Original Article

Incidence and risk factors associated with retrorenal colon

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Keywords:
Percutaneous nephrolithotomy, retrorenal colon, colon injury

Abstract

Objective: The aim of this research was to evaluate the incidence rate and risk factors of retrorenal colon in Thai patients.

Material and method: This research was an observational study. Data were collected from a review of CT whole abdomen performed on patients at Rajavithi Hospital aged 15 years or older, from 1 March 2016 – 31 December 2016.

Result: The total number of patients who underwent CT scan was 1,010 (male/ female= 49.2%/ 50.8%). Retrorenal colon was found in 73 patients (7.23%), including 32 patients (3.16%) on the right side, 50 patients (4.95%) on the left side, and 9 patients (0.89%) on both sides. Retrorenal colons were found more often on the left side than on the right side (5.0% vs 3.2%, p=0.04). Age had no impact on retrorenal colon. BMI had a statistically significant impact (p<0.01) on retrorenal colon incidence, 33.8% in underweight patients (BMI<18.5), 13.4% in patients with a normal weight (BMI18.5-22.9), 0.9% in patients who were overweight (BMI23-24.9), and 0.26% in obese patients (BMI>25).

Conclusion: CT scanning before PCNL in order to diagnose retrorenal colon is advantageous to persons with a low BMI, especially when access at the lower pole of the kidney is required.

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นิพนธ์ต้นฉบับ

อุบัติการณ์และปัจจัยที่มีผลต่อการพบภาวะลำไส้ใหญ่อยู่หลังต่อไต

กิตติพงศ์ เชาวรัตน์, เสริมสิน สินธุบดี, วรพจน์ ชุณหคล้าย, วิโรจน์ จิตต์แจ้ง, สมเกียรติ พุ่มไพศาลชัย, ณัฐพงศ์ วงศ์วัฒนาเสถียร, ธเนศ ไทยดำรงค์, ชววรรธน์ โกสีย์ศิริกุล, มัชฌิมา ฮวบกอง

หน่วยศัลยศาสตร์ระบบปัสสาวะ กลุ่มงานศัลยกรรม โรงพยาบาลราชวิถี กรุงเทพฯ

คำสำคัญ:
ภาวะลำไส้ใหญ่อยู่หลังต่อไต, ดัชนีมวลกาย, ผ่าตัดนิ่วไตด้วยวิธีส่องกล้องผ่านผิวหนัง

บทคัดย่อ

วัตถุประสงค์: ศึกษาหาอุบัติการณ์และปัจจัยเสี่ยงของการพบภาวะลำไส้ใหญ่อยู่หลังต่อไต

ผู้ป่วยและวิธีการศึกษา: งานวิจัยนี้ทำโดยการแปลผลการตรวจรังสีด้วยคอมพิวเตอร์ช่องท้อง (CT whole abdomen) ในผู้ป่วยอายุมากกว่า 15 ปีขึ้นไปที่เข้ารับการรักษาที่โรงพยาบาลราชวิถี ตั้งแต่วันที่ 1 มีนาคม 2559-31 ธันวาคม 2559

ผลการศึกษา: ผู้ป่วยได้รับการศึกษาวิจัยทั้งหมด 1,010 คน (ชาย ร้อยละ 49.2 และหญิง ร้อยละ 50.8) ภาวะลำไส้ใหญ่อยู่หลังต่อไต (retrorenal colon) พบทั้งหมด 73 ราย (ร้อยละ 7.23) พบข้างขวา 32 ราย (ร้อยละ 3.16) พบข้างซ้าย 50 ราย (ร้อยละ 4.95) และพบทั้งสองข้าง 9 ราย (ร้อยละ 0.89) ภาวะลำไส้ใหญ่อยู่หลังต่อไต (retrorenal colon) พบที่ไตซ้ายมากกว่าขวาอย่างมีนัยสำคัญ (ซ้าย ร้อยละ 5 และขวา ร้อยละ 3.3, p=0.04) อายุไม่มีผลต่อการพบภาวะลำไส้ใหญ่อยู่หลังต่อไต (retrorenal colon) ดัชนีมวลกาย (BMI) มีผลต่อการพบภาวะลำไส้ใหญ่อยู่หลังต่อไต (retrorenal colon)อย่างมีนัยสำคัญทางสถิติ (p<0.01) โดยพบร้อยละ 33.8 ในผู้ป่วยน้ำหนักน้อย (BMI<18.5) ร้อยละ 13.4 ในผู้ป่วยน้ำหนักปกติ (BMI 18.5-22.9) ร้อยละ 0.9 ในผู้ป่วยน้ำหนักเกินเกณฑ์ (BMI23-24.9) และพบเพียงร้อยละ 0.26 ในผู้ป่วยอ้วน (BMI>25)

