragm, and I was disappointed to find, on replacing these coils, that some of the fluid had been pent up above it. Owing to gaseous distension, very considerable difficulty was experienced in replacing all the intestines within the abdomen, and I was quite unable to introduce my hand and cleanse the upper part of the peritoneal cavity so satisfactorily as I could have wished ; but the patient's shoulders were raised, in order to make the pelvis more dependent, and all fluid that found its way there removed. The intestines that had been lying out of the abdomen during the operation were sponged over with warm water and carefully cleansed before returning them. So extreme was their distension, that to enable me to introduce sutures and close the external wound, Mr. Langton, who assisted me, was obliged to spread out his hand and restrain the bowels from forcing their way through the wound, withdrawing his hand gradually as the successive sutures, also of Chinese silk, were tightened. Through the lower angle of the abdominal wound, I passed a carbolized drainage-tube into the pelvis, securing it to the edge of the external wound, which was then dressed precisely as after ovariectomy. A Thompson's catheter was introduced and retained in the bladder. On being replaced in bed, hot bottles were placed beside him, and he was well covered up. Wound in the abdominal parietes was found on the autopsy to be adherent almost along its whole line ; not much swelling of abdomen. The intestines immediately behind wound were adherent to it. All the coils of intestine in the lower half abdomen were adherent to each other and to the abdominal walls by recent lymph. The intestines in contact with bladder were adherent to it. There were about two ounces of bloody fluid at the back of the peritoneal cavity ; about an ounce of this lay just above the bladder. The opening in the bladder was everywhere well closed, except between the posterior two stitches, where there *was an orifice through which water injected per urethram escaped very freely*. Even here there appeared to be an attempt at repair. Elsewhere the edges of the wound were adherent.

There was very little sign of inflammation in the interior of the viscus.

1876. CHRISTOPHER HEATH. Man, *æt.* 47. Pubes being shaved and washed with carbolic lotion, an incision was made in the middle line just above the pubes for two inches, and the tissues divided down to the peritoneum which appeared blue, the recti muscles which were firmly contracted being held aside by retractors with difficulty. The peritoneum was then picked up and a cut made into it, when a gush of fluid like that drawn off by the catheter came out; a large quantity of clots was then taken out from the peritoneal cavity. The finger introduced into the peritoneal cavity found a long rent in the posterior wall of the bladder high up. This was sewn up by a continuous catgut suture firmly tied at both ends. The clots were removed as far as possible from the peritoneum, and the cavity sponged out after injection with warm water, and a long large sized drainage-tube was inserted at the lower angle of the wound, the upper part of the wound being brought together by deep and superficial sutures. A catheter was passed into the bladder, to which was afterwards attached some india rubber tubing leading into a vessel under the bed. Hot poultices were applied to the abdomen, and one grain of opium was administered every four hours. The further history shows great relief and improvement, but on the fourth day after the operation he became rapidly worse and died. Autopsy. Small intestines considerably distended. For two inches around the abdominal wound, the intestines were adherent by recent lymph to each other, and to the abdominal parietes. Above and on each side of these adhesions there was no trace of peritonitis. On tearing away these adhesions, some coils of intestine were seen lying over the pelvis, glued together, and to adjacent parts by recent blood-stained lymph. On lifting these coils upwards, the recto-vesical pouch of peritoneum was exposed, containing about six ounces of clotted blood, black in color and moderately offensive odor. There was a rent in the mid line of the posterior wall of the bladder, two inches in length extending upwards as high as the apex. The lower third of the rent was gaping, the edges of the rest were approximated by the catgut suture, the lower end of which was free and loose.

The advantages of laparotomy in intraperitoneal lacerations are :

(1.) That it permits direct inspection of the seat of lesion and the appreciation of concomitant injury to other parts; (2.) That it permits of the removal from the peritoneal cavity of the extravasated urine and blood; (3.) That it permits of the cleansing and disinfection of the peritoneal cavity; (4.) That it permits the accurate closure of the vesical wound preventing further effusion of urine.

