Lesson of the Week

Recovery of renal function after delayed revascularisation of acute occlusion of the renal artery

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In anuric patients with compromised renal blood flow due to renal artery embolus or thrombosis the diagnosis is often delayed or established post mortem. Despite diagnostic delay a successful outcome after surgical intervention is possible with active management.

Case report

A 53 year old woman was admitted to hospital after 24 hours of worsening hypertension, severe congestive cardiac failure, and anuria without chest or abdominal pain. She was a heavy smoker with a five year history of hypertension, angina, obstructive airways disease, congestive cardiac failure, and peripheral vascular insufficiency. She had a small non-functioning right kidney, although her serum creatinine concentration had been normal one month before admission.

On examination she was dyspnoeic, distressed, and feverish (38°C). She had a sinus tachycardia, a blood pressure of 190/110 mm Hg, and severe biventricular failure with an aortic systolic flow murmur but no pericardial friction rub. All but the pedal pulses were palpable with no vascular bruits. Funduscopy showed a single retinal haemorrhage. Her abdomen was obese and not tender, and her rectum and vagina were normal on examination. An electrocardiogram showed sinus rhythm and left ventricular hypertrophy with no evidence of recent infarction. A chest x ray film showed severe pulmonary oedema.

Serum sodium concentration was 136 mmol/l, potassium 5.4 mmol/l, urea 12.9 mmol/l, and creatinine 208 µmol/l. Haemoglobin concentration was 149 g/l. White cell count was $18.9 \times 10^9/l$, 82% being neutrophils. The pH of arterial blood was 7.34, oxygen pressure 7.5 kPa, and carbon dioxide pressure 4.2 kPa. Catheterisation of the bladder produced only 20 ml urine, which showed proteinuria and microscopic haematuria but no casts.

She remained anuric despite treatment with diuretics and the next day was transferred to the nephrology service in Leicester for further management. Serum urea concentration was 25.4 mmol/l, creatinine 377 µmol/l, and potassium 5.9 mmol/l. Ultrasonographic findings excluded obstruction of the urinary tract and confirmed that the right kidney was small and showed the left one to be normal. An aortogram showed that the left renal artery was occluded 0.5 cm from its origin, neither collateral circulation nor nephrogram phase being visible. The right renal artery was not visualised and there was generalised atheroma (figure).

She was treated by ultrafiltration and haemodialysis in preparation for immediate surgical exploration, which proceeded 72 hours after the onset of her initial symptoms. At operation the right kidney was hypoplastic, measuring only 4 cm in length. The left kidney was normal in size but purple. The aorta was atheromatous, and the left renal artery was pulsating for its first few millimetres, thereafter branching into two unequal non-pulsating vessels. When the left renal artery was opened fresh clot was

Acute renal artery occlusion may not produce renal infarction. Surgical management is justified even when presentation is delayed, and good recovery of renal function may be achieved

Aortogram showing no filling of right renal artery and filling of left renal artery (arrow) to only 0.5 cm from its origin.

present in its branches, and removal of this clot started back bleeding. An anastomosis was fashioned from the aorta to each of the two branches of the left renal artery, using a branching long saphenous vein graft. The kidney became normal in appearance and the flow of urine was immediately restored, being initially 30 ml/h.

During the first week after surgery she needed haemodialysis, although the urine output was maintained, but by the 10th postoperative day she was polyuric and did not need dialysis. At discharge four weeks later her serum creatinine concentration was 135 µmol/l. She required antihypertensive treatment but was not given anticoagulants. A year later she was well with no further deterioration in her renal function.

