

Capacity of the Unused Bladder in End Stage Renal Disease

Atchara Mahayosnond MD*,
Sommanus Nilpetchploy MD*

* Department of Radiology, Faculty of Medicine, Chulalongkorn University

Objectives: To evaluate the bladder capacity in patients diagnosed with end stage renal disease (ESRD)

Material and Method: A six-month prospective study was conducted at the outpatient X-ray unit, Department of Radiology, King Chulalongkorn Memorial Hospital from July 2002 to January 2003. Datas from adult patients sent to the unit for voiding cystourethrography (VCUG) were collected. Bladder capacity was obtained by calculating the amount of contrast material introduced into the urinary bladder in each VCUG. The urinary bladder was assumed to be at the maximum capacity when the patient had a strong desire to void during contrast instillation. Patients with voiding dysfunction or neurogenic bladder were excluded from the present study.

Results: There were 11 patients with ESRD (male=7, female=4, mean age=41 years) and 7 patients without ESRD (male=1, female=6, mean age=41 years). The maximum bladder capacity was 400 ml for the ESRD patients and 500 ml for the non-ESRD patients. The smallest bladder capacity was 100 ml for the ESRD patients and 250 ml for the non-ESRD patients. The mean bladder capacity was 254.5 ml (\pm SD) for the patients with ESRD and was 364.28 ml for the patients without ESRD. The P-value was 0.043.

In conclusion, the mean bladder capacity of the patients with ESRD was statistically smaller than that of patients without ESRD.

Keywords: Bladder capacity, End stage renal disease, ESRD

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The voiding cystourethrography (VCUG) is one of the routine investigations in the potential renal transplant recipients. The main objective of VCUG is to detect the vesicoureteral reflux (VUR). The native kidney with VUR will be considered to be removed at the time of transplantation to prevent later infection and rejection⁽¹⁾.

Most of the patients diagnosed with end stage renal disease (ESRD) usually have a small amount of urine in the urinary bladder due to poor renal function and most of them usually have continuous long-term hemodialysis prior to renal transplantation. The urinary bladder in ESRD patients may be in the unused status and collapsed. The timing of the unused bladder is different in each patient depending on when they had renal transplantation. Recently, in Chulalongkorn Hospital, there were three cases with ESRD in whom there was extravasation of the contrast material during

VCUG performed prior to renal transplantation⁽²⁾. All extravasations were without symptoms and self-limiting without treatment.

Caroline et al reported self-limiting extravasation in the unused bladder in potential renal transplant recipients⁽³⁾. Eight cases from 321 patients had focal extravasation at the ureterovesical junction. Deborah L Day also reported the extravasation of contrast material from unused bladder during VCUG and noted that it may be owing to over distension⁽⁴⁾. Both studies mentioned mucosal injury of the unused bladder as probably one of the causes of extravasation. However, they did not mention the bladder volume at the time of leakage.

The authors' hypothesis is that the unused bladder might have some degree of contracted volume and is prone to be injured by over distension. The aim of the present study was to measure the capacity of the bladder in the ESRD patients and compare it with that of patients without ESRD.

Correspondence to : Mahayosnond A, Department of Radiology, Faculty of Medicine, Chulalongkorn University, Bangkok, 10330, Thailand.

Material and Method

This prospective study was conducted at the outpatient X-ray Unit, Department of Radiology, King Chulalongkorn Memorial Hospital, Bangkok, Thailand from July 2002 to January 2003. The authors collected the data from all adult VCUG performed during that 6-month study period. Patients with bladder dysfunction or neurogenic bladder were excluded from the present study. Bladder capacity was obtained by calculating the volume of contrast material introduced into the urinary bladder in each VCUG. The red rubber catheter was used for bladder catheterization. Five hundred ml of diluted contrast material (100 ml of 300 mgI/ml Ioxithalamate in 400 ml of NSS) was prepared for filling of the urinary bladder under gravity with the patient lying in supine position on the fluoroscopic table. The bottle containing contrast material was fixed at 70 cm above the fluoroscopic table. The urinary bladder was filled until there was a strong desire to void. At this point, the urinary bladder was assumed to be at the maximum capacity. Then the catheter was removed and the volume of infused contrast material was recorded. Fluoroscopic spot radiographs were obtained as routine for VCUG. An immediate overhead radiograph of the abdomen after voiding completed the examination. The volume of full-distended bladder or bladder capacity was obtained by subtracting the residual volume of contrast in the bottle after completion of bladder instillation from the prepared volume. Descriptive statistics : range, mean, SD were analyzed to describe the bladder capacity. Unpaired t-test was used to compare the mean bladder between the patients with ESRD and without. A p-value of less than 0.5 was considered significant.