These are undoubtedly the indications to be fulfilled in cases of intraperitoneal lacerations, and the more successfully they are met the greater the chances of recovery from an otherwise almost certainly fatal injury. When we consider what abdominal surgery has achieved during the last few years, with its marvelous results in ovariectomy, its successes in the removal of uterine tumors, in the resection of intestine and of the stomach, in the extirpation of spleen, kidney, etc., further argument in favor of laparotomy for an injury less fatal than the one under consideration would seem unnecessary.

Both clinical and experimental experience, (See experiments of Vincent, *Lyon Médical*, September 25, 1881, and also of Fischer, *Arch. f. Klin. Chir.*, Bd. 27, H. 3) teach that the danger to life is not in the laparotomy, but in the presence within the peritoneal cavity of a decomposable and septic fluid, and when this is removed shortly after such extravasation has occurred laparotomy may be practiced with almost a certainty of success. The disposition of the bladder wound to union is so great that it may be regarded as certain if the edges of the same are accurately brought together, while the danger to life from wounding of the peritoneum is in itself very slight. It may be suggested, however, that in cases of doubt as to the seat of rupture it would be well at first to avoid the peritoneum in the abdominal section, including this structure only when it is found that the rent communicates with the abdominal cavity.

If we ask what encouragement do the three cases of laparotomy above detailed, hold out for a repetition of the operation, we find that only one of the three proved successful. Yet if we examine into the causes of failure in the cases of Willett and Heath, we shall find several factors that operated against their success, and which may hereafter be avoided.

(1.) Walters' successful case was operated on only ten hours after the accident, while Willett operated thirty hours and Heath forty-two and a half hours after the injury; both the latter cases being pretty well advanced in dangerous symptoms before the operation was made. This fact would tend to show as experimentation on animals has shown that the chances of success diminish with the time that has elapsed from the moment of injury. Nevertheless, the sequel showed, especially in Willett's case, that the delay in operating was not the material cause of failure, and I think the principle here is good, that "an empty house is better than a bad tenant," and that even in the presence of severe symptoms the decomposing fluid should be removed "better late than never."

(2.) In both the fatal cases there was imperfect closure of the vesical wound. In the case of Willett the edges of the wound were not closed even at the time of the operation, and in Heath's case, in which a continuous suture was used, the knot slipped or gave way a few days afterwards. Willett's patient died twenty-three hours after the operation, the autopsy showed "the opening in the bladder was everywhere well closed except between the posterior two stitches, where there was an orifice through which water injected *per urethram* escaped very freely." Even here there appeared to be an attempt at repair. Elsewhere the edges of the wound were adherent. Mr. Willett says: "It was a source of deep regret to me to find I had not sufficiently closed the

bladder wound." At another place he speaks of the embarrassment occasioned during the operation by the great gaseous inflation of the intestine, which, no doubt, rendered access to bladder difficult. Heath's patient lived more than four days after the operation. "There was a rent in the midline of the posterior wall of the bladder two inches in length extending upwards as high as the apex. The lower third of the rent was gaping, the edges of the rent were approximated by the catgut suture, the lower end of which was free and loose." In this case the continuous suture was used, and Mr. Heath believes that the wound opened from the slipping of the knot or giving way of the catgut—some time after the operation "since clear urine in large quantity flowed up to the fifth day when bloody urine was noticed in the evening, and the whole of the urine passed on the last day contained blood."

