

Management of Genitourinary Injuries in Patients with Pelvic Fractures

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Associated injuries frequently occur in patients who sustain fractures of the pelvis. Hemorrhage from intrapelvic vessels, rupture of the urinary bladder and avulsion of the membranous urethra in males are among the integral risks in this trauma. Non-operative methods of managing hemorrhage have gained favor in recent experience. The case records of 282 male patients with pelvic fractures were reviewed to evaluate experience with lower genitourinary injuries. Early recognition is important in bladder injuries, and surgical repair is advised, except in selected patients who may be managed by catheter drainage alone. Delayed complications of bladder injury are rare. Membranous urethral injuries entail a high risk of chronic stricture disease and sexual impotence. The rationale of early repair versus delayed repair of these injuries is discussed. The results in this series show advantage for delayed repair.

PATIENTS WHO HAVE SUSTAINED TRAUMA of sufficient magnitude to fracture the bones of the pelvic girdle are exposed to a high risk of associated injuries. Some of these injuries are coincidental with pelvic fractures and reflect the fact that multiple injuries can be expected in patients whose accidents involve high speed and great force. These injuries involve the abdominal viscera, chest, central nervous system, other bones, etc. Such injuries are often important factors in management and may be determinants of outcome.⁶ Other injuries may appropriately be considered to be an integral part of the trauma to the pelvis. Such injuries include bleeding from intrapelvic vessels, rupture of the urinary bladder and avulsion of the membranous urethra in males.

Hemorrhage from pelvic vessels is the most consistent problem encountered in patients with pelvic fractures and is cited by most authors as the leading cause of death.⁵ The bleeding is difficult to control by surgical means. Attempts to identify and ligate injured vessels are often unsuccessful. Ligation of the hypogastric arteries has been discredited as an effective means of controlling hemorrhage. The trend in recent

years has been toward non-operative methods of coping with hemorrhage. In many patients hemorrhage will spontaneously cease and attention should be focused upon adequate blood volume replacement. Angiographic techniques have been successfully employed therapeutically as well as for diagnostic purposes.⁷⁻¹⁰ The "G suit" has also been utilized to tamponade bleeding.¹

Rothenberger et al.⁹ found a 50% mortality rate in patients with open pelvic fracture, as opposed to 10% in closed injuries. Sepsis was a major factor in the fatal outcome in this group of patients. This observation is relevant to the management of bleeding and of other injuries associated with pelvic fracture, since infection is much less common if the pelvic hematoma is not invaded surgically or contaminated by instrumentation.

Our experience in management of patients with genitourinary injuries associated with pelvic fractures will be reviewed in more detail.

Diagnosis

Injury to the genitourinary organs should be suspected in patients with pelvic fracture if the patient has hematuria, is unable to void or if there is a bloody urethral discharge. Injury is confirmed by radiographic study, which is conducted as follows: Retrograde urethrogram is performed first. Catheterization is often recommended as the first diagnostic step after the injury is suspected; however, we have discouraged this practice since catheterization may introduce infection into the pelvic hematoma, may add to the trauma of the injured urethra and may fail to reveal the presence of incomplete urethral injury. If the urethra is demonstrated to be intact, a catheter is inserted into the bladder and a cystogram is performed by instillation of approximately 300 cc of contrast media. A post-evacuation film is also obtained. Measurement of fluid

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TABLE 1. *GU Injuries in 282 Pelvic Fractures*

	Number	Per Cent
Bladder	19	6.7
Urethra	20	7.1
Kidney	9	3.2
Hematuria	38	13.5
Total	86	30.5

instilled and fluid returned should be made. Intravenous pyelogram is obtained to evaluate the upper urinary tracts.

