

THE PREVALENCE OF RETRORENAL COLON AMONG COMPUTERIZED TOMOGRAPHY SCANNED PATIENTS

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ABSTRACT

Background: percutaneous nephrolithotomy (PCNL) is regarded as the treatment of choice for most renal stones larger than 2cm. Colon injury is one of the rare and preventable complications during PCNL. The rare and unusual location of the colon behind the kidney (retrorenal colon) is an anatomical predisposing factor and other factors that can result in colon perforation during PCNL.

Aim: To evaluate the prevalence of retrorenal and posterolateral colon and among CT scanned patients.

Patients and methods: one thousand CT scanned patients of all ages and both sexes were included and their CT images were evaluated prospectively at the CT scan center at Azadi Teaching Hospital for the presence of retrorenal colon and the relation of the colon to different parts of the kidney.

Results: In this study, 1000 CT scanned patients of different ages and both sexes were included. There were 522 males and 478 females; their ages ranged from 6 to 85 years. The overall prevalence of retrorenal colon was 7.5% (6.3% in males and 8.7% in females). The prevalence of retro renal colon according to different ages was: at below 10 y was 16%, 11-20 years 8.3%, 21-30 y 5.9 %, 31-40 y 7.2 %, 41-50y 7.2%, 51-60y 11.2%, 61-70y 5.8% 71-80y 7.2% and at 81-90 y was 9%, and the differences regarding the ages and sexes were statistically not significant. The lower pole of the left kidney is the most common part involved by the retrorenal colon in 70.6%, while the right lowers pole by 12%, the left middle part by 10.6%, and bilateral lower poles by 6.6%.

Conclusion: Locally, the prevalence of retrorenal colon is within the usual range with no sex or age predominance, and a pre-operative abdominal CT scan (native one) is a diagnostic one and is essential if left lower renal calyx is planned to be targeted to avoid colonic injury.

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Keywords: Colon injury, Retrorenal colon, Percutaneous nephrolithotomy,

The prevalence of retrorenal colon among computerized tomography scanned Patients

Urolithiasis is a worldwide problem, and due to its high prevalence and frequency of recurrence, more than a single surgical intervention may be needed. Historically, large kidney and ureteral stones were removed through open surgery (requiring a large flank incision) has been replaced by percutaneous nephrolithotomy (PCNL)

a minimally-invasive procedure to remove stones from the kidney by a small 1 cm puncture wound through the skin, and its regarded the gold standard procedure for the treatment of large and complex renal stones since its application in the early eighties for its cost-effectiveness, lower morbidity, shorter operative time and lower complications. The first successful renal stone extraction through the nephrostomy tract was performed in 1976

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by Fernström and Johansson¹.

As with any surgical procedure, there are risks and potential complications that are associated with PCNL, like bleeding, renal collecting system injury, visceral organ injury, pulmonary and thromboembolic complications, extrarenal stone migration, failure to achieve stone-free status, urosepsis, urine leak, and death. The complication rate for PCNL is as high as 83%, and most are minor. Major complications occur at a rate between 1.1% -7.0%, including colonic injury, which rarely occurs during PCNL (0.2%–0.8%)^{2,3}.

The colon is among the organs that has a non-constant anatomical relation to the lateral margins of the kidneys (especially to the lower pole of the left kidney), and in rare occasions related to the posterior surfaces (retrorenal colon), and colonic injury is classified as a grade IVa according to the Clavien-Dindo classification system, and it is of great significance, due to its diagnostic challenges as well as severe and fatal complications like septicemia, peritonitis, abscess formation, and nephrocolic or colocutaneous fistula².

In most studies, the most frequent etiology for colon perforation during PCNL is the retrorenal position; additional factors include renal anomalies such as horseshoe kidney, previous intestinal bypass surgery, female sex, elderly, thin patients, and colonic distension. The incidence of colonic injury is greater on the left side and when a more lateral puncture site used⁴⁻⁸.

Based on the computerized abdominal tomography (CT) scan, retrorenal colon is usually found in 0.9% to 16.1% of the

general population. This normal variation is higher in females, in the prone compared to the supine position, in the left rather than the right side, and higher to the lower than upper poles^{3, 9-11}.

The increasing use of multiphasic CT scanners has made it the main imaging preference in the diagnosis of renal stones (including the radiolucent ones) and to determine the stone location within the kidney and thus enables the most suitable track selection and the relationship of the kidney to the surrounding structures, and unsuspected retrorenal colon, so it will alert the endo-urologist to such anatomic colonic variant and helps in the planning of an approach that will avoid a potentially serious colonic complication^{5,12}.