สรุป: การตรวจรังสีด้วยคอมพิวเตอร์ช่องท้องเพื่อวินิจฉัยภาวะลำไส้ใหญ่อยู่หลังต่อไต ก่อนการผ่าตัดนิ่วไตด้วยวิธีส่องกล้องผ่านผิวหนัง ควรทำในผู้ป่วยที่มีดัชนีมวลกายน้อยโดยเฉพาะอย่างยิ่ง ในผู้ป่วยที่ต้องการจะแทงเข็มเข้าที่ท่อกรวยไตส่วนล่าง

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Introduction

At present, percutaneous nephrolithotomy (PCNL) is a standard treatment for renal stones applied worldwide, especially for patients with a large stone, hard stone, or stone at the lower pole of kidney.

General complications from PCNL are hemorrhage, urinary tract injury, sepsis and injuries to adjacent organs such as lung, intestine, and spleen[1]. Although colon injury is found infrequently, it is unfamiliar to the urologist and can lead to severe complications, such as peritonitis, sepsis, and renocolic fistula. Some patients with such symptoms need to be treated by exploratory laparotomy[2]. Chance of colon injury occurring during PCNL is approximately 0.2-1%[2-5]. Retrorenal colon is the main risk factor for colon injury from PCNL.

Incidence of retrorenal colon varies from 10-20% in the prone position, and 2-10% in the supine position[6-12]. The known significant risk factors for retrorenal colon are severe scoliosis, horseshoe kidney, previous abdominal or kidney surgery, old age, on the left side, and a low amount of perinephric fat[2,8,9]. However, the incidence and risk factors of retrorenal colon in the Thai population remain unknown. The computed tomography (CT) scan is the imaging of choice to delineate the position of the colon[13]. However, in Thailand, a CT scan is not performed on every patient before PNCL because of the high cost.

The aim of this research was to evaluate the incidence rate of retrorenal colon in Thai patients and the risk factors for retrorenal colon.

Material and method

This research was an observational study approved by the Rajavithi Hospital Ethics Committee. Data used were collected from the reviews of CT whole abdomen with contrast performed on all Southeast Asian patients aged 15 years or older in Rajavithi Hospital, from 1 March 2016 - 31 December 2016.

Exclusion criteria:

- Upper abdominal mass
- Hepatomegaly or spleenomegaly
- Ascites
- History of renal surgery or abdominal surgery
- Small kidney (less than 8 cm)
- Renal mass (more than 3 cm) or renal cyst (more than 3 cm)
- Congenital abnormality of the kidney (ectopic kidney, horseshoe kidney)
- Severe spinal deformity
- Insufficient data (either weight, height or age)

Two methods were used to identify retrorenal colon: first, we drew a line parallel to the horizontal plane through the posterior edge of each kidney. If any part of the colon extended posteriorly to this line, it was defined as retrorenal colon. The second method was described by Prassopoulos: we drew a line from the anterolateral edge of the vertebral body through the middle of the renal hilum and extended it to the abdominal wall. The presence of the colon medial to this line was regarded as retrorenal colon[14].

For this research, diagnosis of retrorenal colon was made when either of the mentioned methods was positive.

This research also studied the following factors: sex, age, and body mass index (BMI). In our research, BMI was categorized according to the WHO guidelines for obesity for Asian people[15].