Clinical Material

The experience which we report consists of 282 pelvic fractures encountered in male patients who were managed at The University of Mississippi Medical Center from 1965 to 1978. The cause of injury was related to the operation of motor vehicles in 243 of the 282 patients. In this group, there were injuries to 191 automobile passengers, 40 pedestrians and 12 motorcycle riders. Fifteen patients were injured in falls, and 24 sustained other types of crushing trauma. Associated injuries were encountered in approximately half of these patients. Other bones were fractured in 102 (36%). Genitourinary injuries occurred in 80 patients (28%), thoracic injuries in 53 (19%), head injuries in 51 (18%) and abdominal visceral injuries in 28 (10%). Genitourinary injuries included the bladder, urethra and kidney (Table 1). Hematuria was the only evidence of genitourinary injury in 38 patients. Seven patients died as a direct and immediate result of injury in this series (2.5%). Two of the 19 patients with ruptured bladder died (10%); both deaths were due to associated injuries. The 17 other patients with ruptured bladder recovered with no chronic sequelae of the bladder injury. Twenty patients were treated for injury to the membranous urethra. Nine of the patients underwent primary repair of the injury with insertion of urethral and suprapubic catheters. The results of this management are shown in Table 2. These results are not entirely representative of results generally obtained, because of the inclusion of patients who were referred to

TABLE 2. *Patients Treated by Primary Closure and Urethral Catheterization*

Complication	Incidence	Per Cent
Stricture	7	77
Incontinence	2	22
Impotence	3	33
Abnormal ejaculation	4	44
Urinary infection	6	66

TABLE 3. *Patients Treated Initially by Cystostomy*

Complication	Incidence	Per Cent
Stricture	0	0
Incontinence	0	0
Impotence	1	9
Abnormal ejaculation	1	9
Urinary infection	2	18

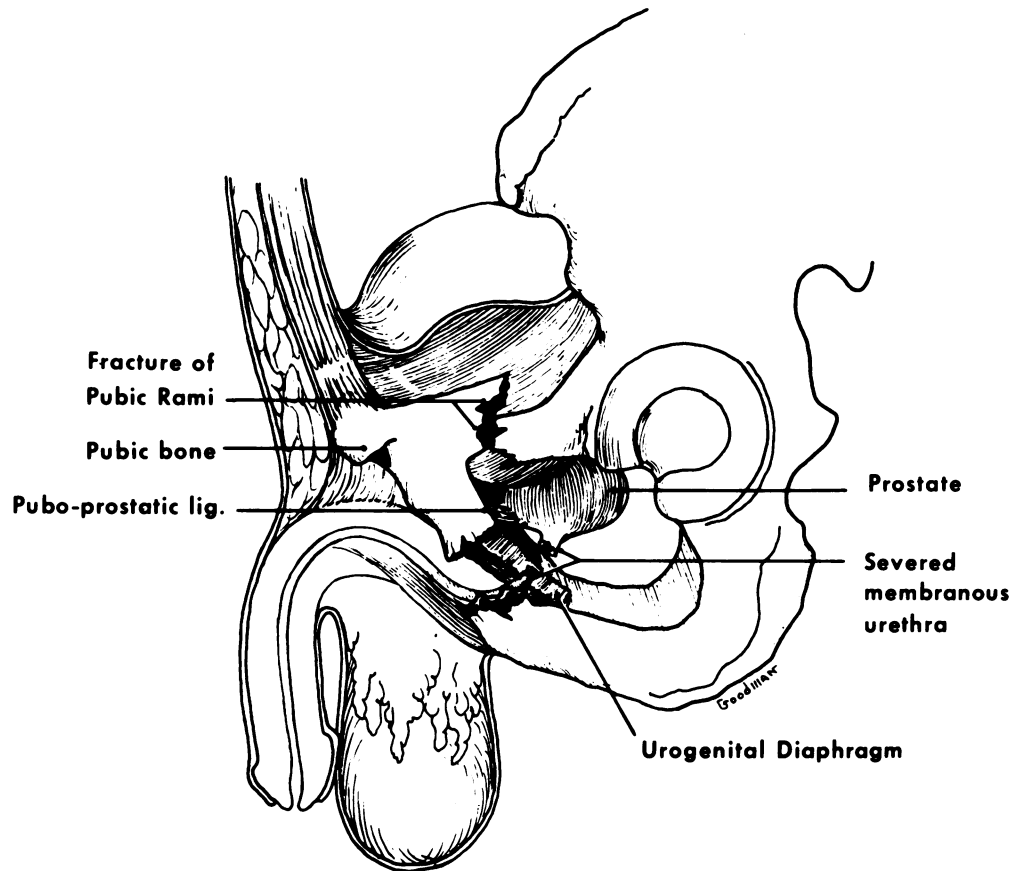
us because of complications of primary repair performed elsewhere. Eleven patients were treated initially by cystostomy alone; all of these patients required subsequent surgery for urethral stricture. However, normal urinary function was eventually restored in all of this group. Two patients were left with some sexual disability (Table 3).