(3.) The retention of a drainage tube through the abdominal wound not only did not serve the purpose for which it was secured, but actually caused and intensified peritoneal inflammation. Mr. Heath says: "I introduced a large india-rubber perforated drainage-tube into the pelvis and secured it at the lower end of the wound, and I find that Mr. Willets adopted the same practice. Finding that nothing came through the tube, but that clear serous fluid from the peritoneum welled out by the side, I withdrew it on the second day, and I cannot but think that its presence was harmful to the patient. *The peritonitis had been limited to the pelvis and its greatest intensity had been exactly where the tube passed.*

I think it must be admitted that with such an imperfect experience behind us we have no reason to lose confidence in laparotomy. On the contrary, we should feel encouraged to give it a further trial. In both cases, but especially in that of Mr. Heath, the operation afforded immediate relief,

and improvement was decided, and clear urine flowed in large quantity for several days, until the suture gave way and fresh extravasation ensued; and although Mr. Willett's patient lived but twenty-three hours after the operation, the autopsy showed that the "peritonitis was less marked than when the operation was performed." The chief and most important points in the performance of laparotomy for this injury are two-fold: thorough cleansing of the peritoneal cavity and the accurate closure of the vesical wound. It is true Walter was successful with the vesical wound left open, but I think few will care to follow his example. In the application of sutures the bladder may be made more accessible by distending the rectum with a colpeurynter. We would take the stitches very close together, and in a double set, as recommended by Vincent. In one set—the sero-muscular—taking each suture through the peritoneal and muscular coats of the bladder on each side of the wound; in the other set—the sero-serous—taking the peritoneum alone, a considerable width of this coat, being included on both sides, so that when these sutures are tied, wide serous surfaces are brought together in close contact, as from this surface the most plastic material is exuded. The mucous membrane should not be included in any of the sutures. As to the material used, carbolized silk is probably the best; silver wire is good, but catgut is not as secure, and is apt to break down too quickly.

If the edges of the wound are much damaged or very ragged, they may be vivified before the sutures are applied, but usually this will be unnecessary. Before the abdominal wound is closed the accurate coaptation of the vesical wound should always be tested by moderately distending the bladder with water or milk, and if there is any escape between the sutures, an additional stitch applied. A catheter should afterwards be retained in the manner

already described. To what extent a retention catheter can be relied on for purposes of drainage may again be noted in the case of Walter, just cited, where an intraperitoneal rent two inches in extent was left open.

SUTURING BLADDER TO ABDOMINAL WALLS.

As early as 1716, Joh. Jacob Woyt (*unterricht von den todtlichen wunden des gantzen menschlichen Leibes*—Dresden, p. 417) recommended suturing the injured bladder to the abdominal wall, but I am not aware that this suggestion has ever been carried out until recently by T. G. Thomas of our city. In the course of a laparotomy for the removal of a large multilocular ovarian cyst, an incision had to be made through the anterior wall of the bladder in order to determine the upper limit of the viscus which was adherent to the tumor. After the removal of the cyst the lips of the vesical incision were drawn up and clamped between those of the abdominal wound by means of silver sutures. A Sims' sigmoid catheter was kept in the bladder. The sutures were removed on the tenth day, and, at the end of three months, the patient went home entirely well.

With a view of further testing the feasibility of this procedure, I undertook the following experiment on dogs. I am indebted to Dr. R. H. Harrison, House Surgeon of the American Veterinary College Hospital for the following notes:

EXPERIMENT 1, January 3d, 1882. Brown dog, partly setter, weight about 60 lbs., 3 years old. Etherized, suprapubic incision of abdomen. Bladder opened, on the end of a catheter introduced through the perineal incision to the extent of nearly an inch, and the vesical lips brought together with the abdominal wound by means of silk sutures. Lister's dressing—catheter tied in the bladder through a perineal incision. January 4th, 8 A. M., temp. 104° ; pulse 120; resp. 18; no appetite; considerable depression; catheter removed thirty-six

hours after operation. January 5th, 8 A. M., temp. 102° ; pulse 110; resp. 18; drinks a little milk. From this time dog rapidly improved; sutures remained five days, but urine escaped through abdominal wound. Granulations touched with nitrate of silver. January 18th, wound entirely closed; urine passes *per viam naturalem*; appetite and spirits good. January 24th, killed. Firm adhesions of bladder with abdominal walls.

