Sonourethrogramy Compared to Retrograde Urethrogramy

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〈국문초록〉
超音波 尿道 撮影術과 逆行性 尿道 撮影術의 放射線學科學的 比較

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臨床的으로 尿道  협착이나 누공이 怖心되어, 1988년 7月부터 1989年 6月中 慶尚大學校病院 및
忠南大學校病院 放射線科에서 逆行性 尿道 撮影術을 施行한 15名의 男子 患者를 對象으로, 尿道
카테터를 插入한 逆行性 尿道撮影術이 끝나자마자 그 카테터를 通해 逆行的으로 生理的 食鹽
水를 注入하면서, 혹은 排尿가 可能한 患者에서는 Eschmann clamp를 한 재로 小便으로 尿道を
擴張시키면서 先行의으로, 尿道의 超音波 検査を 實施하여, 二 放射線科學的 撮影術의 所見을 比
較 分析해보았다.

全例에서 尿道鏡 検査を 實施하였다.
超音波 尿道 撮影術 時 患者が 特別한 不便을 呼訴하지 않았다.

二例에서는 尿道を 切開하여 尿道 成形術 施行時 尿道 협착의 竄이를 실지 測定하였는데, 超音波
尿道 撮影術이 逆行性 尿道 撮影術보다 尿道 협착의 竄이를 더 正確하게 나타낼을 確認할
水があった.

超音波 尿道 撮影術으로 尿道壁의 織維化된 部分을 測定하여 尿道 협착의 程度를 分類할 수  있어
서, 內視鏡下の 內部 尿道 切開術 施行時 切開할 部位의 方向과 깊이에 關한 有益한 情報을 提供
할 수 있었다.

二例에서는 逆行性 尿道 撮影術로 正確한 診斷을 할 수 였던 尿道 및 尿道 周辺部의 病変을
超音波 尿道 撮影術로 手術 前에 診斷할 수  있었다.
交通事故 後 尿道 直腸 間  누공이 생겨 再次 手術했던 患者の 例에서는 아직도 남아있는 晴公을
兩側 検査法으로 모두 證明할 수  있었다.

骨盤骨 骨折後 膜性 尿道部 협착 周辺部의 甚だ 織維化を 手術하고 GRAFT를 냈던 환자에
Jong Chul Kim, et al.: Sonourethography Compared to Retrograde Urethrogram

Abstract

A total of 15 patients with suspected urethral stricture or fistula underwent conventional retrograde urethrography & following sonourethography with saline infusion or voiding against Eschmann penile clamp, in Gyeong sang & Chungnam National University Hospital from July, 1988 to June, 1989.

The sonographic findings were as diagnostic as the roentgen findings in 12 patients. When the length of the strictures assessed by each imaging modality was compared to measurement at open urothoplasty of 2 patients, sonourethography was consistently more accurate.

Urethroscope was done in all cases.

Sonourethography using distension technique of the urethra enabled classification of the degree of spongiosfibrosis, thus provided the guide ande of direct vision internal urethrotomy in 9 patients. In 2 patients, the sonourethrogram identified periurethral tumor & urethral polyp which were not definitely analysed on the retrograde urethrogram.

In the patient of posttraumatic postoperative urethrorectal fistula, residual fistulous tract was seen on both examinations.

In 1 patient of stricture with severe periurethral scar, urethral stricture recurred after graft. No patient reported significant discomfort during the sonourethrogram.

The sonourethrogram provided valuable, dynamic, 3-dimensional information about the luminal & extraluminal anatomy & pathology of the anterior urethra.

The new method of sonourethrogram allows for the appropriate decision to be made easier for optimal treatment of urethral stricture, etc., and can be used as a follow-up study.

Introduction

Simple roentgenographic techniques such as retrograde, or anterior urethrography, and voiding cystourethrography have been used as diagnostic imaging modalities of male urethra. But these methods have disadvantages such as radiation exposure to the testis, poor & variable definition of stricture length & depth or periurethral pathology, and poor analysis of interurethral filling defects.

