

The Clinical Spectrum of Acute Renal Infarction

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Abstract

Background: Acute renal infarction is an oft-missed diagnosis. As a result, its true incidence, although presumed to be low, is actually unknown. Surprisingly, the medical literature on the subject, other than anecdotal case reports, is scarce.

Objectives: To increase physician awareness of the diagnosis and to identify predictive clinical and laboratory features of the entity.

Method: Between 1 November 1997 and 31 October 2000, 11 cases of acute renal infarction in 10 patients were diagnosed in our center by contrast-enhanced computerized tomography. The medical charts of these patients were reviewed regarding risk factors, clinical presentation, possible predictive laboratory examinations, and outcome.

Results: During the 36 month observation period, the incidence of acute renal infarction was 0.007%. The mean age of the patients (5 men and 5 women) was 67.4 ± 21.1 (range 30–87 years). In four cases the right and in five the left kidney was involved; in the other two cases bilateral involvement was seen. In 7/10 patients, an increased risk for thromboembolic events was found. Six had chronic atrial fibrillation and one had a combined activated protein C resistance and protein S deficiency. Three patients had suffered a previous thromboembolic event. Two cases were receiving anticoagulant therapy with an INR of 1.6 and 1.8, respectively. On admission, flank pain was recorded in 10/11, fever in 5 and nausea/vomiting in 4 cases. Hematuria was detected in urine reagent strips in all cases. Serum lactate dehydrogenase and white blood cell count were elevated in all cases ($1,570 \pm 703$ IU/L and $12,988 \pm 3,841/\mu\text{l}$, respectively). In no case was the diagnosis of acute renal infarction initially entertained. The working diagnoses were renal colic in 2, pyelonephritis in 3, renal carcinoma, digitalis intoxication, and suspected endocarditis in one patient each, and an acute abdomen in 3. Time from admission to definitive CT diagnosis ranged from 24 hours to 6 days. Three patients were treated with intravenous heparin and another with a combination of IV heparin and renal intra-arterial urokinase infusion with, in the latter case, no recovery of function of the affected kidney. With the exception of this one patient (with a contralateral contracted kidney) who required maintenance dialysis, in all other cases serum creatinine levels remained unchanged or reverted to the baseline mean of 1.1 mg/dl (0.9–1.2).

Conclusions: Acute renal infarction is not as rare as previously assumed. The entity is often misdiagnosed. Unilateral flank pain in a patient with an increased risk for thromboembolism should raise the suspicion of renal infarction. In such a setting, hematuria, leucocytosis and an elevated LDH level are strongly supportive of the diagnosis.

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Acute renal infarction is rarely detected in clinical practice. This is reflected in the literature in which multiple scattered case reports are described but a prospective single or multicenter study of the

entity is lacking. Lessman et al. [1] reported on 17 patients within 14 years in whom major renal artery emboli were diagnosed on either clinical grounds or at autopsy; in a postmortem study, Hoxie and Coggin [2] reported an incidence of 1.4%, but the majority of their cases were not diagnosed antemortem; and Domanovits et al. [3] recently described the clinical characteristics of 17 patients over a 45 month period.

The diagnosis of acute renal infarction is often missed or delayed due both to the rarity of the disease and its non-specific clinical presentation [1,4]. Since contrast-enhanced CT is currently the imaging modality of choice for evaluating various acute abdominal conditions, it may be the first instance at which an unsuspected renal infarction may be discovered [5]. Having encountered 11 cases of acute renal infarction (diagnosed by contrast enhanced CT) in the last 36 months, the aim of the present study was to identify possible predictive clinical and/or laboratory parameters of the disease, thereby increasing physician awareness regarding its diagnosis.