Discussion

The bladder may be injured by perforation, by displaced spicules of bone or by sudden compression resulting in bursting due to a rise in intravesical pressure. Hemorrhage from the ruptured bladder is rarely a problem in terms of blood loss, although clots may obstruct the catheter which is used to drain the bladder and thereby complicate management. Extravasation of urine is the major problem in injuries to the bladder. Net renal function is reduced proportionately to the amount of urine reabsorbed. Continued leakage of urine predisposes to infection. Extravasation of sterile urine for a brief time, however, induces little inflammatory response in the retroperitoneum or the peritoneal cavity. Therefore, rupture of the bladder is not a catastrophic event if it is recognized early. With prompt recognition and appropriate treatment the outcome should be good. Chronic sequelae are rare. The customary treatment in the practice of most urologists has been operative repair and postoperative catheter drainage. However, recent experience reported from several centers suggests that many of these patients can be successfully treated without surgery if the bladder is drained by way of an indwelling catheter.⁸ Selection of patients for non-operative treatment is a matter of judgment. At the present time, we advise operative closure, except in those patients who have only minimal extraperitoneal extravasation and who do not require abdominal surgery for other reasons.

Injuries to the membranous urethra are a more difficult problem because of the prevalence of late complications. The mechanism of this injury is based on the following anatomic considerations (Fig. 1): The urogenital diaphragm is firmly attached to the pubic rami. The prostate is fixed to the pubis by the puboprostatic ligament. When the central portion of the pubis is displaced, traction is exerted upon the

FIG. 1. Anatomy of injury of membranous urethra.



urethra which, at this point, is a thin, delicate structure. Aside from the fact that the patient is unable to void, the injury poses no immediate problem. Extravasation of urine is minimal because of the competence of the bladder neck. Late sequelae are frequent, however. Strictures are common. Sexual impotence is reported to occur in approximately 30% of patients who sustain this injury.²

Management should be directed toward minimizing the risk of late complications. Myers and Deweed, in reporting the experience at the Mayo Clinic, summarized the principles of management that are accepted by most American urologists.⁴ Prevailing practice has been to attempt primary repair in the immediate postinjury period, along with the insertion of urethral and suprapubic cystostomy catheters and drainage of the prevesical space. Results have not been entirely satisfactory in light of problems with infection in the pelvis and the frequent occurrence of strictures and impotence. Johanson in Sweden and, subsequently, other authors have proposed conservative early management in this injury.³ This proposal followed the development of urethroplasty techniques which permit repair of urethral defects at this level. We became interested in this approach in 1965 and since then have managed most of the membranous urethral in-

juries in the following way: Retrograde urethrography is performed in all male patients with pelvic fractures who are suspected of having the injury by virtue of inability to void, bloody urethral discharge or hematuria (Fig. 2). When extravasation is demonstrated,

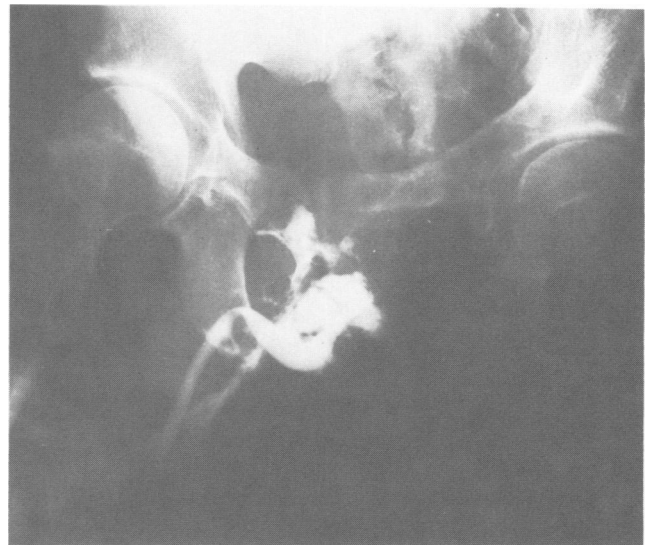


FIG. 2. Retrograde urethrogram showing extravasation from the severed membranous urethra.