Recently sonourethography with saline infusion has been tried by McAninch & associates1) and Merkle & Wagner2), etc. Considering its simple, repeatable, three dimensional dynamic property without radiation hazard, we have studied sonourethrogram just after retrograde urethrogram in patients complaning urethral stricture or urethral fistula, etc.

We report our experience with an ultrasound technique that outlines the luminal & extraluminal periurethral tissue structures, analysing two examinations.

Materials and Methods

We prospectively studied retrograde urethrogram & sonourethography of 15 patients com-
plaining urethral stricture, discomfort or fistula, in Gyeongsang & Chungnam National University Hospital, from July, 1988 to June, 1989.

Retrograde urethrography was done injecting 20–30 cc Angiographin' –310 (65 %) thru 7–12F Nelaton catheter located at distal urethra with Eschmann penile clamp at the corona, on both oblique positions. The catheter then remained in situ or changed by 12F Foley cather with baloon for sonourethrography. After application of ultrasonic gel to both dorsal & ventral surface of penis, scrotum & perineum, an electronically focused 7.5 or 10 MHz linear array transducer of Diasonic DRF–400 or Siemens Sonoline SL–2 was applied externally over the urethra. The transducer application site was mainly ventral adjusting to high frequency probe. With slow constant retrograde syringe injection of approximately 15–25 ml saline, the entire anterior urethra & periurethral structure could be evaluated, in supine position. If the patient can void with full continuous urinary stream, voiding sonourethrogram was possible, applying a Eschmann clamp at the corna to distend the urethra with urine. Multiple longitudinal & transverse scans were performed. The distal bulbar urethra was imaged transscrotally and the proximal bulbar urethra, membranous urethra or external spincter was imaged transperineally. The study was recorded with a multiformat camera and the videotape.

Findings of both examinations were analyzed & compared with operation or urethroscopic findings.

Stricture length was determined by direct measurement from the retrograde urethrography considering magnification rate, and by electronic caliper measurements from the sonourethograms. Strictures were characterized as focal if they were less than 1 cm in length, and diffuse if the length is more than 1 cm. The degree of stricture was classified as mild if AP diameter of the stricture is less than one third of the normal luminal diameter, moderate if within a third to half, and severe if more than half (Fig. 1).

During sonourethography, saline or urine leakage was scrutinized.

Urethroscopy was done in all cases.

In 2 cases who underwent open urethroplasty, the precise stricture length was measured during surgery & compared with the measurements obtained during retrograde urethrography & sonourethrography.

**NORMAL**

![NORMAL](image)

**MILD** < 1/3 Lumen occluded

![MILD](image)

**MODERATE** 1/3, 1/2 Lumen occluded

![MODERATE](image)

**SEVERE** >1/2 Lumen occluded

![SEVERE](image)

Fig. 1. Classification of urethral strictures based on sonographic appearance. ③)

**Results**

Normal retrograde urethrography and sonourethrogram were accomplished and reviewed in 5 normal volunteers of young males (Fig. 2). but not included in this study.
Twelve urethral strictures were diagnosed in 11 patients. Sonourethrogram classified only 10 strictures of anterior urethra: 3 strictures as mild, 3 as moderate and 4 as severe. Ten strictures were focal, while 2 were diffuse (Table 1, and Figs. 3 & 4). One patient had two separate areas of stricture. In the two patients who underwent urethroplasty, sonourethrogram was an accurate indicator of stricture length. Sonourethrogram was poor in posterior urethral image. Filling defect in penile urethra on retrograde urethrography could not differentiate that lesion, but sonourethrogram could identify the solid soft tissue nature of the mass and the stricture length exactly (Fig. 5). The mass was resected (confirmed as fibrous polyp) & end-to-end anastomosis of stricture segment was done. Sonourethrogram detected post-graft periurethral scarring in severe urethral stricture patient due to previous pelvic bone fracture.

