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RESEARCH ARTICLE

TREATMENT PROTOCOL FOR MALE BLUNT URETHRAL TRAUMA IN EMERGENCIES IN INDIA: OUTCOME OF DIFFERENT METHODS IN COMPARISON WITH OTHER COUNTRIES - OUR EXPERIENCE

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ABSTRACT

Treatment of male urethral trauma is always a challenging problem. In India, as the incidence of urethral trauma keeps rising, more and more studies relating to this are being published. To compare the outcome of different emergency treatments in India and other countries, we searched Indian and English literature about this topic in the past 10 years. Based on the analyses, surgical methods include open realignment, endoscopic realignment and primary repair, and we summarized and compared the success rate and complications (mainly erectile dysfunction and incontinence) of each method. We found that realignment of posterior urethra has similar success rate in India and other countries, but the outcome of realignment of anterior urethra is variable. The reason remains unknown. While abandoned long back in Western countries, primary repair of anterior urethra is still an option in India with high success rate.

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INTRODUCTION

With reference to urogenital diaphragm, urethral injuries (UIs) are divided into anterior urethral injury (AUI) and posterior urethral injury (PUI). UIs mostly occur in men, and are usually blunt trauma. The emergency treatment of urethral injury is very important for prognosis. If not treated properly, simple urethral trauma could lead to infection, fistula, urethral stricture, incontinence or impotency, significantly compromising the patient's quality of life and increasing the difficulty of further treatment. However, the urologists worldwide have not yet reached an agreement in many aspects of the treatment of urethral trauma. India is one of the most populated countries in the world, and the rapid development of labor intensive industries in the last decade has led to a large number of urethral trauma cases. In Indian literature, there are many studies about the treatment of UIs. Comparing these with the studies in English literature, which have rather low sample

amount, the large number of patients in Indian studies could provide useful information. So, the emergency treatment of UIs in India, is somewhat different from developed countries. Here, we analyzed reports from India and other countries, comparing surgical methods, outcomes and complications, and analyzed the cause for the difference.

MATERIALS AND METHODS

Search for Indian literature was performed using domestic search engines. The key words to search included "urethral realignment", "urethral injury", "primary repair", "straddle injury", and "endoscopic realignment". Only the studies with exclusive information about history, surgery method, follow-up and complications were included. A total of 66 studies entered in this research, including 20 about endoscopic realignment (ESR) of anterior urethra, 13 about primary open repair of bulbar urethra, 24 about open realignment (OR) of PUI and 9 about ESR of PUI. A search of the English literature was performed with PubMed using the same key words. A total of 16 studies were included, including five about ESR of

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AUI and 11 about ESR of PUI. All of them were retrospective studies. Because all the studies included were retrospective studies, the method of meta-analysis is not applicable here. Due to the heterogeneity of these studies, analytical statistic methods like Chi-square test and student t-test are not applicable either. Hence, we summarized the results of different studies and compared and the different emergency treatment to show the outcome of each treatment. Due to the large number of Indian studies (66 in total) we only showed the cumulated results. Their results were not listed individually.

the most reported emergency treatment of PUI were OR (24 studies) and ESR (9 studies), while the most reported treatment of AUI were ESR (20 studies) and primary open repair (13 studies). In contrast, in English literature there were no reports about OR in the past 10 years. ESR and cystostomy were the most frequently used treatments. Table 1 listed the results of 16 studies in English literature. The success rate of ESR in PUI ranged from 6% to 85.7%. Average erectile dysfunction (ED) rate was 21.5%, and in one study it was as high as 66.0%. Two studies reported high rate of incontinence (16.7% and 17.5%), while the other studies reported few or no incontinence.