Patients and Methods

Patients

Meir General Hospital is a regional university-affiliated hospital serving a population of 600,000. Between 1 November 1997 and 31 October 2000 we retrospectively reviewed the charts of all inpatients in whom a diagnosis of renal infarction was made. Definitive diagnosis was established by the use of contrast-enhanced CT (as detailed below). The data collected included:

- History suggestive of an increased risk for thromboembolism: atrial fibrillation, previous embolism, mitral stenosis, ischemic heart disease, anticoagulant therapy and, where available, an abnormal coagulation profile.
- Clinical features at presentation: the time from admission to the emergency department to definite CT diagnosis and initial working diagnoses was recorded.
- Urine and laboratory parameters: urine dipstick examination (Combur Test, Boehringer-Mannheim, Germany), white blood cell count, baseline serum urea, creatinine levels and serum lactic dehydrogenase (Hitachi 747 autoanalyzer, Japan).
- Treatment and outcome: specific treatment was registered. Maximally attained serum creatinine as well as that at discharge was recorded.

Computerized tomography examination

CT scans were obtained on an Elscint 2400 Elite (Israel) or an Elscint CT Twin with 10 mm collimation and 1.0 cm intervals from the diaphragm to the symphysis pubis. All patients were given 1,000

LDH = lactate dehydrogenase.

ml of diluted water-soluble contrast material to drink over 2 hours prior to the examination and a further 250 ml just before the study.

A bolus intravenous injection (80–100 ml) of ionic, Telebrix (meeglumine-ioxitalamic) or non-ionic contrast, Ultravist (iopromide) was routinely given. All films were interpreted by a radiologist (R.Z.) experienced in abdominal and vascular imaging.

Renal infarction was defined as any hypodense area of the renal parenchyma, either triangular in shape or otherwise, up to a global absence of the nephrogram. Additional features included a rim of capsular enhancement surrounding the hypodense area (cortical rim sign), perirenal stranding with thickening of Gerota's fascia, and an absence of urinary excretion of contrast material.

Results

Incidence

During the 36 month observation period, 11 cases (in 10 patients) of acute renal infarction were identified. During the same time period, there were 151,914 total admissions (excluding pediatric and obstetric patients) of which 53,165 were admitted through the emergency department. The annual incidence of renal infarction is

therefore 0.007% of admissions or 6.1 patients per million. Of the 10 patients, 5 were male. Mean patient age was 67.4 ± 21.1 years. In four cases the right and in five cases the left kidney were involved. In the remaining two cases there was bilateral involvement.

Increased risk of thromboembolism [Table 1]

An increased risk of thromboembolism was found in 7 of the 10 patients. Chronic atrial fibrillation was present in six of them, one of whom had underlying rheumatic heart disease with mitral valve replacement. In one patient a coagulation profile revealed combined activated protein C resistance and protein S deficiency. Three patients had experienced a previous thromboembolic event (a lower limb embolus in two, and a previous renal infarct in one). Two patients were receiving anticoagulant therapy with an INR of 1.6 and 1.8, respectively. Ischemic heart disease was documented in two patients.

Clinical features and laboratory findings [Table 2]

Ten of the 11 cases presented with severe persistent flank pain. Fever was recorded in five and nausea/vomiting in four cases. Hematuria was detected on a dipstick urinalysis in all cases. In all subjects, the

Table 1. Demographic data, clinical features and initial diagnoses (clinical and CT)