Discussion

Our patient underwent successful revascularisation of an ischaemic kidney with restoration of renal function 72 hours after the renal artery became occluded. The time between occlusion and

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operation is not critical to the success of the procedure, and intervals from hours to many months have been reported.^{1,6}

Restoration of renal function by operation after a delay in diagnosis was initially discouraged because of the results of experimental work in dogs that suggested that occlusion of the renal artery for more than three hours led to irrevocable destruction of the kidney.⁷ Later studies showed, however, that the viability of nephrons can be maintained by an arterial perfusion pressure that is so low that filtration does not occur.^{8,9} These subfiltration pressures are provided in man by a rich collateral circulation that develops within hours after total occlusion of the renal artery.¹⁰ The origin of this circulation varies but is most commonly the periureteral, peripelvic, and adrenal vessels.¹¹ This renal perfusion via the collateral circulation has occasionally been sufficient to result in spontaneous reversal of renal failure.¹² The immediate development of a collateral circulation that can maintain viability of nephrons at subfiltration arterial pressures provides the rationale for surgical intervention, even when the diagnosis of total occlusion of the renal artery has been delayed.

Occlusion of the renal artery is often established only at necropsy. In one study 205 cases of renal infarction were identified from 14 411 necropsies, an incidence of 1.4%, but the lesion was diagnosed during life in only two cases.¹³ Symptoms are often mild, with pain or tenderness in the flank present in fewer than half of the patients, so unilateral occlusion may often be subclinical when the remaining kidney is healthy. More consistent features are fever, leucocytosis, and haematuria.¹⁴ Acute occlusion of the renal artery should, however, be considered when a patient develops acute oliguria or anuria and has suddenly worsening hypertension, widespread vascular disease, or atrial fibrillation. Its diagnosis requires renal ultrasonography to exclude obstruction of the urinary tract. Renal scintigraphy may show inequalities in renal perfusion, but its interpretation can be misleading and some perfusion may be seen even with complete occlusion of the renal artery.¹⁵ Angiography is therefore mandatory for unequivocal diagnosis. Angiograms show total occlusion of the renal artery which is occasionally accompanied by retrograde filling of the area of the kidney beyond the occlusion as well as a faint nephrogram from a collateral circulation, but these changes are not constant and can be detected only with delayed films.^{16,17}

What factors predict a successful outcome of surgical intervention? Angiographic findings of a collateral circulation do, but their absence does not contraindicate surgery.¹⁸ Evidence of preserved glomerular morphology on intraoperative renal biopsy is a good predictor of success, although ischaemic tubular atrophy will invariably be present.^{4,5,17} The time between occlusion and operation and renal size are not, however, important prognostic criteria.^{4,5}

Other approaches to revascularisation include percutaneous angioplasty¹⁹ and thrombolytic treatment,^{20,21} but experience with these is insufficient for them to be regarded as a suitable alternative to surgery.

This case report confirms that occlusion of the renal artery is a reversible cause of acute renal failure and does not necessarily imply infarction. The outcome cannot be confidently predicted at presentation even if presentation is delayed, and therefore an active approach to diagnosis and treatment is justified: angiography is the most appropriate diagnostic method and surgery the most appropriate treatment. When successful such intervention can prevent irreversible renal failure.