Table 1. English Studies about the treatment of Urethral Injury

| Study | Country | Cases (n) | Success, n(%) | ED (n) | Incontinency (n) |
|-------------------------------------|------------|-----------|---------------|----------|------------------|
| ESR of PUI | | | | | |
| Hadjizacharia <i>et al.</i> , 2008 | US | 14 | 12 (85.7) | 0 (0%) | 0 (0%) |
| Moudouni <i>et al.</i> , 2009 | France | 27 | 15 (55.6) | 4 (14%) | 0 (0%) |
| Soferetal., 2010 | Israel | 11 | 6 (54.5) | (54%) | 6 (48%) |
| Mouraviev <i>et al.</i> , 2010 | US | 57 | 29 (50.9) | 19 (33%) | 10 (17%) |
| Olapade-Olaopa <i>et al.</i> , 2010 | Nigeria | 10 | 5 (50.0) | 0 (0%) | 0 (0%) |
| Moudouni <i>et al.</i> , 2011 | France | 29 | 17 (58.6) | 4 (13%) | 0 (0%) |
| Leddy <i>et al.</i> , 2012 | US | 18 | 4 (22.2) | 4 (22%) | 0 (0%) |
| Kim <i>et al.</i> , 2013 | US | 18 | 10 (55.6) | 7 (38%) | 3 (16%) |
| Shrestha and Baidya, 2013 | Nepal | 8 | 6 (75.0) | 1 (12%) | 0 (0%) |
| Johnsen <i>et al.</i> , 2015 | US | 27 | 10 (37.0) | 18 (66%) | 2 (7%) |
| Lee <i>et al.</i> , 2016 | Korea | 12 | 6 (50.0) | 0 (0%) | 0 (0%) |
| Total | 11 studies | 231 | 120 (51%) | 47 (20%) | 21 (9%) |
| ESR of AUI | | | | | |
| Ku <i>et al.</i> , 2008 | Korea | 65 | 53 (81.5%) | 2 (4%) | 0 (0%) |
| Elgammal, 2009 | Brazil | 22 | 4 (18.2%) | 0 (0%) | 0 (0%) |
| William <i>et al.</i> , 2012 | Korea | 51 | 31 (60.8%) | 0 (0%) | 0 (0%) |
| Ken <i>et al.</i> , 2012 | Korea | 17 | 15(88.2%) | 3(12%) | 0 (0%) |
| Park and McAninch, 2014 | US | 6 | 0 (0.0%) | 0 (0%) | 0 (0%) |
| Total | 5 studies | 161 | 103 (60%) | 5 (4.3%) | 0 (0%) |

none or not reported; ED, erectile dysfunction; ESR, endoscopic realignment; PUI, posterior urethral injury; AUI, anterior urethral injury

Table 2. Studies in Indian literature about emergency treatment of urethral injury from 2008 to 2018

| | Number of studies | Total cases n | Success n(%) | ED n(%) | Incontinence (%) | Overall Complication (%) |
|----------------------------|-------------------|---------------|--------------|-----------|------------------|--------------------------|
| OR of PUI | 24 | 2582 | 1498(58.0) | 179 (6.9) | 47 (1.8) | 8.8 |
| ESR of PUI | 9 | 574 | 327 (57.0) | 25 (4.4) | 5 (0.9) | 5.2 |
| ESR of AUI | 20 | 1015 | 579 (57.0) | 13 (1.3) | 0 | 1.3 |
| Primary open repair of AUI | 13 | 591 | 506 (85.6) | 12 (2.0) | 0 | 2.3a |

OR, Open realignment; PUI, posterior urethral injury; ESR, endoscopic realignment; AUI, anterior urethral injury; ED, erectile dysfunction. Including ED, infection and bleeding.

Table 3. Comparative studies of PR and ESR for anterior urethral injury

| Study | Treatment | Patients n | Success n (%) | Complication n |
|-----------------------------|-----------|------------|---------------|----------------|
| Khan <i>et al.</i> 2004 | PR | 14 | 12 (85.7) | 1 (infection) |
| | ESR | 8 | 6 (75.0) | 0 |
| Sami <i>et al.</i> 2008 | PR | 8 | 8(100) | 0 |
| | ESR | 20 | 0 (0) | 0 |
| Arora <i>et al.</i> 2012 | PR | 13 | 12 (92.3) | 2 (infection) |
| | ESR | 20 | 14 (70.0) | 0 |
| Kulkarni <i>et al.</i> 2008 | PR | 15 | 5 (33.3) | 0 |
| | ESR | 15 | 13 (86.7) | 0 |
| RP Singh <i>et al.</i> 2016 | PR | 26 | 24 (92.3) | 0 |
| | ESR | 32 | 23 (71.9) | 0 |

RESULTS

Outcome of different emergency treatments: Emergency treatments of UIs include cystostomy, primary realignment (open or endoscopic) and primary open repair. Most studies have reported that the incidence of urethral stricture is consistently over 90% after cystostomy, so the result of cystostomy is not the focus of this analysis. In Indian literature,