Case No.	Gender/ Age (yr)	Risk factors	Previous thrombotic event	Anti-coagulation	Affected kidney	Presenting symptoms	Initial clinical diagnosis	Additional imaging procedures	Initial CT diagnosis	Intervention	Time to diagnosis (h)
1	M/63	CAF, carcinoma of stomach	–	No	R	Abdominal pain	Renal carcinoma	–	Renal SOL	–	NA
2	M/40	RHD, MVR, CAF	–	Warfarin	B	Weight loss	Suspected endocarditis	–	Renal infarct	–	NA
3	M/87	CAF, AS	Leg embolus	No	R	Abdominal pain, fever, vomiting	Acute abdomen	–	APN	IV heparin	72
4	M/87	CAF, AS	Leg embolus, renal infarct	Warfarin	L	Abdominal pain	APN	–	Renal infarct	–	24
5	M/30	Protein-S deficiency, recent MI	Renal infarct	No	R	Abdominal pain, vomiting	Renal colic	IVP	Renal infarct	–	24
6	F/74	CAF	–	No	B	Abdominal pain, fever	APN	Renal US	Renal infarct	–	144
7	F/85	Dilated CMP	–	No	L	Abdominal pain	Acute abdomen	Renal scan, renal angio	Renal infarct	IV heparin, intra-arterial urokinase	24
8	F/85	ND	–	No	R	Abdominal pain, fever	Acute abdomen	–	Renal infarct	–	24
9	M/42	ND	–	No	L	Abdominal pain, fever	APN	IVP, abdominal US	APN	–	72
10	F/83	CAF, severe HTN	–	No	L	Abdominal pain, fever	Digitalis intoxication	–	Renal infarct	IV heparin	148
11	F/66	CHF, CAF	–	No	L	Abdominal pain, vomiting	Renal colic	Abdominal US, renal scan	Renal infarct	IV heparin	48

CAF = chronic atrial fibrillation, RHD = rheumatic heart disease, MVR = mitral valve replacement, AS = aortic stenosis, MI = myocardial infarct, CMP = cardiomyopathy, HTN = hypertension, CHF = congestive heart failure, APN = acute pyelonephritis, IVP = intravenous pyelogram, US = ultrasound.

Cases 3 and 4 occurred in the same patient on two separate occasions.

Table 2. Laboratory parameters at presentation and follow-up

Case No.	Creatinine (mg/dl)	Urea (mg/dl)	LDH (IU/L)	WBC (cells/ μ l)	Urine RBC	Follow-up (mo)	Follow-up creatinine (mg/dl)
1	1.1	20	NA	NA	+	NA	NA
2	1.2	45	306	5700	+	1	1.0
3	1.2	24	1,169	12,900	+	5	1.2
4	1.9	31	916	11,130	+	13	1.2
5	1.2	18	1,816	11,690	+	14	1.0
6	1.0	29	1,868	17,800	+	0	NA
7	3.5	135	1,589	20,000	+	4	3.5, ESRD, HD
8	1.7	49	2,271	13,800	+	2	1.2
9	1.0	25	2,396	12,500	+	NA	NA
10	1.1	33	2,364	12,200	+	NA	NA
11	0.9	35	1,011	12,160	+	NA	NA
Mean	1.4	40.4	1,570	12,988		5.7	
SD	0.7	32.8	703	3,841		5.5	

Creatinine – maximally attained value during the acute episode.

Follow-up creatinine – value obtained at the end of the follow-up period.

NA = not available, ESRD = end-stage renal disease, HD = hemodialysis



Figure 1. Contrast-enhanced CT of a 30 year old man who presented with acute right flank pain, showing a wedge shaped nephrographic defect in the posterior aspect of the right kidney compatible with acute segmental renal infarction. Note a scar in the posterolateral aspect of the left kidney probably indicative of an old infarct.

white blood cell count and serum LDH were increased, mean values being $12,988 \pm 3,841/\mu\text{l}$ and $1,570 \pm 730$ IU/L, respectively. Time from admission to the emergency department to CT diagnosis ranged from 24 hours to 7 days. In one case, the diagnosis of right renal infarction was completely missed. This patient was treated as a case of acute pyelonephritis. On admission 2 months later with left renal infarction, CT confirmed the presence of an old right renal infarct. Initial working diagnoses were renal colic in two, pyelonephritis in three, acute abdomen in three, and renal carcinoma, digitalis intoxication and suspected endocarditis in one each.

Treatment and outcome [Table 2]

Mean baseline serum creatinine was 1.1 (0.9–1.2) mg/dl, which rose to a mean of 2.37 (1.7–3.5) mg/dl in three cases with no change in

the remaining eight. Three patients were treated with intravenous heparin. No information, however, is available regarding the functional outcome of the infarcted kidney. One other patient was administered a combination of intravenous heparin and renal intra-arterial ur-kinase infusion, with no success in restoring function of the affected kidney. This patient had a SCr of 3.5 with a contralateral contracted kidney and required maintenance dialysis. In all other cases SCr reverted to and maintained baseline values over a follow-up period of 5.7 ± 5.5 months (range 1–14).