EXPERIMENT 2, January 10th, 1882. Black Newfoundland bitch, weight 50 lbs., age 4 years. Operation same as in Experiment 1. Dressing of oakum applied over abdomen. For six days temperature ranged from 102° to 106° ; pulse 100 to 145; resp. 18 to 24. A subcutaneous extravasation of urine occurred extending to the left mamma, which afterwards sloughed leaving a large granulating surface. The wounds, however, all healed; and on February 12th the animal was killed, and the bladder was found adherent to the anterior wall of the abdomen.

EXPERIMENT 3, January 17th. Poodle bitch, 20 lbs. weight, 2 years old. Operation same as before. Sutures held for three days, after which, healing by granulation. Dog seemed in good health and spirits throughout. Fistula closed January 28th; February 7th, killed; bladder found attached to the anterior abdominal wall.

The bladder in the dog is covered on all sides by peritoneum, hence our operations were intraperitoneal. In neither of our experiments did we succeed in getting union by first intention. After three or four days the sutures gave way, and healing went on by granulation with escape of urine from the abdominal wound; nevertheless, it was interesting to note that adhesions, preventing the escape of urine into the peritoneal cavity, had already occurred, thus early, and a rapid closure of the fistulous tracts ensued. In the first two cases the dressings applied were practically useless; and in the third experiment no dressings were used, the wound being occasionally irrigated with carbolized water. The catheter could be retained in only one of the

dogs, and that, with difficulty, for only thirty-six hours. We observed that the bladder had, in each of the cases, become considerably hypertrophied, in consequence, no doubt, of its abnormal attachments. It is true that the peritoneum in the dog is very tolerant of injury, but, on the other hand, the position of the quadruped is obviously a great disadvantage to contend against, and we cannot, in them, resort to measures which, in man, would greatly enhance the success of such an operation.

The above experiments are few in number, but, pointing one way, indicate to us another method of closing the vesical wound, which, under certain circumstances, may offer prospects of better results than ordinary cystorrhaphy.

BIBLIOGRAPHY.

- ADAMS, R., cited by Stokes (*Virchow-Hirsch Jahrsb.*). 1872.
Ärztlicher, Bericht aus dem K. K. Allgem. Krankenhaus M. Wein. 1861.
- ALLIN, CHAS. M., *N. Y. Medical Record*, p. 102. 1866.
- ANGERER, OTTMAR, *Chir. Klin. in Julius Hosp., Würzburg.* 1876.
- AMMUSSAT, M., *Coulson Diseases of Bladder, etc.*, p. 102. 1881.
- ASSMUTH, 2 cases, *St. Petersburg Med. Woch.*, June 11, 1881.
- ASTIER, *Des corp setrangers qu on a trouves dans la vessie*, These., Paris. 1839.
- BANGS, *N. Y. Medical Record*, July 31, 1881.
- BARTELS, MAX, *Arch. f. Klin. Chir.*, Bd. 22, 1878.
- BARTLEET, T. H., *Lond. Lancet*, Feb. 5, 1876.
- BEDINGFIELD, *Lond. Lancet*, June, 1837.
- BELL, SIR CHAS., *Diseases of the Urethra*, p. 437, 1822.
- BENNETT, E. H., *Dub. Jr. Med. Sc.*, July, 1881.
- BERGERON, *Bull., Soc. Anat. T.*, 18, p. 186.
- BERNER, *De efficacia et usu aeris in Corpora humano*, 1723.
- BLIZARD W., *Catal. Mus. Royal Coll. Surg., Lond.*, 1849.
- BOEHM, *Centralb. f. d. Med. Wiss.*, p. 39, 1869.
- BOEHR, *vide Bartels Arch. f. Klin. Chir.*, Bd. 22, 1878.
- BONETUS, Chopart *Traite des Malad des Voies Urinaires*, t. 1, p. 409, 1830.