Results

There were 18 patients included in the present study. Eleven patients were diagnosed with ESRD (male=7, female=4, mean age=41 years) Seven patients were without ESRD (male=1, female=6, mean age=41 years). Patients without ESRD were diagnosed with recurrent urinary tract infection, chronic pyelonephritis, abnormal vaginal discharge, duplex kidney with VUR, bilateral hydronephrosis and suspected urethral stricture. The bladder capacity and findings of VCUG in ESRD patients are summarized in Table 1 and that of patients without ESRD are in Table 2. The maximum bladder capacity was 400 ml for the ESRD patient and 500 ml for the non-ESRD patient. The smallest bladder capacity was 100 ml for the ESRD patient and 250 ml for the non-ESRD patient. The mean bladder capacity was

Table 1. Data of the ESRD patients concerning age, sex, bladder capacity and presence of associated VUR

Patient No.	Age (year)	Sex	Bladder capacity (ml)	Presence of VUR
1	18	male	150	no
2	46	male	200	no
3	48	male	150	Grade1, left
4	34	male	350	no
5	25	female	250	no
6	48	female	400	no
7	55	female	250	Grade1, right
8	48	male	350	no
9	39	female	400	no
10	59	male	200	no
11	33	male	100	Grade2, right
Mean	41		254.5	

Table 2. Datas of the patients without ESRD concerning age, sex, bladder capacity and presence of associated VUR

Patient No.	Age (year)	Sex	Bladder capacity (ml)	Presence of VUR
1	49	female	400	no
2	63	male	250	no
3	25	female	500	Grade4, left
				Grade2, right
4	64	female	250	no
5	40	female	400	no
6	22	female	450	Grade1, right
7	30	female	300	no
Mean	41		364.28	

254.5 ml for the patients with ESRD and was 364.28 ml for the patients without ESRD. There was a significant difference between mean bladder capacity in the patient with ESRD and without ESRD at the P-value = 0.043.

Discussion

Part of the present study that had the most critical concern was how to select the method for measuring the exact bladder capacity. Cystometry was accepted as a reliable technique for measuring the bladder capacity but it was more invasive and expensive. Ultrasonographic measurement using the software for calculating the volume of oval-shaped structure was a non-invasive technique and had a high accuracy. However, it was not practical for ESRD patients who almost always had a small amount of urine in their bladder and waiting for time to full bladder without bladder

catherization was not possible. The authors' method of bladder capacity measurement was applied from the routine technique for VCUg which was already requested in the ESRD and Non-ESRD study cases. The authors' technique was the same as that of JM Zerlin et al who studied the reliability of frequently used formula for calculating bladder capacity in children⁽⁵⁾. The authors thought that there may be some pitfalls in determining the point of full bladder. Since the urinary bladder was assumed to be in maximum capacity when there was a strong desire to void which was subjective and the threshold may vary from person to person. The authors also had a small number of cases in the limited study time. In conclusion, the authors found significant evidence of small bladder capacity in ESRD patients compared with non-ESRD patients. The authors suggested that radiologists performing VCUg should have awareness of small bladder capacity in patients with known ESRD to prevent over distension and extravasation.

References

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ความจุของกระเพาะปัสสาวะในผู้ป่วยไตวายระยะสุดท้าย

อัจฉรา มหายศนันท์, สมมนัส นิลเพชรพลอย

การศึกษานี้มีวัตถุประสงค์เพื่อหาค่าความจุของกระเพาะปัสสาวะในผู้ป่วยที่มีภาวะไตวายระยะสุดท้ายเป็นการศึกษาชนิดไปข้างหน้า เป็นระยะเวลา 6 เดือน ตั้งแต่กรกฎาคม พ.ศ. 2545 ถึงมกราคม พ.ศ. 2546 ที่แผนกเอกซเรย์ผู้ป่วยนอก โรงพยาบาลจุฬาลงกรณ์ โดยการบันทึกปริมาตรสูงสุดของสารทึบรังสี ที่ใส่เข้า กระเพาะปัสสาวะจนรู้สึกปวดปัสสาวะเต็มที่ในขณะที่ทำการตรวจ voiding cystourethrography ในผู้ป่วยที่มีภาวะไตวายระยะสุดท้ายเปรียบเทียบกับผู้ป่วยโรคอื่น ๆ ที่ไม่มีภาวะนี้ ผู้ป่วยที่มีความผิดปกติของระบบประสาทที่ควบคุม การทำงานของกระเพาะปัสสาวะ (Bladder dysfunction or neurogenic bladder) จะถูกตัดออกจากการศึกษานี้ ในช่วงเวลาของการศึกษามีผู้ป่วยทั้งหมด 18 ราย ประกอบด้วยผู้ป่วยไตวายระยะสุดท้าย 11 คน (ชาย 7 คน และ หญิง 4 คน มีอายุเฉลี่ย 41 ปี) และผู้ป่วยโรคอื่น ๆ 7 คน (ชาย 1 คน และหญิง 6 คนมีอายุเฉลี่ย 41 ปี) ผลการศึกษาพบว่าผู้ป่วยโรคไตวายระยะสุดท้ายมีค่าความจุของกระเพาะปัสสาวะสูงสุดเท่ากับ 400 มิลลิลิตรและต่ำสุดเท่ากับ 100 มิลลิลิตร ผู้ป่วยโรคอื่น ๆ มีค่าความจุของกระเพาะปัสสาวะสูงสุดเท่ากับ 500 มิลลิลิตรและต่ำสุดเท่ากับ 250 มิลลิลิตร ผู้ป่วยไตวายระยะสุดท้ายมีค่าเฉลี่ยความจุของกระเพาะปัสสาวะเท่ากับ 254.5 มิลลิลิตร และผู้ป่วยโรคอื่น ๆ มีค่าเฉลี่ยความจุของกระเพาะปัสสาวะเท่ากับ 364.28 มิลลิลิตร โดยมีค่า P-value เท่ากับ 0.043 ผลการศึกษาสรุปได้ว่าผู้ป่วยโรคไตวายระยะสุดท้ายมีค่าเฉลี่ย ความจุของกระเพาะปัสสาวะน้อยกว่าผู้ป่วยโรคอื่น ๆ ที่ไม่มีภาวะนี้อย่างมีนัยสำคัญทางสถิติ