



The renal resistive index as a predictor of acute hydronephrosis in patients with renal colic

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KEYWORDS

Renal colic;
Hydronephrosis;
Renal color Doppler
ultrasound;
Renal resistive index.

Abstract *Introduction:* The objective of this study was to determine whether the renal resistive index (RI) can predict hydronephrosis in patients with renal colic (RC) and whether or not its performance is time-dependent.

Materials and methods: The study population was composed of 54 patients admitted for unilateral RC. At the time of the first observation (time point I, tpI), each patient underwent routine examinations, abdominal ultrasonography, and renal color Doppler ultrasound (CDUS) with measurement of the RI. The two imaging studies were repeated 6, 12, 18, 24, 36, and 48 h later (tpII, tpIII, tpIV, tpV, tpVI, tpVII). In addition, each patient underwent non-contrast urinary tract CT 48–60 h after admission. A mean renal RI of >0.70 (mRI+) for the symptomatic kidney was considered indicative of obstruction. Patients were retrospectively divided into two groups: those who developed dilatation (group A) and those who did not (group B).

Results: A mRI+ on CDUS predicted the onset of hydronephrosis with 100% sensitivity, 84% specificity, 92.6% accuracy, PPV and NPV of 87.9% and 100%, and diagnostic efficiency of 84%. In group A, mRI+ were always observed before onset of hydronephrosis in a time-dependent manner. In group B, mRI+ were observed occasionally in 4/25 patients (16%) and all were recorded at tpII. In these cases, the RI had returned to normal by tpIII.

Conclusions: In our RC patients, renal RI obtained with CDUS predicted the onset of acute dilatation with higher sensitivity, specificity, accuracy, and diagnostic efficiency than ultrasonography, and it can be used routinely in the emergency department to supplement ultrasound findings.

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Sommario *Introduzione:* Obiettivo di questo studio è stato verificare se l'Indice di Resistenza Renale (IR) possa essere considerato un parametro predittivo dell'insorgenza dell'idronefrosi (IN) in caso di colica renale (CR) monolaterale e se esso è tempo correlato.

Materiali e metodi: Lo studio ha incluso 54 pazienti ricoverati per CR monolaterale. Al momento della prima osservazione (time point I) tutti i pazienti sono stati sottoposti a esami routinari, a Ecografia addome e a Eco color Doppler renale (ECD) bilaterale con misurazione dell'IR. Dopo 6 (tpII), 12 (tpIII), 18 (tpIV), 24 (tpV), 36 (tpVI) e 48 (tpVII) ore è stata ripetuta l'ecografia dell'apparato urinario e l'ECD con la misurazione bilaterale dell'IR. A 48–60 ore dal ricovero inoltre tutti i pazienti sono stati sottoposti a TC dell'apparato urinario senza mezzo di contrasto. Un valore medio di IR maggiore di 0,70 (mRI+) a livello del rene sintomatico è stato considerato come suggestivo di ostruzione. I pazienti, in relazione allo sviluppo di IN, sono stati suddivisi a posteriori in gruppo A (dilatazione presente) e B (dilatazione assente). *Risultati:* L'ECD con il rilevamento dei valori mRI+ ha mostrato un significativo valore diagnostico relativamente all'insorgenza dell'IN con una sensibilità del 100%, specificità 84%, accuratezza 92,6%, VPP 87,9%, VPN 100% ed efficienza diagnostica 84%. Inoltre, nel gruppo A, i valori mRI+ sono stati registrati sempre precocemente rispetto all'insorgenza dell'idronefrosi e in modo tempo correlato. Anche nel gruppo B sono stati registrati alcuni mRI+, ma solo in 4/25 pazienti (16%) e tutti al time point II; in questi casi comunque i valori di mRI sono rientrati nei range della normalità già nel time point successivo.

Conclusioni: Nel nostro studio l'ECD con la misurazione dell'IR si è dimostrato capace di diagnosticare anticipatamente l'insorgenza della dilatazione acuta con livelli di sensibilità, specificità, accuratezza ed efficienza diagnostica superiori all'ecografia; si può prospettare quindi il suo impiego routinario nei reparti di emergenza ad integrazione dell'ecografia.

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Introduction

Renal colic (RC) is one of the most common conditions seen in the emergency department (ED). The frequency of RC in the general population ranges from 2% to 12%, and it accounts for 30–35% of all urological emergencies. The incidence is higher in men (10–20% vs 3–5% in women), and 30–40% of all patients experience symptomatic recurrence within 5 years [1–3]. In most cases, the colic is caused by ureteral spasm in response to the passage of a calculus, but in rare cases the pain stems from the transit of a blood clot (secondary to trauma or neoplastic disease), fibrin (caused by infection), tissue fragments (urinary tract tumors or acute renal necrosis), or other factors [4,5].

Regardless of the cause, patients with RC are at risk for acute urinary obstruction (partial or complete) leading to hydronephrosis. The frequency of this complication ranges from 33% to 68.3% [6–9]. Hydronephrosis is a serious clinical problem because it can produce progressive deterioration of renal function over time [10]. If the obstruction is caused by urolithiasis, spontaneous resolution can occur, more or less rapidly. The frequency of this outcome depends on the size of the stone. If the latter is less than 2 mm in diameter, all cases generally resolve spontaneously within 4 weeks; the frequency drops to 80% for calculi 2–4 mm, to 50% for those 4–6 mm, and to 10% for those larger than 6 mm. If the calculus has not been expelled after 4–5 weeks, renal function impairment can become severe and sometime irreversible [11]. For this reason, the obstruction needs to be diagnosed and treated as soon as possible. Some studies have shown that dilatation may be

absent in the early phases of renal colic, especially in dehydrated patients (30% of all cases), and this can lead to misdiagnosis [12].

The imaging studies most frequently ordered in the ED for patients with renal colic are plain abdominal radiography and ultrasonography; urography, CT, and MRI are considered second-line studies. The advantages, limitations, and sensitivity/specificity of each of these methods in identifying the cause, site, and degree of obstruction have been well documented in the literature. Plain films alone of the urinary tract are of limited value in identifying ureteral calculi (sensitivity 53–62%, specificity 67–69%) [13,14]. Urography has a sensitivity of 87% and specificity of 94% [15,16], but most authors do not feel that it is useful in the acute phase of RC, particularly in view of the risks it entails and its contraindications (renal failure, dehydration, allergy to contrast material, pregnancy). For this reason, they prefer to use urography more selectively as a second-level study for cases that cannot be diagnosed with other means [17]. CT without contrast enhancement has excellent sensitivity (91–100%) and specificity (91–97%) [18,19], and it is undoubtedly the examination of choice when RC is suspected because it reduces assessment times and allows the physician to identify other causes of the patient's pain [20,21]. In fact, in 57% of the patients whose CTs are negative for urinary calculi, other lesions are discovered (aneurysms of the abdominal aorta, appendicitis, diverticulitis, bladder tumors). A major drawback to the use of CT is the radiation exposure it causes, which makes it unsuitable for monitoring purposes [22,23]. In addition, calculi that are not radiopaque and those smaller than 3 mm are difficult to

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