- BOWER, *Lond. Lancet*, vol. 2, p. 660, Dec. 19, 1846.
- BOYER, *Malad. Chir.*, 1 tom. 9, p. 61, 1831.
- BRANTES, DE, *Gaz. des hôp.*, p. 387, 1846.
- BUSH, *Western Jr. Med. and Phys. Sc.*, vol. 4, (*vide* Smith.)
- CALL T. I., *Lond. Lancet*, Dec. 10, 1881.
- Catalogue N. Y. Hosp. Museum, 5 cases.
- Catalogue St. Barthol. Hosp. Museum, Lond., 1846.
- Catalogue St. Thomas Hosp. Museum, 4 cases, 1859.
- Catalogue St. George's Hosp. Museum, 4 cases, 1866.
- CHALDICOTT, *Lon. Lancet*, vol. 2, p. 112, 1846.
- CLARK, *Boston Med. and Surg. Jour.*, vol. 53, p. 185, 1856.
- CLOQUET J., *Arch. Gen. de Med.*, t. 14, p. 453, 1827.
- CLOQUET, *Journ. gen. de Med. de Chir. et de pharm.*, t. 71, p. 401.
- COOPER, 3 cases, *Guy's Hospital Report*, vol. 2, 1844.
- COOPER, B., *Lon. Med. Gaz.*, Aug. 27, 1845.
- COULSON, W. I., *Diseases of Bladder*, etc., 1881.
- CROSSLEY, L., *Lon. Med. Times and Gaz.*, Sept. 28, 1872.
- CRUISE, T. K., 2 cases, *N. Y. Med. Record*, Aug., p. 241, 1871.
- CUSACK, 2 cases, *Dub. Hosp. Rep.*, vol. 7, p. 312, 1818.
- CUTLER, *Lon. Med. Gaz.* (*vide* Hawkins) 1850.
- DEMME, H., *Chir. der Schusswunden*, p. 164, Würzburg, 1863.
- DENONVILLIERS, *Gaz. des Hôp.*, p. 50, 1843.
- DEWAR, *Edin. Med. and Surg. Jr.*, vol. 31, p. 86, 1829.
- DICKENSON AND HOLMES, *St. George's Hosp. Rep.*, Lond., vol. 8, 1877.
- DUPUYTREN, *Amer. Journ. Med. Sc.*, vol. 12, 1832.
- DUPUYTREN, *Arch. Gen.*, June (*vide* Smith) 1834.
- DUTSCH, *Arch. Klin. Chir.*, Bd. 22, (*vide* Bartels) 1878.
- EARLE, H., *Medico-Chir. Trans.*, p. 257, 1833.
- ECCLES, *Lancaster Lent. Assizes*, 1836.
- ELLIS, A., 2 cases *Lond. Lancet*, Sept., 1835.
- EVE, P. E., *Remarkable Cases in Surgery*, p. 367.
- EWBANK, *vide* Bell, p. 404, 1822.
- FANO, *Bull. de la. Soc. Anat.*, t. 20, p. 113, 1845.
- FAYE, *Schmidt's Jahrb.*, Bd. 106, p. 193.
- FERGUSON, W. M., *Med. T. and Gaz.*, vol. 2, p. 253, 1866.
- FIELD, *Lon. Med. T. and Gaz.*, Dec. 13, 1856.
- FIX, *vide* Stephen Smith, 1851.
- FLEMING, *Dub. Quart. Jr. Med. Sc.*, vol. 42, p. 499, 1866.
- FLEMING, CHRISTOPHER, 2 cases, *Clin. Rec. Injuries and Diseases Genito-Urinary Organs*, Dublin, 1877.
- GAMAK, *Med. Chir. Rev.*, vol. 13.