References

- 1 Quantock OP, Thatcher GN. Reversible renal failure with renal artery occlusion. *Br Med J* 1972;ii:27-8.
- 2 Perkins RP, Jacobren DS, Feder FP, *et al*. Return of renal function after late embolectomy, report of a case. *N Engl J Med* 1967;276:1194-5.
- 3 Sullivan MJ, Cronin R, Lackner LH, *et al*. Embolization of a solitary kidney. Successful embolectomy after nine days. *JAMA* 1972;222:82-3.
- 4 Morgan T, Wilson T, Johnson W. Restoration of renal function by arterial surgery. *Lancet* 1974;ii:653-6.
- 5 Raju S, Williams S. Renal revascularisation for preservation of renal mass and function. *South Med J* 1986;79:277-80.
- 6 Thomas TV, Faulconer HT, Lansing AM. Management of embolic occlusion of renal arteries. *Surgery* 1969;65:576-83.
- 7 Hamilton PB, Phillips RA, Hiller A. Duration of renal ischemia required to produce uremia. *Am J Physiol* 1948;152:517-22.
- 8 Moyer JH, Heider CF, Morris GC, Handley C. The effect of complete renal artery occlusion for variable periods of time as compared to exposure to subfiltration arterial pressures below 30 mm Hg for similar periods. *Ann Surg* 1957;145:41-58.
- 9 Morris GC, Heider CF, Moyer JH. The protective effect of subfiltration arterial pressures on the kidney. *Surgical Forum* 1955;6:623-5.
- 10 Love L, Bush IM. Early demonstration of renal collateral arterial supply. *American Journal of Radiology* 1968;104:296-301.
- 11 Abrams HL, Cornall SH. Patterns of collateral flow in renal ischaemia. *Radiology* 1965;84:1001-12.
- 12 Manly RJ, Belzer FO. Spontaneous reversal of renal failure by renal artery recanalization. *Arch Surg* 1981;116:107-9.
- 13 Hoxie HJ, Coggin CB. Renal infarction. Statistical study of two hundred and five cases and detailed report of an unusual case. *Arch Intern Med* 1940;65:587-94.
- 14 Lessmen RK, Johnson SF, Coburn JW. Renal artery embolism. Clinical features and long term follow up of 17 cases. *Ann Intern Med* 1978;89:477-82.
- 15 Strauss HW, Kirchner PT, Wagner HN. Nuclear medicine in the evaluation of renal disease. In: Earley LE, Gottschalk CW, eds. *Strauss and Welt's diseases of the kidney*. 3rd ed. Boston: Little Brown and Co, 1979:149-64.
- 16 Boijesen E. Angiographic studies of the anatomy of single and multiple renal arteries. *Acta Radiol [Suppl] (Stockh)* 1959;183:1-135.
- 17 Alexander HA, Briant BW. Revascularisation of kidneys with totally occluded renal arteries. *South Med J* 1982;75:1087-92.
- 18 Dean RH, Englund R, Dupont WD, *et al*. Retrieval of renal function by revascularisation. Study of preoperative outcome predictors. *Ann Surg* 1985;202:367-75.
- 19 Dotter CT. Transluminal angioplasty: a long view. *Radiology* 1980;135:561-4.
- 20 Sanfelliop CJ, Goldin A. Intra-arterial streptokinase and renal artery embolization. *Urology* 1978;11:62-8.
- 21 Frey FJ, Stirneman P, Fritshi P, Mahler F. Renal artery embolus treated with intraluminal streptokinase infusion results in patent but small renal arteries. *Am J Nephrol* 1986;6:214-6.

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MATERIA NON MEDICA

Examination blues

Everybody knows what it is like to sit an examination, but sometimes the plight of the examiner may not be very different. With the variety of replies he gets from candidates his feelings must range from sublime satisfaction to almost wanting to drop dead on hearing or reading the answers offered.

One candidate when asked in the anatomy examination what passes through the foramen magnum replied hesitantly, "Oesophagus, trachea, and a few nerves and arteries." The examiner, taken aback, probed further: "What else?" After a lot of coaxing by the examiner the candidate scratched every grey cell and replied beamingly, "Obviously food, water, and air." Needless to say, he had to appear again.

Checking theory papers may be equally entertaining. To a question requiring a short note on "singers' nodules" the answer from about a quarter of the candidates started with, "Dr Singer was a leading ENT surgeon in Britain whose contribution cannot be ignored." Of course, as the question was in the ENT paper, the site of the nodule varied from the nose to trachea to anywhere on the tympanic membrane.

The Alma Ata declaration of "Health for all by 2000 AD" was a frequent subject of questions in the early 1980s. One candidate writing a short note on Alma Ata knew nothing about it and asked the one behind him. Promptly, the whispered reply came, "It is about health for all by 2000 AD." In his nervousness and anxiety the poor man seems to have misheard the whisper as "Health for all by 2000 lady" and hence his reply began with, "The government of India is training 2000 ladies to deliver health to the suffering masses."

Another candidate writing the same short note thought that Alma Ata was a special kind of "attar" (which in Hindi means flour) and his reply read "Alma Ata is a special 'attar' meant to be given to undernourished children and is rich in proteins and vitamins."

I do not know how the examiners feel while reading such answers—but one thing is certain: the candidate writes them with his best effort and with full conviction.

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