FIG. 3. Retrograde urethrogram demonstrating blind ending of the urethra.

urinary diversion is accomplished by way of a suprapubic cystostomy tube, which is introduced through a small, low abdominal transverse incision. This may be done with the patient under local anesthesia. The cystostomy catheter may be introduced by trocar if the bladder is palpably distended.

Two or 3 weeks after the injury, a cystogram is performed by instillation of contrast media into the bladder via the cystostomy tube. If the urethral injury was incomplete, the urethra may heal spontaneously and the patient may be able to void; in which case, the cystostomy is removed and subsequent examinations are scheduled to monitor for the development of stricture. In most patients, complete loss of continuity of the urethra will be found (Fig. 3). In this event, repair of the defect is electively scheduled 3–6 months following the injury. In the meantime, cystostomy drainage is maintained on an outpatient basis. We have used a two-stage scrotal inlay urethroplasty successfully to restore continuity of the urethra in our series. However, the possibility of accomplishing a definitive repair in one stage is attractive and probably is feasible in selected patients.

Our experience suggests several disadvantages of delayed repair. The prostate may remain displaced so

that subsequent repair is difficult because of the distance between the ends of the divided urethra. This is an unusual occurrence. In most cases, the prostate returns to its anatomic position with reabsorption of the pelvic hematoma. Patients who receive cystostomy alone as initial treatment of necessity experience delay in full recovery, because of the need for subsequent diagnostic evaluation and, in most cases, surgical repair of the urethra.

Advantages gained by this approach are compelling, however, in some circumstances. Early surgical requirements are simplified. This is a particular advantage in the patient with multiple injuries. Many times there are diagnostic uncertainties in these patients. Anesthesia risks and the risks involved in elective surgery may be increased by the existence of associated injuries. Simplification of early management of urethral injuries is also an advantage when the patient is in a hospital with less than optimal facilities and staff. Cystostomy may be performed with relative safety even by inexperienced surgeons. Infection is less likely to occur in the pelvic hematoma if it remains inviolate. Cystostomy may be performed without invading the hematoma, affording the opportunity to delay definitive repair until the hematoma has been absorbed. Reported experience indicates that there is less risk of sexual impotence when early definitive repair is not undertaken.³ The reason for the high incidence of impotence with primary repair is not clear. It may be related to injury to vessels or nerves incurred in mobilization of the prostate or perhaps to infection, which often occurs after surgery. Perhaps the risk could be reduced by improvement in operative technique. Another consideration is the possibility that incomplete injuries may heal spontaneously if urine is diverted, and subsequent repair may not be necessary; whereas, incomplete injuries may be converted to complete injuries in the course of dissection to define the anatomy and attempt repair in the early postinjury period.

Summary

The results of management of bladder injuries associated with pelvic fractures should be good if the condition is recognized early. Late sequelae are rare in this injury, as opposed to injuries of the membranous urethra in males. Controversy surrounds the question of non-operative management of injuries of the bladder. The feasibility of delayed repair of injuries of the membranous urethra has been well established. Ultimately successful rehabilitation of the lower urinary tract can be anticipated. Impotence is an important consideration, since reports indicate that it occurs with greater frequency when early repair is performed. If conditions

are unfavorable for primary repair, either because of associated injuries or because of unavailability of experienced urologic assistance, the surgeon may defer definitive repair by the simple expedient of performing a cystostomy. Every effort should be made to avoid infection in the pelvic hematoma.