In postoperative patient of posttraumatic urethrectal fistula, the residual fistulous tract was demonstrated on both imaging modalities (Fig. 6).

In 59 year old male patient who has complained voiding difficulty due to growing penile mass, retrograde urethrogram could not evaluate the periurethral penile mass, but sonourethrogram could evaluate the periurethral soft tissue mass and the exact length of urethral stricture. The penile

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Fig. 2. A. Normal retrograde urethrogram. B.C. Ventral longitudinal scan of penis using a 7.5 MHz probe. Retrograde infusion of saline outlines the easily distensible urethra (especially anterior urethra, filled with echoluent saline & urine and echogenic multiple small linear air bubbles). Periurethral structures (corpus spongiosum & cavernosum, etc.) are demonstrated well.

Fig. 3. Focal severe pendulous urethral stricture. Sonourethrogram (B) demonstrated more exact stricture length & degree of spongiosfibrosis (arrows: inelastic, nondistensible), compared with retrograde urethrogram (A).
mass was identified as non-Hodgkin's lymphoma on endoscopic biopsy. Sonography of other areas showed masses of rt. adrenal gland, peripheral portion of middle lobe of rt. lung, and base of the urinary bladder (Fig. 7).

Generally speaking, the correlation between retrograde urethrogram and sonourethrogram was poor, with the former usually underestimating the length of urethral stricture & not demonstrating the periurethral structures. To get good quality of retrograde urethrogram, multiple radiographs with additional radiation exposure were sometimes required, but the length of urethral stricture was not exact & constant due to patient position and magnification factors, etc.

The echogenic appearance of collagen tissue within the stricture did not allow ultrasound per se to distinguish between normal and involved corpus spongiosum. But, when the urethra was distended with saline or voiding urine the normal corpus

### Table 1. Comparison of Sonourethrogram with Retrograde Urethrogram

<table>
<thead>
<tr>
<th>Pt. Location No.</th>
<th>Sonourethrogram</th>
<th>Retrograde Urethrogram</th>
<th>Operative Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stricture Length(mm)</td>
<td>Diameter(mm)</td>
<td>Stricture Length(mm)</td>
</tr>
<tr>
<td>1. Penile</td>
<td>4.1 (Focal)</td>
<td>Moderate</td>
<td>4</td>
</tr>
<tr>
<td>2. Penile</td>
<td>9.5 (Focal)</td>
<td>Severe</td>
<td>9</td>
</tr>
<tr>
<td>3. Penile</td>
<td>9.5 (Focal)</td>
<td>Moderate</td>
<td>8.5</td>
</tr>
<tr>
<td>4. Penile</td>
<td>5 (Focal)</td>
<td>Mild</td>
<td>4.5</td>
</tr>
<tr>
<td>5. Bulb</td>
<td>8.9 (Focal)</td>
<td>Mild</td>
<td>9</td>
</tr>
<tr>
<td>6. Bulb</td>
<td>6 (Focal)</td>
<td>Moderate</td>
<td>5</td>
</tr>
<tr>
<td>7. Penile to membranous</td>
<td>79.2 (Diffuse)</td>
<td>Severe</td>
<td>70</td>
</tr>
<tr>
<td>8. Membranous</td>
<td>Poor</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>9. Membranous</td>
<td>Poor</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>10. Penile</td>
<td>8.3 (Focal)</td>
<td>Mild</td>
<td>9</td>
</tr>
<tr>
<td>11. Penile</td>
<td>104.5 (Diffuse)</td>
<td>Severe</td>
<td></td>
</tr>
<tr>
<td>12. Membranous</td>
<td>Urethrocetal fistula</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Prostatic</td>
<td>Normal ant. urethra</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Normal</td>
<td>Normal ant. urethra</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Normal</td>
<td>Normal ant. urethra</td>
<td></td>
<td></td>
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</tbody>
</table>
Fig. 4. Diffuse pendulous & focal membranous (arrows) urethral stricture. Sonourethrogram (B) correlates well with retrograde urethrogram (A), and demonstrates scarred collagen tissue around the stricture site.