There are fewer studies about ESR in AUI than in PUI (5 vs. 11 studies). The success rate was high in two studies (60.8% and 81.5%), but was much worse in other two (18.2% and 0%). One study reported two cases of ED, while there were no reports of incontinence. Table 2 concluded the result of different emergency treatments opted in Indian literature. The average success rate of OR for PUI was 58.0% (0%-83.3%). Average ED rate was 6.9% (0%—12.6%), and overall

incontinence rate was 1.8% (0%-16.1%). The overall success rate of ESR in PUI is 57.0% (0%-88.9%). Overall ED rate was 4.4% (0%-9.7%), and three studies reported five cases of incontinence. In anterior urethra, 33 studies from Indian literature have overall success rate of 57.0%, but the success rate varied greatly. Ten studies reported no success, while some studies reported above 70%. ED and incontinence is not so frequent as in PUI (overall ED rate was only 1.3%, with no reports of incontinence). We found 13 studies about the primary repair of AUI in India. The results were quite consistent (Fig. 1A). The average success rate of primary repair was 85.6% (33.3%-92.3%), much higher than ESR. Major complications include ED (12 cases), infection (6 cases) and bleeding (2 cases). The only study about primary urethral repair in English literature reported similar success rate of 88.2% (Table 1). In both English and Indian literature, ESR in PUI had similar success rate (51.0% vs. 57.0%). But studies from other countries reported higher complication rate than in India (25.0% vs. 8.8%). The success rate of ESR in AUI was quite low in both India and other countries (Fig. 1B and 1C). However, the overall success rate was similar (57.0% vs. 61.1%). Primary repair of AUI had rather high success rate, close to that of delayed urethroplasty. Reported ED rate was no more than ESR, and there was no case of incontinence.

DISCUSSION

There are still some unsolved controversies in the diagnosis and treatment of UI. Published researches about emergency treatments of UI are mostly retrospective, and generally have low sample capacity. The European Association of Urology (EAU) has published its guideline of urethral injuries, but many of its suggested options only have evidence level II b or lower. As a result, many urologists are still treating UI with their own preferences. Here we will discuss the current trend of treating UI in India and compare its difference from the practices in other countries.

Diagnosis: Western urologists always regard retrograde urethrogram (RUG) as the gold standard of UI diagnosis. For any patient suspected of UI, the urologist would perform RUG first, and choose treatment based on RUG result. Literature published about UIs all mentioned that RUG served as the confirmative test. This could avoid the wrong diagnosis. The most important about RUG is judging the continuity of urethra, and choosing appropriate treatment accordingly. Indian urologists, on the other hand, usually do not perform emergency RUG for diagnosis. Only 15 of 66 studies used RUG for emergency diagnosis, and nine studies opposed performing emergency RUG. Their diagnosis of urethral trauma was mainly based on patient's history, symptoms and signs. Without RUG, foley catheter became their most important tool. When suspected of UI, if one can successfully pass a foley, other emergency interventions were usually unnecessary. There are many reasons why Indian urologists do not do emergency RUG. Firstly, most Indian hospitals have X-ray equipment, but its emergency use is usually limited to plain films. Secondly, the diagnostic value of RUG is dependent on the experience of operator and the training of technicians on RUG. Lastly, what Indian doctors worry the most is the risk of additional damage like contrast induced allergy, irritation, infection, fibrosis and fistula. But we could not find enough evidence to support this apprehensions. We did not find any research about the possibility of contrast media triggering

inflammation or infection, neither any report of such cases in India or other countries.

Treatment of PUI: Emergency treatment of PUI includes cystostomy and open/endoscopic realignment. In this, the opinions of Indian urologists are largely similar to their western companions. Their common beliefs are: 1) PUI patients should receive early open/endoscopic realignment if it is available; 2) If the patient shows significant hematoma or extravasation, or has concomitant rectal and bladder injury, open repair, debridement and realignment are necessary; 3) If the patient has unstable vital signs or has severe concomitant injury, emergency cystostomy should be done to temporally drain urine, and realignment could be done afterwards. Most of the studies about PUI in India mentioned these points. But in India, the choice could be limited by the experience of doctors and the equipment in local hospitals.

Open Realignment (OR) in PUI: In India, patients with acute UIs are usually referred to the nearest hospital. Such patients often have other concomitant injuries or even unstable vital signs, preventing the local hospital from transferring them to higher level hospitals. Emergency doctors of these hospitals often lack the experience of cystoscopic realignment. If the patient does not have any indication of open exploration, cystostomy is the optimum choice. One reason is that cystostomy is fast, safe and easy. Another reason is that the possible benefit of OR could not justify its additional trauma, since cystostomy and delayed urethroplasty also have rather high success rate. Severe hematoma, extravasation, penetrating injury of perineum or lower abdomen, bladder rupture and rectal injury are the indications of open exploration. If doctors decide to perform open surgery, they usually perform realignment at the same time. That is the main reason why there are still many reports about OR in India. We suggest that OR should no longer be used, as the additional damage to the bladder could not be justified. It should only be considered when the patient has bladder rupture that needs open repair. We also suggest that UI patients should be treated in special urethral centers. If the doctors in the local hospital are inexperienced in treating UIs and the patient cannot be safely transferred, cystostomy is the best choice.