Supine native CT is not accurate to plan PCNL access in the prone position. The prone decubitus is associated with more potential organ injuries in the upper pole. In supine, the kidney situates deeper in the abdomen, but the access angle is wider than in prone⁷.

Aim: To study the prevalence of retrorenal colon position among CT scanned patients locally.

PATIENTS AND METHODS:

A prospective cross-sectional study in the main CT scan center of the radiology department at Azadi-Teaching Hospital in Duhok province/ Iraq was done from September 2019 to May 2020. All patients of all ages and both sexes who were subjected to abdominal CT scan imaging for any indication were included in the study and supine position only after giving consent. CT scans were carried out using 64- and 16-detector CT devices (Philips, Eindhoven, The Netherlands). The dose

parameters for CT were chosen as 250 mAS and 120 kV. The pitch value was 0.92; rotation time was 0.75 s, and the collimation was 64 90.625. The evaluations were carried out on the axial reconstructed images at the workstation. Besides the axial plane, reformatted images on the coronal and sagittal planes were also used. An evaluation was performed using a workstation (View Pro-X version3.0, Rogan-Delft, Veenendaal, The Netherlands) on multi-planar reconstructed images. Any patients with congenital renal anomaly, spinal deformity, ascites, or large abdominal pathology detected in CT scan were excluded from the study.

The anatomic relation of the colon to different levels of both kidneys was evaluated in relation to different age groups, both sexes, and the presence of congenital or acquired pathologies. Retrorenal colon is regarded as partial when any part of the colon is seen crossing the imaginary horizontal line between the posterior surfaces of both kidneys, and a complete one when part of the colon is located behind the kidney and totally separates the kidney from the posterior abdominal wall (fig 1). Fisher exact test was used to evaluate the difference significance between age groups and sexes.

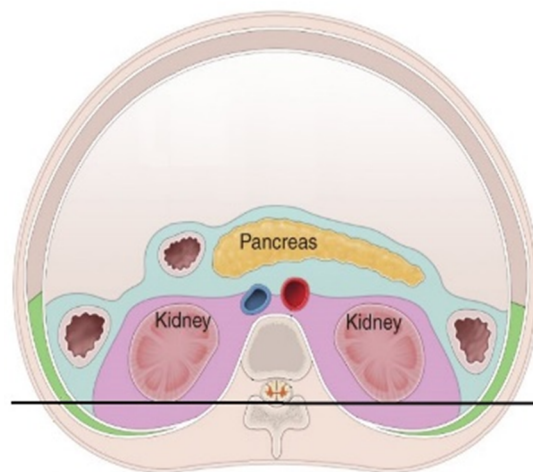


Figure (1): The imaginary line between the posterior surfaces of both kidneys to mark the retrorenal colon position

RESULTS:

In this study, 1000 patients of different ages and both sexes underwent CT scans for different urological and non-urological conditions. There were 522 males and 478 females, and their ages ranged from 6 to 85 years.

The overall prevalence of retrorenal colon was 7.5% (6.3% in males and 8.7% in females). The prevalence of retro renal colon according to different ages was: below 10 y was 16%, 11-20 years 8.3 %, 21-30 y 5.9 %, 31-40 y 7.2 %, 41-50y 7.2%, 51-60y 11.2%, 61-70y 5.8% 71-80y 7.2% and at 81-90 y was 9%. The highest rate of retrorenal colon seen in females in the age group of 51-60 years (6.4%), and the differences regarding the ages and sexes were statistically nonsignificant (Table 1). The lower pole of the left kidney was the commonest part involved by the retrorenal colon in 70.6%, while the right lower pole by 12%, the left middle part by 10.6%, and bilateral lower poles by 6.6%. partial retrorenal colon in 71(94.6%) and complete one in 4 (5.3%) (Table 2).