- GARRY A., *Lond. Lancet*, vol. 1, p. 25, 1828-9.
- GILLESPIE, I. D., *Edin. Jr.*, Mch., 1859.
- GRAW A., 2 cases, *Zur Casuistik der Blasen Rupturen*, Breslau, 1871.
- GROSS, SAM'L, *System of Surgery*, vol. 2, p. 720, 1872.
- GRUBER, JOS., *Ueber harnblasenzerreissung*, *Weiner Wochenbl.*, 1857.
- GUERSANT P. AND DENIS, *Anal. d'hygiene publ.*, Jan'y, 1836.
- GÜNSBURG F., *Gansburg Zeitschrift f. Klin. Med.* 1854.
- HALL, *Provincial Med. and Surg. Jr.*, May 1, 1844.
- HAMILTON, *Dub. Med. Jr.*, p. 532, 1846.
- HAMILTON, F. H., *Fractures and Dislocations*, 1866.
- HARRISON, 3 cases, *Dub. Jr. Med. Sc.*, vol. 9, p. 349, 1836.
- HARRISON, R., *Clin. Lectures*, Stricture, etc., p. 32, 1878.
- HAWKINS, 6 cases, *Lond. Med. Gaz.* Ap. 26, 1850.
- HAUFF, *vide Civiale*, vol. 3, p. 260, 1842.
- HEATH, CHRIS., *Lon. Lancet*, May 12, 1877.
- HEATH, CHRIS., *Med. Chir. Trans.*, vol. 62, 1879.
- HEY, *Med. Observ. and Inquiries*, vol. 4.
- HILEY, JNO., *Lon. Lancet*, May 14, 1842.
- HIMLY, JNO., *Arch. f. Klin. Chir.*, 8, p. 709, 1867.
- HIRD, *Lon. Lancet*, Oct. 26, 1846.
- HOFF, O., *Hæmaturia*, etc., Phila., 1878.
- HOFFMEISTER, *Prager Med. Wochen*, 1864.
- HOME, SIR E., 2 cases, *Surgical Works*, vol. 2, 1821.
- HONEL, *Des Plaies et des Ruptures de la Vessie*, Paris, 1857.
- HOURLMANN, *Clin. des Hôp.* t. 1., p. 3, 1827.
- HUNTER, G., Chopart, *Traite des Malad. voies Urinaires*, 1830.
- JEANMAIRE E., *Les traum de la vessie*, Strasbourg, 1865.
- INGHAM, JAS., *Amer. Jr. Med. Sc.*, Oct., 1867.
- JOHNSTONE, *Med. Observ. and Inquiries*, vol. 4, 1793.
- KEAL, *Lon. Med. Gaz.*, 1836.
- KEATE, 2 cases, *Lond. Med. Gaz.*, Ap. 26, 1850.
- KIRKBRIDE, *Amer. Jr. Med. Sc.*, vol. 16, 1835.
- KNEELAND, *N. Y. Med. Jr.*, Mch., 1851.
- LARREY, D. I., *Relations Med. de Campagnes et Voyages*, Paris, 1841.
- LARREY, H., *Memoires de la Soc. de Chir.*, Paris, t. 2, p. 328, 1851.
- LAWRENCE, *Lon. Med. Gaz.*, Feb. 2, 1839.
- LEIGH, W. T. H., *Lond. Med. and Surg. Jr.*, Dec., 1834.
- LENTE, N. N., *Journ. of Med.*, vol. 4, 1850.
- LIMAN, C., *Pract. Handbuch der Gerichtl. Med.*, Berlin, 1871.