Endoscopic Realignment (ESR) in PUI: In developed countries, OR is being replaced by endoscopic treatments, evidenced by the fact that not a single article about OR could be found in recent 10 years. If the urethra maintains some continuity, the operator usually has no difficulty passing the catheter using a single urethroscope, but many reports had mentioned that the ESR for complete posterior urethral injury was challenging. Complete rupture often has severe hematoma at the injured site that would affect the vision, and the two ends can move apart significantly. Many articles mentioned that under such circumstance, cystostomy would be necessary. Urologists from India and Western countries alike mentioned that ESR could not completely replace open surgery.

Outcome: The cumulative results of different PUI treatments are shown in Table 1 & 2. The results of three groups are similar: in English literature ESR had overall success rate of 51%; OR in India have overall success rate of 58.0%, and ESR 57.0%. We can see that in India, the success rate of OR has less deviation than ESR. We believe that the larger number of patients contributed to the less deviation. Researches about ESR of PUI from English literature have less deviation than

Indian reports while have similar patient numbers, possibly due to the uneven level of skill and experience of Indian doctors.

Complications: In English literature, studies of ESR of PUI had overall ED rate of 20%, but Indian studies about ESR had much lower ED rate (4.4%). We believe this difference is largely culture originated, as many Indian patients do not like reporting their sexual problem to doctors, and doctors often do not initiatively ask about patients' erectile function during interview. Indian studies about ESR only reported five cases (0.9%) of incontinence, but studies from other countries reported 9% incontinence. Based on the details of two groups, we assume that the selection of patients is the main reason. The endoscopic treatment of UIs is still a new procedure in India and many urologists are not so familiar with it. That makes Indian doctors perform ESR less frequently. As a result, patients who received ESR tend to be more stable and have less severe injury in India, but in other countries patients with more severe injury could receive ESR. That may contribute to higher complication rate in western studies. Compared to ESR, OR has more complications. In Indian literature, ED rate is 6.9% in OR patients and 4.4% in ESR patients, and incontinence rate is 1.8% and 0.9% respectively. During OR, blind probing of the posterior urethra with finger may disrupt the normal bladder neck and surrounding neurovascular bundle, increasing the risk of ED and incontinence. The minimally invasive ESR could avoid too much interruption of bladder neck and surrounding nerves, and thus can ameliorate such problems. The selection of patients could also be a reason. As mentioned before, Indian urologists tend to perform ESR in less severe patients, and patients who received OR often have severe symptoms and concomitant injury. Their ED or incontinence is likely caused by the initial trauma rather than the realignment operation. There are two comparative studies about OR and ESR in Indian literature. The two studies had similar patient groups while the patients with severe concomitant injury were excluded. These two studies both claimed OR had significantly longer operation time, more blood loss and longer hospital stay. Though there is still not enough evidence to evaluate complication rates, these studies together with English literature suggest that ESR is superior to OR under specified conditions.

Treatment of AUI: Blunt trauma of anterior urethra mostly affects the bulbar urethra, with straddle injury being the most common cause. Currently urologists have not reached an agreement in the treatment of AUI. The debate mainly focuses between cystostomy and ESR, with many supporters on preferring either treatment. Western urologists generally do not support primary repair for AUI, for they believe that blunt trauma of the anterior urethra always comes together with cavernous body contusion, making it hard to recognize normal mucosa and hard to dissect the broken ends of the urethra.

Primary Repair in AUI: In India, while in many hospitals cystostomy is the optimum choice for AUI (reason given before), some hospitals consider primary repair an option. Indian urologists have been performing it since late 1980s. It is deemed as a relatively simple operation and could be done in under experienced hands. Many urologists believe primary anastomosis is the optimum treatment of anterior, especially bulbar urethral trauma. From the literature published in India, primary anastomosis has the advantage of low stricture rate and short catheter draining time. Theoretically, local