THE PREVALENCE OF RETRORENAL COLON AMONG COMPUTERIZED

Table 1: distribution of retrorenal colon among scanned patients in regard to age and sex

Scanned ages group	N	Scanned patients sex		Sex related retrorenal colon*				Retrorenal colon	
		Male	Female	Male		Female		N	%
				No	%	No	%		
6-10	6	2	4	0	0	1	16	1	16
11-20	84	50	34	5	5.9	2	2.3	7	8.3
21-30	184	96	88	5	2.7	6	3.2	11	5.9
31-40	194	94	100	7	3.6	7	3.6	14	7.2
41-50	206	117	89	5	2.4	10	4.8	15	7.2
51-60	124	64	60	6	4.8	8	6.4	14	11.2
61- 70	136	74	62	3	2.2	5	3.6	8	5.8
71-80	55	22	33	2	3.6	2	3.6	4	7.2
81-90	11	3	8	0	0	1	9	1	9
Total	1000	522	478	33	6.3%	42	8.7%	75	7.5%

* P = 0.847 (based on Fisher's exact test)

Table 2: distribution of retrorenal colon in relation to the kidney parts.

Right kidney			Left kidney			Bilateral	Partial	Complete
Upper	Middle	Lower	Upper	Middle	Lower	Lower poles		
0	0	9	0	8	53	5	71	4

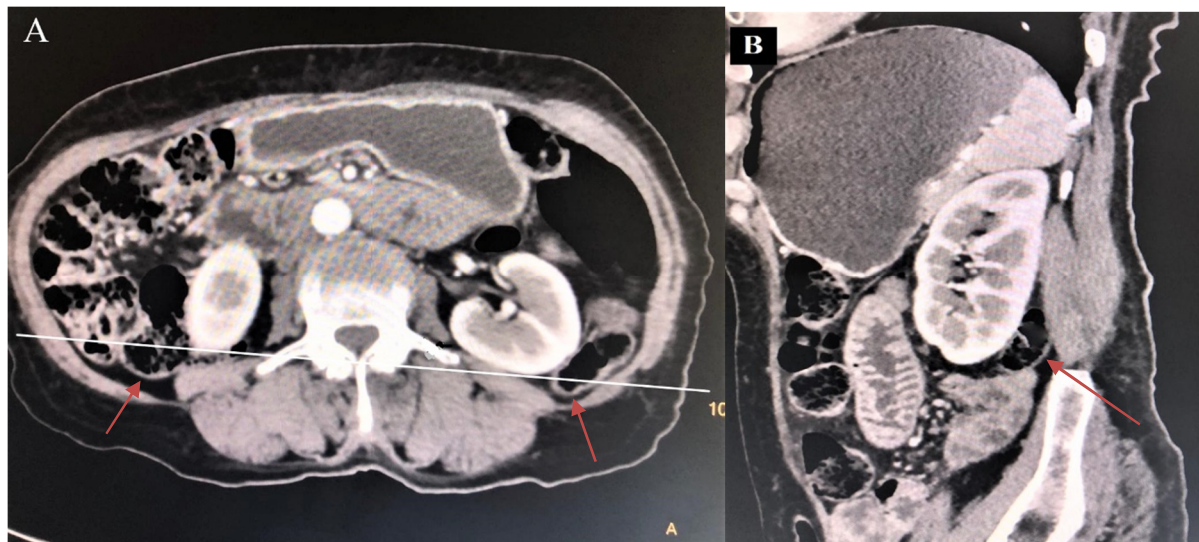


Figure 2: CT images of retrorenal colon: A, Cross section CT shows the bilateral posterior location of the colon to the line drawn between the posterior surfaces of both kidneys. B, Sagittal section CT image shows the posterior position of the colon to the lower pole of the kidney.

DISCUSSION:

The success of any surgical procedure depends on the effectiveness of dealing with the pathology and with minimal morbidity. As there is no single surgical procedure without possible complications, the ones with the least complications will generally gain acceptance. Since the introduction of percutaneous renal surgery forty years ago, the continuous evolvement of the procedure is taken place through miniaturizing the standard size of 24-30 Fr to the mini and ultra-mini one¹¹⁻¹³ Fr to minimize the renal tissue damage, the replacement of fluoroscopy by ultrasound to access the pelvicalyceal system to minimize the hazard of radiation exposure to the patient and operating personnel and the patient positioning during the procedure from prone to supine or oblique to ease the patient position for less anesthetic complications, to shorten the operation time and to decrease the chance of colonic injury as the colon changes its relation to the kidney with patient position^{13,14}.

Despite the invasiveness of the PCNL procedure the colonic injury is a rare (0.2%) but it is a serious one and every effort should be made to avoid colonic injury.