Statistical analysis was performed using SPSS version 17. Comparison of categorical data was performed using the Chi-square test. Analysis of factors correlated to retrorenal colon was performed using Binary Logistic Regression. Relative risks were reported with OR (95% CI), and all tests were based on statistically significant levels at a p-value lower than 0.05.

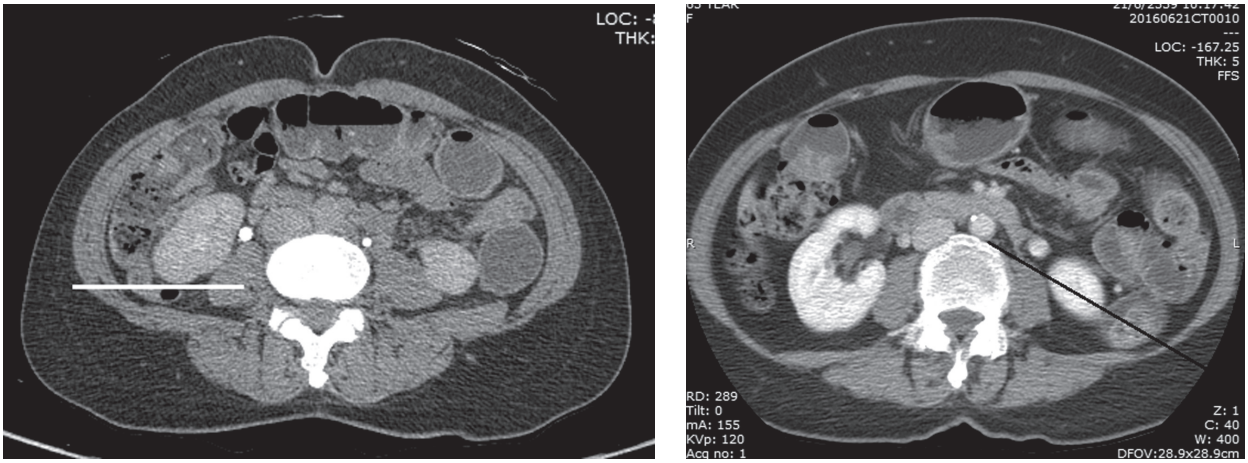

Figure 1: The colon extended posteriorly to the parallel line through the posterior edge of each kidney (A). The colon extended medially to the line from the anterolateral edge of the vertebral body through the middle of the renal hilum (B).

Results

From 1 March 2016 - 31 December 2016, there were 3,080 patients aged over 15 years who underwent CT whole abdomen with contrast in Rajavithi Hospital. After sorting the patients based on the exclusion criteria, there remained 1,010 patients: 497 (49.2%) were men, 513 (50.8%) were women; the average age was 53.45 years (SD 16.63), and average BMI was 24.29 (SD 4.52).

Retrorenal colon was found in 73 patients (7.23%), including 32 patients (3.16%) on the right side, 50 patients (4.95%) on the left side, and 9 patients (0.89%) on both sides. Retrorenal colon was found more regularly at the left kidney than the right kidney, with statistical significance (p=0.04). Retrorenal colon was found almost equally in males and females (7.4% vs 6.8%, p=0.7). Age had no impact on retrorenal colon incidence as it was found to be 6.8% in patients aged 15-60 years and 7.7% in patients aged over 60 years (p=0.62).

If categorized based on BMI: retroneral colon was found in 33.8% of the patients who were under-weight (BMI<18.5), 13.4% in patients with normal weight (BMI18.5-22.9), 0.9% in overweight patients (BMI23-24.9), and 0.26% in obese patients (BMI>25). The research found that BMI had a statistically significant impact (p<0.01) on retrorenal colon incidence.