Fig. 5. Fibrous polyp in anterior pendulous urethra causing urethral stricture. Retrograde urethrogram (A) demonstrates only nonradiopaque filling defect (curved arrow), but ventral transverse scan of sonourethrogram (B) demonstrates the soft tissue nature of this benign polyp (arrow).

Fig. 6. Both retrograde urethrogram (A) and sonourethrogram (B) identify the urethrorectal fistula at the membranous urethra portion. The real time sonourethrogram demonstrates abnormal flow pathway (arrow) behind the membranous urethra (recorded on videotapes).
Fig. 7. Non-Hodgkin's lymphoma involving anterior urethra (A,B.) causing diffuse urethral narrowing, base of urinary bladder (C) rt. adrenal gland & both kidneys (D), and middle lobe of rt. lung, etc.
Retrograde urethrogram only shows diffuse anterior urethral stricture (A), but sonourethrogram well demonstrates the periurethral etiology of urinary stricture (B).
Insonourethrogram (B), the entire anterior urethra was nearly collapsed showing only the echogenic air bubbles (arrows) in small amount of infused saline, due to surrounding diffuse lymphoma masses.

spongiosum was readily compressed(Fig. 2), while the collagen-laden & scarred stricture segment maintained a fixed non-compressable configuration(Fig. 3). So the classification of spongiosfibrosis was possible(Fig. 1).

Discussion

Recently the use of ultrasound to image the anterior urethra has been reported by McAninch & associates\(^1\), Merke & Wagner\(^2\), and Gluck & associates\(^3\) in the patients of urethral strictures, applying 5–7 MHz linear array transducer dorsally or ventrally. We used 7.5–10 MHz high frequency superficial linear transducer applying usually ventrally with good quality real time dynamic 3-dimensional image & simultaneous videotape recording. Sonourethrography was easier and repeatable in any direction during saline infusion or urination with Eschmann penile clamp at the corona, providing valuable information about the luminal & extraluminal anatomy or pathology of the anterior urethra. We found the sonourethrogram to be equally efficacious or superior as a diagnostic modality compared with retrograde urethrogram in all patients studied for urethral stricture, mass, fistula, etc.

The anterior urethra is defined as that portion of the urethra distal to the external urinary sphincter. Retrograde urethrogram visualize anterior & posterior urethra, but the strictures in the prostatic urethra are uncommon\(^5\).

Many of the strictures showed thickening consistent with scar tissue on the ventral aspect of the urethra, sometimes greater than the dorsal aspect. Intraoperative use of ultrasound may lead to more adequate incision for scar tissue.

The wall thickness (spongiosfibrosis) of the
urethra at the stricture site and the luminal size can be measured accurately, so the degree of urethral stricture and length can be classified. Luminal measurement is not always possible by retrograde urethrogram due to magnification, variable patient position, and different degree of urethral distension with contrast media. The pendulous urethra can be studied to the fossa navicularis, which is not usually possible with a retrograde urethrogram.

The sonourethrogram requires urethral distension with retrograde saline infusion or antegrade voiding against the Eschmann penile clamp. Because the urethral wall and corpus spongiosum normally are elastic even at lower intraluminal pressure, distended urethra will compress the normal spongiosum, but inelastic scarred wall of strictured urethra cannot be distended well due to their rich collagen content.

Excessive transducer pressure must be avoided to prevent false positive urethral stricture. Excessive overdistension of urethra should be avoided to prevent complications of bloody urethral discharge or urethral rupture on either retrograde urethrogram or sonourethrogram.

Pre-, intra- & post-operative sonourethrogram may be useful to localize the external urinary sphincter to guide cold-knife urethrotomy and calibrate the urethra to assess adequacy of incision, and predict the recurrence of postoperative urethral stricture at previous severe scarred site.

The sonourethrogram is simple, rapid to perform and comfortable, so its applicability will be expanded and may guide the operative method of anterior urethral disease.

REFERENCES