In this study, we tried to evaluate the relation of the ascending and descending colon (hepatic or splenic flexure) to the right and left kidney, and the prevalence of the unusual position of the colon behind the kidney among CT scanned patients to avoid its injury during percutaneous renal procedures or biopsy. The overall prevalence of retrorenal colon in the general population shows to be variable in

regard to age and sex in different studies, from 0.6% to 16.1%^{9, 15-17}.

Generally, in the young group, the position of the colon is similar in both genders, with the increase in age; the colon is displaced anteriorly in men, whereas it kept its lateral position in women. The retrocolon in our study was more prevalent in females than males (8.7% vs. 6.3%), but it was statistically not significant. Two factors have determined this situation, first colon ontogenesis, a long mesocolon, allowing the colon to pass behind the kidneys, and second, the mechanical factor of increasing peri-renal fat with aging may be a limiting factor for retrorenal colon displacement^{15, 18, 19}.

According to different studies, including ours, the lower pole of the left kidney was the commonest part of the kidney involved by the retrorenal colon position, so the exclusion of the retrorenal colon is essential in any patient when the left kidney is accessed through its lower pole. Boom et al in reviewing CT images of his PCNL patients showed that the left colon was posterior in 16.1% of cases, and the right colon was posterior in 9% of cases at the level of the lower pole^{9, 12}.

Although the prone position CT scan has not been done in this study, other studies showed the prevalence of retrorenal colon in prone position is five folds more than in supine position 10% and 1.9% respectively as prone positioning results in a more gas-distended colon, so the trend now is toward changing the patient position during PCNL to supine one to decrease the positional retrorenal position and hence decreasing the possibility of colonic injury^{10, 17}.

In the other hand, in a meta-analysis of the supine vs. prone PCNL, the incidence of colon injury in the prone position was estimated to be 0.2–0.5%. The rate of colonic injury in supine PCNL from comparative studies was \approx 0.5%, similar to the rate in other reports of prone PCNL, concluding that supine PCNL does not increase the risk of colonic injury. In contrast, Marchini et al.⁸ concluded that supine CT is not suitable for prone PCNL as the kidneys are located deeper, resulting in a higher chance for colonic injury^{8,16,20,21}.

In conclusion, a locally retrorenal colon is a rare anatomical position but within the normal range, and low-dose and cost-effective CT should be performed to avoid colon injuries as it provides an excellent representation of the kidney anatomy and other risk factors predisposing to colonic injury while planning a PCNL intervention. A prone position CT study is needed because PCNL is usually performed in the prone position.

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پوخته

بلاڤ بوون وریژا کۆلونا د کهڤیته پشت گولچیسکا لنگ نهخوشیت تیشکا کومپیوتهری بو هاتیته گرتن

پیشهکی: شکاندنا بهرکیت گولچیسکا د ریکا بیستی را تیتته ههژمارتن وهک چارهسهریا ههلیژاری بو بارا پتری بهرکیت گولچیسکا کو مهزنترین ژ ۲ سم، وبریندار بوونا کۆلونی ئیکه ژ ئالوزیت دهگمهن ریددهت و دشیان دایه بیته پاراستن لدهمی بهرک شکاندنی. جهی نه ئاسایی یی کۆلونی لپشت گولچیسکا ئیکه ژ فاکتهریت کهلاشتنی بیته سهپاندی ژبلی چهند فاکتهرهکیت دی کو دبنه ئهگهرا کونکرنا کۆلونی لدهمی قی کریار ئی

مههم: ههلسهنگاندنا ههبوونا کۆلونا پشت گولچیسکا ل نک نهخوشیت تیشکا کومپیوتهری بو هاتیته نهجام دازین.

ریکتن فهکولینی: هزار نهخوشیت کوتیشکا کومپیوتهری بو هاتیته نهجام دان کو ژ گشت تههمنا و ههردوک رهگهزا لگه ل ههلسه نگاندا وینی تیشکا و ا لسه نتهری تیشکا نهخوشخانا نازادی یا فیرکرنی دا کو دیارکه ن ههبوونا کۆلونا پشت گولچیسکا و پهیمندی یا کۆلونی لگه ل گولچیسکا.