Table 1. Dermographic data

		n = 1010
Age		53.45 (+/- 16.63)
Sex	- malr	497 (49.2%)
	- female	513 (50.8%)
Body mass index (BMI)		24.29 (+/-4.52)

Discussion

Nephrolithiasis is a common disease in Thailand, especially in the northeastern part. The current treatment for urinary stones has shifted from open surgery to minimally invasive treatments, such as extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL), and ureteroscopic lithotripsy (URSL). PCNL is the standard treatment for renal stones applied worldwide, especially in patients with large or hard stones, or stones at the lower pole of the kidney.

Table 2. Incidece and risk factor of retrorenal colon

		Retrorenal colon/all (%)	P-value
Age	15-59 yrs	44/631 (7.0%)	
	>60 yrs	29/379 (7.7%)	0.69
Sex	Male	37/497 (7.4%)	
	Female	36/513 (7.0%)	0.79
BMI	under weight (BMI<18.5)	24/71 (33.8%)	
	normal weight (BMI 18.5-22.9)	46/343 (13.4%)	
	over weight (BMI 23-24.9)	2/213 (0.9%)	
	obesity (BMI>25)	1/383 (0.26%)	<0.01
Side	Right retrorenal colon	32/1010 (3.2%)	
	Left retrorenal colon	50/1010 (5.0%)	0.042

In the past, intravenous pyelogram (IVP) was the main investigation before performing PCNL. However, at present, usage of the CT scan is prevalent and, therefore, some institutions perform CT scanning as a standard investigation before performing PCNL because the CT scan has advantages in its ability to evaluate not only the stone burden and anatomy of the renal collecting system, but also the adjacent organs. In 2016, AUA (American Urologic Association) published its guidelines strongly recommending that "clinicians should obtain a non-contrast CT scan on patients prior to performing PCNL[16]." However, the disadvantages of CT scans are the high amount of radiation exposure to patients and the high costs of the procedure; as a result, it is not possible for all patients in Thailand to undergo a CT scan before receiving PCNL.

Incidence of colon injury after PCNL is found at the rate of 0.2-1%. Extraperitoneal injury can be treated by conservative methods but intraperitoneal injury must be treated by laparotomy[13]. The risk factors for incidence of colon injury from PCNL include age over 60 years, previous kidney surgery, and congenital kidney abnormalities, such as horseshoe kidney and retrorenal colon. Incidence of retrorenal colon varies from 10-20% in the prone position, and 2-10% in the supine position. The significant factors for retrorenal colon are severe scoliosis, horseshoe kidney, previous abdominal or kidney surgery, old age, and a low amount of perinephric fat. Retrorenal colon is found more regularly on the left than the right side.

In 2015, Balasar and colleagues conducted a retrospective study on 394 patients who underwent

PCNL surgery with pre-screening CT scan[7]. They found that 27 patients (6.9%) had retrorenal colon at the lower pole, 18 patients (4.6%) on the left side, 4 patients (1.0%) on the right side, and 5 patients (1.3%) on both sides. In 2010, Chalasani and colleagues reported their results regarding the prevalence of retrorenal colon in 134 patients[9]. For male patients, retrorenal colon was found in 13.6% at the right kidney and 11.9% at the left kidney. For female patients, retrorenal colon was found in 13.4% at the right kidney and 26.2% at the left kidney. They concluded that retrorenal colon is found more often in females than males, and more regularly at the left kidney than the right kidney.

Hopper and colleagues (1987) reviewed the CT scans of 500 patients in the supine position and 90 patients in the prone position, and retrorenal colon was found 1.9% and 10%, respectively[17,18]. In 2015, Sharma and colleagues reported the results of a retrorenal colon study on 700 patients who underwent CT scan investigations; 300 patients had a CT scan in the supine position and another 350 patients in the prone position. Retrorenal colon was found in 7 patients (2%) in the supine position and in 24 (6.9%) in the prone position[8]. In total, 31 patients (4.4%) were found to have retrorenal colon: 20 patients (2.8%) at the left kidney, 6 patients (0.8%) at the right kidney, and 5 patients (0.7%) at both kidneys. Sorting based on age, it was found that most of the patients with retrorenal colon were aged over 50 years, as there were 22 patients aged over 50 years and the remaining 9 patients were aged under 50. They concluded that the significant factor for incidence of retrorenal colon is aged over 50 years; and retrorenal colon is usually found at the left kidney rather than the right kidney.