- LIMAIRN, *vide* Bartels.
- LISTON, *Arch. Gen. de Med.* t. 17, p. 307, 1827.
- MACDOUGAL, I. A., *Edin. Med. Jr.*, Jan., 1877.
- MACEWEN, W., *Lon. Lancet*, Sept. 13, 1873.
- MASON, E., *N. Y. Med. Jr.*, vol. 16, 1872.
- MASON, E., *N. Y. Med. Record*, Dec. 1, 1874.
- MASON, E., *N. Y. Med. Record*, July 22, 1876.
- MERCIER, *Bull. Soc. Anat.*, t. x., p. 11, 1835.
- MONTAGUE, *Med. Communications*, Lon., vol. 7, p. 284, 1790.
- MORRIS, *Lon. Med. T. and Gaz.*, Nov. 29, 1879.
- MOTT, *vide* Stephen Smith.
- NELATON, *vide* Syme. *Lon. Lancet*, vol. 1, p. 287, 1848.
- NIVET, *Bull. de la Soc. Anat.* Paris, t. 11, p. 194, 1837.
- OLDFIELD, *Lon. Lancet*, vol. 1, p. 79, 1844.
- OLLENROTH, *vide* Thedan.
- PADLEY, GEO., *Lon. Lancet*, Mch. 4, 1882.
- PARKER, WILLARD, *N. Y. State Med. Soc. Trans.*, 1867.
- PARTRIDGE, *Trans. Path. Soc.*, vol. 5.
- PATTERSON, *Assoc. Journ.* (*vide* A. S. Taylor) p. 88, 1853.
- PEACOCK, *vide* Coulson.
- PEASLEE, E. R., *Amer. Jr. Med. Sc.*, vol. 19, p. 383, 1850.
- PENDLETON, *Charleston Med. Jr.*, vol 5 (*vide* Smith.)
- PERCY, 2 cases *Dictionnaire des Sci. Med.* t. 7, p. 349, Paris, 1813.
- PIERUS, *Hist. Anat. Med. par Lieutand*, Lib. 1, Sec. 12, Art. 6, Obs., 1279 (*vide* Smith.)
- PLATERUS *Hist. Anat. Med. par Lieutand*, Lib. 1. Sec. 12, Art. 6, Obs., 1279 (*vide* Smith.)
- PORTER, H., *Schmidt's Jahrb.*, Bd. 91, 1856.
- QUAIN, *Lon. Lancet*. vol. 2, 1865.
- QUINTEN DE CAMBRAI, *Gaz. Hebdom.*, p. 89, 1856.
- RAKE, *vide* Bartels.
- RAMSBOTHAM, 2 cases *Pract. Observ. in Midwifery*, 2d ed., 1842.
- RICHERAND AND CLOQUET, *Journ. Hebdom.*, p. 592, 1830.
- RIEDEL, B., *Deut. Med. Wochensch*, No. 12, 1882.
- RIEDEL, B., *Deut. Zeitschrift, f. Chir.*, xv., p. 483, 1881.
- RIVINGTON (Page), *Lon. Lancet*, Mch., 1, 1879.
- ROONHUYSEN, H. VON, *Eine Historische Anmerk. de Rupt. Vesicæ, etc.*, Nurembourg, 1674.
- ROSE, E., 2 cases *Verletrungen-Charite Annalen*, Bd. 13, H. 2, Berlin, 1865.
- ROSS, I. M., *Edin. Med. Jr.* Jan., 1882.