hematoma and extravasation could be cleared during the operation and the injury site is fresh and scar-free, and thus could ensure higher success rate. With perineum incision, the bulbar urethra is rather easy to mobilize. Even when the urethra is completely ruptured, the proximal end of the broken urethra would not retract too much, and could be located without much mobilization. Usually there is no need to open the bladder for the probing of posterior urethra, as long as the proximal end could be located. Indian doctors do admit that this operation has its problems. The trauma site is not very stable. Inflammation, hematoma and swelling of damaged tissue will make it harder to recognize normal mucosa, often require longer dissection of broken ends, and increase blood loss. Poor local condition also demands more skill and experience than delayed urethroplasty. Open repair of AUI is often done without the confirmation of RUG. There is a possibility that a patient with minor partial rupture would receive open repair. One study reported three such cases, and that study is one of the few Indian studies that advocate emergency RUG. We found five studies that compared the result of primary repair and ESR for AUI, and their results were listed in Table 3. All studies pointed out that open repair has more blood loss, longer hospital stay, higher cost, and has complications like bleeding, ED and infection [69]. One of them found primary repair had lower success rate, while other four reported that primary surgery has better outcomes and significantly shorter draining time than ESR, especially for complete rupture. As a major operation, the result of primary repair should be compared with delayed urethroplasty. We did not find any such study in Indian literature, but there is a study from Korea that compared primary repair with delayed repair. That study reported that in AUI, primary repair had comparable result with delayed repair.

Endoscopic Realignment (ESR) in AUI: ESR works well in PUI with many supporting evidence. The data in table 1 & 2 confirms the same story. However, its effect on AUI is seriously doubted. Some reports stated ESR had significantly lower stricture rate than cystostomy, and those with stricture could be more often resolved by minimally invasive operations (like internal urethrotomy), greatly reducing the need of open urethroplasty. But there are also reports that have quite the opposite results: ESR has in fact higher stricture rate, requires higher rate of urethroplasty, and usually could not be solved by simple anastomosis, requiring need for flap or graft urethroplasty. Some believe the higher stricture rate is triggered by the catheter, which is a foreign body in the urethra. Some suggest that unlike posterior urethra, anterior urethra is enclosed in the cavernous body, and the broken urethra will not separate so much even after complete rupture, and stenting the urethra with a foley will not help reducing stricture length. As there is always cavernous contusion after blunt trauma of AUI, the stricture is caused by spongiofibrosis, different from posterior urethra. Currently there is not enough evidence for these theories, and the controversy remains unexplained. In India, in the last decade, endoscopic treatment of UI saw its wide use, especially in AUI, slowly replacing open cystostomy and primary repair. In the last decade in India, reports of ESR in AUI were twice of that of PUI (20 vs. 9). But its application has limitation too. Some studies reported that ESR would take longer time in some complete ruptures, and argue that one should shift to open repair should he have problems finding the distal end - similar to PUI. AUI patients have fewer complications than PUI. In Indian literature, ED rate of ESR in AUI is lower than in English literature, maybe

still due to cultural reasons. 14 Indian studies and five English studies about ESR in AUI, all reported no case of incontinence. The success rate distribution of the English studies is shown in Table 1. Most of the studies achieved good result. Some studies reported success rate over 90% and two studies even reported 100% success. But a few studies reported success rate lower than 30%. Ten of 49 researches even reported zero success rate. Two of them required the patients to receive persistent dilation, and in the rest eight studies most patients needed dilation because they developed significant dysuria after removing the catheter. This is somehow like the results in English literature, as two studies showed good results while the other two came up with the opposite conclusion.

Limitations: The most important limitation of this study is that all studies included were retrospective studies, as currently there are very few randomized-controlled study about urethral injury. That means we cannot obtain the detailed information about patients' history and treatment, and may affect the result. Another important limitation is that we did not analyze the factors that might affect the outcome of emergency treatment. These factors include the cause of injury, the severity of injury, the length of injured urethra, the presence of concomitant injury (like severe hematoma, local extravasation, rectum rupture, etc.), and so on. All these factors may influence the success rate of emergency treatment, but few of the studies included had reported the presence of these factors. That would inevitably influence the accuracy of this study. Lastly, the studies in English literature were from countries all over the world, and the studies in Indian literature also came from different parts of India. As patients in these studies were heterogeneous, many unknown factors might influence the result when they were joined together and compared in groups.

Conclusion

Emergency Urethral Injuries (UI) in India has some differences in management compared with Western countries. Most Indian urologists make diagnosis mainly basing on history and symptoms rather than urethrogram. Emergency Management is often limited by the equipment of hospital and the experience of the team. Many UI patients only receive cystostomy. Primary open repair of AUI is still an option in India. Application of ESR has more limitations in India and OR is still popular. In India ESR and OR of PUI have similar success rates but fewer complications, and the overall success rate is concordant with western studies, further justifying the application of ESR in PUI. Early repair of AUI appears to have good effect in India and may be worth promoting. Although having larger sample size, Indian studies about ESR in AUI still showed rather variable success rates like western reports (results from different studies varied greatly). The reason largely remains unknown. It is important for this patients with UI to be referred to special care centers where relevant infrastructure is available to treat these patients.

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