In 2013, Atar and colleagues studied retrorenal colon[6]. They decoded the CT abdomen results of 1,000 patients. Seventeen patients (1.7%) were found to have retrorenal colon: 12 patients at the left kidney, 3 patients at the right kidney, and 2 patients at both kidneys. Considering the incidence of position, 11 patients were found to have retrorenal colon at the lower pole, 2 patients at the middle pole, and 4 patients at the upper pole. In this research, the significant factor for incidence of retrorenal colon was the low quantity of perinephric fat. According to the data of the aforementioned 17 patients with retrorenal colon, 13 patients had a low quantity of perinephric fat, 4 patients had a middle quantity, and no patient had a high quantity. In 1984, Hadar and colleagues studied colon position and perinephric fat by performing CT scans on 140 patients. It was found that, for males, visceral fat and perinephric fat would increase in quantity together with their increased ages, thus their colon would be positioned anterior to the kidney; however, for females, when they get older, subcutaneous fat would increase but perinephric fat, compared to males, would not increase. Therefore, female colons were often found to be positioned lateral to the kidney[19].

In our study, 7.23% of the research population was found to have retrorenal colon. Sex was not a factor for incidence of retrorenal colon as 7.4% of our male subjects and 6.8% of our female subjects were found to have retrorenal colon (p=0.7). Past research determined that old age is correlated to retrorenal colon incidence; however, our study showed that age had no impact on retrorenal colon incidence as retrorenal colon was found in 6.8% patients aged 15-60 years and 7.7% in patients aged over 60 years (p=0.62). For the left and right kidney, many studies in the past found that retrorenal colon occurred more often at the left kidney than the right kidney. Our study had the same results: 31 patients (3.07%) were found to have retrorenal colon at the right kidney and 49 patients (4.85%) at the left kidney. According to statistical calculations, retrorenal colon was found at the left kidney more regularly than the right kidney, with statistical significance (p=0.04).

The next interesting factor is whether BMI has an impact on retrorenal colon or not. The study results show that patients with low BMI tend to have retrorenal

colon rather than those with high BMI, with statistical significance. Retrorenal colon was found in 33.8% of underweight patients, 13.4% of patients with normal weight, 0.9% of overweight patients, and 0.26% of obese patients. According to Hadar's report, it was found that the colons of persons with high perinephric fat tend to be anterior to the kidney, but those of persons with low perinephric fat tend to be lateral to the kidney and sometimes become a factor for retrorenal colon[19]. It is in the same way as the report by Atar, which found that persons with low perinephric fat tend to have retrorenal colon more frequently than those with high perinephric fat[6].

According to past studies, the incidence rate of retrorenal colon is much higher than colon injury from PCNL. There are many descriptive reasons for such matters. First, retrorenal colon is mostly found at the lower pole of the kidney; therefore, performing PCNL by gaining access at either the mid pole or upper pole of the kidney can greatly reduce the chance of colon injury. Second, retrorenal colon incidences reported in many studies are diagnosed with an axial view of the CT scan, which provides a less exact view than 3D analysis does; therefore, retrorenal colon found on the axial view might be higher than in actuality. In 2005, Tuttle and colleagues found that if making oblique parasagittal reformations on the CT scan image, retrorenal colon will be found only 3%, formerly 15%, in the prone position[20].

Colon injury from PCNL for persons with retrorenal colon can be prevented by using ultrasound-guided puncture or CT-guided puncture[21].

The limitation of this research: retrorenal colon was diagnosed using only the axial view of CT scans in the supine position, while most patients in Thailand receive PCNL treatment in the prone position.

Conclusion

Low BMI is the most significant risk factor for retrorenal colon. Retrorenal colon is usually found at the left kidney. CT scanning before PCNL in order to diagnose retrorenal colon is advantageous to persons with a low BMI, especially when access at the lower pole of the kidney is required.

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