- SASIE, *Bull. Soc. Anat.*, t. vii., p. 38, 1832.
- SCHAARSCHMIDT, SAM'L., *Med. Chir. Nachrichten*, Berlin, 1743.
- SCHMIDT, BENO., *Beitrage Zur. Chir. Anat. der Harnwerkzeuge*, Heft. vol. 1, 1865.
- SCHOEMAKER, A. H., *Nederl-Tijdschr v. Geneesk* 6, 129, 1862; *Schmidt's Jahrb.*, 1863.
- SCHWARZ, *Centralb f. Gynakol*, Mch. 13, 1880.
- SCOTT, *Lon. Lancet*, vol. 1, p. 387, 1844.
- STOLL, *Lon. Med. Repository*, vol. 17, p. 60, 1822.
- SMITH, R. W., *Dub. Jr. Med. Sc.*, Ap., 1844, and *Dublin Hosp. Rep.*, 1844.
- SMITH, R. W., *Dub. Jr. Med. Sc.*, vol. 53, 1872.
- SMITH, STEPHEN, *N. Y. Journ. of Med.*, vol. 6, 1851.
- SMITH, STEPHEN, cites *Lon. Med. and Phys. Jr.*, 1828.
- SMITH, STEPHEN, cites *Anal. de Hygiene et de Med. legeli*, Mch., 29, 1836.
- SMITH, STEPHEN, cites *Lon. Med. Gaz.*, Apr., 1836.
- SOLLY L., *Lon. Lancet*, vol. 1, and *Lon. Med. Gaz.*, Ap. 26, 1850.
- SOUTH, *Lon. Med. T. and Gaz.*, 1853.
- SOUTH, St. Thomas' Hosp. Rep., vol. 1, 1836.
- SPENCE, JAS., *Lectures on Surgery*, 2 Ed., Edinburgh, 1876.
- STAPLETON, *Dub. Quart Jr.*, Feb., 1850.
- Stations buch von Bethanien, *vide* Bartels.
- STEAVENSON, *Taylor's Med. Jurisprud.*, Amer. ed., p. 245.
- STOKES, WM., *Brit. Med. Jr.*, 1872.
- STONE, JNO., *vide* Bartels.
- SYME, *Edin. Med. and Surg. Jr.*, vol. 2, p. 268, 1836.
- SYME, *Lond. and Edinb. Monthly Journ. Med. Sc.*, p. 498, 1843.
- SYME, *Ed. Med. and Surg. Jr.*, p. 250, 1848.
- SYMES, *Dublin Jr. Med. Sc.*, p. 485, 1866.
- TANCHON, *Arch. gen. de Med.* t., 22, 1 series.
- TATUM, by Hewett, *Lon. Med. Gaz.* Ap., 26, 1850.
- TAUZSKY, *N. Y. Med. Record*, Mch. 25, 1882.
- TAYLOR, A. S., *Princ. and Pract. Med. Jurisprud.*, Lond., 1865.
- TAYLOR, cited in *Lancet*, 1842 (*vide* Bartels.)
- THEDAN, I. C. A., 1795, *vide* Bartels.
- THOMPSON, SIR H., *Lon. Lancet*, vol. 1, p. 851, 1872.
- THOMPSON, SIR H., *Surg. Diseases, Urinary Organs*, 1877.
- THORP, HENLY, *Dub. Quart. Journ.*, Nov., 1868.
- THOUVENET, *Soc. Anat.*, t. 24, p. 29, 1849.
- TOWNSEND, W., *Lon. Med. T. and Gaz.*, p. 75, 1864.
- VREELAND, *N. Y. Journ. of Med.*, vol. 4, 1850.

- WALKER, W. I., *Med. Comm.*, Mass. Med. Soc., vol. 7, 1845.
WALTER, *Phila. Med. and Surg. Rep.*, Feb., 1862.
WARREN, J. M., *vide* Bartels.
WARREN, I. S., *Cincinnati Lancet and Clinic*, Dec. 17, 1881.
WATSON, 2 cases, *Monthly Jr. Med. Sc.*, Dec., 1848.
WALFORD, DUDLEY, *Lon. Lancet*, Mch. 18, 1882.
WARD, *Lon. Lancet*, vol. 1, 1842.
WEISBACH, *Deut. Militaearztliche Zeitschrift*, Bd. 3, 1874.
WELLS, 2 cases, *Lon. Med. Gaz.*, Aug., 1845.
WERNHER, *Schmidt's Jahrb.*, Bd. 65, p. 220.
WILLETT, ALFRED, *St. Barthol. Hosp. Rep.*, 1876.
WILLIAMS, W. RHY., *Lon. Lancet*, Mch. 31, 1877.
WILLIAMS, A. V., *N. Y. Med. Times*, Jan., 1855.
WILLIAMS, H., *Amer. Journ.*, vol. 53, p. 446, 1867.
ZITTMANN, J. F., 1706, *vide* Bartels.

NOTE.—In the preparation of this bibliography I wish to acknowledge material aid received from the valuable papers on this subject by Drs. Stephen Smith, of New York, and Max Bartels, of Germany. Most of the field explored by these writers has been reviewed, and a large number of additional cases have been brought together.