Figure 2. Contrast-enhanced CT of an 85 year old woman who presented with acute left flank pain, showing a normal sized left kidney with global absence of the nephrogram except for a ring of cortical enhancement (cortical rim sign). In comparison, the nephrogram of the right kidney is preserved.

CT findings

In four cases, triangular wedge-shaped hypodense defects, representing segmental areas of infarction, were visualized [Figure 1]. In the other seven cases, varying areas up to a global nephrographic absence were seen, the latter representing total infarction of the kidney [Figure 2]. Perirenal strandings were demonstrated in four of these cases. Notably, the CT was initially misinterpreted in two cases, one case being misdiagnosed as a renal carcinoma and the other as acute pyelonephritis.

Discussion

The diagnosis of acute renal infarction is often missed, mainly due to the entity's non-specific clinical presentation and lack of physician awareness. Our higher incidence of renal infarction is undoubtedly attributable to the increasing use of CT as a diagnostic tool in undetermined acute abdominal conditions [5].

Currently, abdominal unenhanced helical CT has become the imaging technique of choice for the evaluation of patients with acute flank pain suspected of acute ureterolithiasis [5,6]. The diagnosis of acute renal infarction, however, requires contrast enhancement, and if there are no signs of nephro-ureterolithiasis, a subsequent scan following the injection of contrast material should be performed to exclude renal infarction [7,8].

In contrast to previous reports documenting an up to twofold involvement of the left kidney, we found an equal occurrence of infarction between the left and right kidneys. A history of increased risk of thromboembolism was evident in 7 of our 10 patients (70%): 6 with chronic atrial fibrillation and one with an abnormal coagulation profile. A previous thromboembolic event was recorded in three cases. The INR in the two anticoagulated patients was below the accepted level, indicating inadequate dosage or non-compliance with medication. Despite this impressive history of a tendency to thrombus formation, in none of our cases was the diagnosis of acute renal infarction initially entertained.

Of the clinical features, flank pain was present in all cases but one. It tended to be a severe, persistent pain, often refractory to analgesics, simulating renal colic. The coexistence of fever in five cases led to the erroneous diagnosis of infection of the urinary tract in three instances. The laboratory findings consistently found were hematuria, leukocytosis and an elevated serum LDH.

Baseline renal function as determined by serum creatinine was within normal limits in all subjects. It transiently deteriorated in two, and in one case with a contralateral contracted kidney resulted in end-stage renal failure. In all other cases, serum creatinine values returned to baseline and were maintained after a mean follow-up period of 5.7 months. Attempted anticoagulation and thrombolytic therapy in one case was unsuccessful in restoring function of the affected kidney.

Time from admission to the emergency department to definitive diagnosis ranged from 24 hours to 6 days. Obviously, this delay in diagnosis is much too long and points to a lack of physician awareness regarding the entity. This also applies to the radiologist, since in two cases the initial CT interpretation was incorrect. Our overall incidence of 6.1 per million per year probably underestimates the true incidence, since in this series

only cases diagnosed by CT were included. Even so, it is higher than previously reported and similar to that of a recently published series [3]. Acute renal infarction is therefore not as rare a disease as heretofore considered. In the above-mentioned series [3], Domanovits et al. reported the clinical characteristics of 17 patients with acute renal infarction. Our data are consistent with their findings.

In conclusion, in a patient with an increased risk of thromboembolism, unexplained flank pain should raise the suspicion of acute renal infarction. Under such circumstances, hematuria, leukocytosis and an elevated serum LDH are strongly supportive of the diagnosis. We suggest that LDH be promptly evaluated even in the emergency department setting. Since unenhanced CT is now used almost routinely in the investigation of acute flank pain, it is imperative to remember that contrast enhancement is essential for the diagnosis of acute renal infarction.

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