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DISCUSSION

DR. G. RAINEY WILLIAMS (Oklahoma City, Oklahoma): I think both of these papers add valuable suggestions regarding treatment of this very difficult problem. Although my comments are primarily directed to Dr. Weems' paper, I'll be the first to say that I know very little about technical management of the urologic complications, and our urologists tell me that they agree with Dr. Weems.

Dr. Weems mentions that oftentimes the management of these difficult injuries is in the hands of orthopedic surgeons and, in the case of urologic problems, with urologic surgeons. In our own institution, any patient who has injury to more than one major organ system is managed by general surgery. Since we make absolutely no effort to perform the therapeutic maneuvers of surgical specialists, only to coordinate timing, they do not argue with this position. It causes a few more night calls, but I think it ensures improved care for the patient, particularly while the hemodynamic situation is unstable.

The second point is, I think everyone should take home from this meeting the concept that there are generally available improved methods for managing these injuries. The G-suit or MAST pants are now widely distributed. If you are not studying these patients, as Dr. Polk is doing, early application of the G-suit should limit blood loss, and we try to do this as early as possible, including applying the apparatus before admission to the hospital.

The early use of arteriography and embolizing technics when bleeding can be localized has proven valuable.

The last point I'd like to make is that when patients come in with the MAST pants in place, don't take them off.

DR. ELGIN W. WARE, JR. (Dallas, Texas): I would like to refer my remarks to Dr. Weems' paper. I would also like to congratulate him on this discussion of a practical problem of on-going significance.

Just two minor points regarding the diagnosis of urinary tract injury associated with pelvic fracture. First, in regard to the physical examination, rectal examination is usually done, if for no other reason than to ascertain the presence or absence of blood in the rectum; and in those cases of complete transection of the membranous urethra, the prostate may, obviously, be found to be riding high, and can be pushed higher still into the pelvis, unless already fixed by hematoma and edema.

Second, we often do the intravenous pyelogram first. Lamar didn't comment so much on this, but this study should always be done if the general condition of the patient permits to determine the status of the upper urinary tract, and oftentimes will provide

sufficient information regarding the integrity of the urinary bladder itself to obviate carrying out an opaque cystogram subsequent to this.

We agree with Dr. Weems that attempted catheterization in the emergency room in those cases suspected of having urethral injury should be avoided, not only because of danger of introducing infection, but because such efforts can convert partial tear or transection into complete disruption of the urethra.

To speak to the title of Dr. Weems' paper, the only controversy, aside from the minor one of handling bladder injuries themselves, as I saw it, had to do with the management of complete transection of the membranous urethra. Specifically, as he has indicated, should attempts be made primarily to re-establish continuity of the urethra, or should simple cystostomy only be done with definitive urethral repair left to a later date?

Dr. Weems has outlined the pros and cons of these two concepts well, and although the number of cases he reports is somewhat small, the negligible occurrence of long-term complications, including stricture, impotence, and incontinence in those cases handled in two stages, would certainly tend to favor this method. Zero incidence of stricture and zero incidence of incontinence is pretty convincing.

It may be that the significantly higher figures for such complications in those cases treated with primary closure are somewhat skewed, owing to the fact that Dr. Weems' series were apparently taken from a regional referral hospital, where the more complicated cases tend to be seen.

I think it would be fair to say, however, that increasing numbers of series throughout the country tend to agree with Dr. Weems' implied results. We in Texas were first made aware of this method through the work of Dr. Kenneth McKinnon, of Canada, and although his early results in a somewhat larger series were not quite so impressive as Dr. Weems', they were sufficiently so to make the two-stage repair the standard method of handling these cases currently at our own University of Texas Southwestern Medical School in Dallas.

I would like to ask Dr. Weems three questions. First, were there any females in his series with bladder injuries? We have on occasion encountered tears of the urinary bladder into the vagina, with, in one case, at least, subsequent development of vesicovaginal fistula.

Second, does he always perform secondary repair of the membranous urethra perineally, or does he utilize an anterior approach, with or without symphysiotomy, on occasion?

Thirdly, does he offer the patient some type of penile prosthesis, such as the Small-Carrion, when impotence does, in fact, ensue as a long-term complication?