نهجام: دق قه کۆلینی دا هزار تیشکیت کومپیوتهری بو بو هند نهخوشا کو ژ ته مهنیت جدا جدا بوون و ژ ههردوک رهگهزا بوون، ژوانا 522 نیر و 478 می و تههمن دناڤ بهرا 6-85 سالادا بوون، پهیدا بوونا گشتی یا کۆلونا پشت گولچیسکا 7.5% بو (6.3% لنگ نیرا و 8.7% لنگ می یا) نهف دیارده لگور تههمنیت جدا جدا (تا ۱۰ سال ۱۶%، ۱۱-۲۰ سال ۸،۳%، ۲۱-۳۰ سال ۵،۹%، ۳۱-۴۰ سال ۷،۲%، ۴۱-۵۰ سال ۷،۲%، ۵۱-۶۰ سال ۱۱،۲%، ۶۱-۷۰ سال ۵،۸%، ۷۱-۸۰ سال ۷،۲%، ۸۱-۹۰ سال ۹%) و جیاوازی لگورهی تههمن و رهگهزی نههاتنه دیتن ژ بو ههژمارتنی بگرنگی. جهمسهری خاری یی گولچیسکا چهپی بارا پتری وئ پارچه دهاته وهرگرتن کو کۆلون دکهفته پشت گولچیسکا ۶،۷۰% بو بهلن پارچه یاجهمسهری خاری یاگولچیسکا راستی ۱۲% بو وپارچه نیفهکی یا چهپی ۱۰،۶% و جهمسهری خاری ههردو ۶،۶% بو

دهنهجام: لهجوهی. ههبوونا قی دیاردی یا لئاستی نورمال و نهتههمن و نههگهز ژ چ سهرکیشی بکهتو تیشکا کومپیوته ری یا هنافا یا بهری نشتهرگهزی یا ساده و بهجی ژ بو ده ستنیشانکرنی یه و یا گرنگه و فره ههکه قاما خاری یا چهپی یا کالسیا گولچیسکا بیته نیشان کرن دا بریندار بوونا کۆلونی بیته پاراستن.

الخلاصة

معدل إنتشار القولون خلف الكلوي بفحص المفراس

الخلفية والأهداف: إستخراج حصة الكلية عن طريق الجلد تعتبر الطريقة الحديثة الأمثل لعلاج الحصيات أكبر من 2سم، وإنتقاب القولون هو أحد الإختلاطات النادرة والتي يمكن تجنبها أثناء العملية. وموقع القولون خلف أو جانب الكلية هو أحد العوامل المؤدية لحدوث مثل هذه الإختلاطات أثناء العملية إضافة إلى عوامل أخرى. دراسة معدل إنتشار وجود القولون خلف وجانب الكلية عند المرضى الذين تم فحصهم بالمفراس.

طرق البحث: دراسة مستقبلية ل (1000) مريض من كافة الأعمار وكلا الجنسين تم إخضاعهم لفحص مفراس البطن لأسباب مختلفة لدراسة وجود القولون خلف الكلوي وعلاقة القولون بأقسام الكلية في مستشفى آزادي التعليمي بمحافظة دهبوك.

النتائج: العينة التي تم دراستها تضمنت ألف مريض تراوحت أعمارهم من 6-85 سنة ومن كلا الجنسين حيث كان هناك 522 ذكر و 478 أنثى. أظهرت الدراسة إنتشار القولون خلف الكلوي بمعدل 7.5% (6.3% عند الذكور و 8.7% عند الإناث) وبنسب موزعة على الأعمار على النحو التالي: أقل من 10 سنة 16% ، 11-20 سنة 8.3% ، 21-30 سنة 5.9% ، 31-40 سنة 7.2% ، 41-50 سنة 7.2% ، 51-60 سنة 11.2% ، 61-70 سنة 5.8% ، 71-80 سنة 7.2% ، 81-90 سنة 9% ولم يتبين أي أهمية احصائية في إختلاف النسب من ناحية العمر والجنس. كما أظهرت الدراسة وجود القولون خلف الكلية ذو علاقة مع القطب السفلي للكلية اليسرى بنسبة 70.6% ومع القطب السفلي للكلية اليمنى بنسبة 12% والجزء الوسطي للكلية اليسرى بنسبة 10.6% والقطب السفلي للكليتين في نفس المرضى بنسبة 6.6%

الاستنتاجات: معدل إنتشار وجود القولون خلف الكلية كانت ضمن المعدلات الإعتيادية عند المرضى محليا ولا توجد أهمية إحصائية من ناحية العمر والجنس، والمسح بالمفراس يشخص الحالة ويعتبر ضروريا خاصة اذا كان القطب السفلي للكلية اليسرى ضمن مسلك التداخل الجراحي.