admitted to hospital via the normal channels with their inbuilt and unavoidable delays. Their survival would have been even less likely had they been admitted "normally" to general medical units without access to an intensive care area with full facilities for respiratory resuscitation.

In Scotland during 1969-72 there were 412 deaths from asthma outside hospital and 176 inpatient deaths,⁶ but without knowledge of the total number of patients with asthma in Scotland it is not possible to compare these figures with those obtained from the small selected group of patients admitted through our service. Cochrane and Clark,² however, calculated from their data a crude hospital admission mortality of between 1% and 2.4% and found that over 40% of "hospital deaths" occurred before admission.

All services designed especially for patients considered to be particularly at risk of developing a fatal illness have potential dangers. In the case of our asthmatic patients great care is taken not to cause undue concern about the potentially serious nature of their disease, but in general the reaction of the patient is one of relief rather than alarm when they are told that they, if the need arises, may bypass their general practitioners and admit themselves to hospital at any time. One patient abused the service by being repeatedly admitted with hysterical hyperventilation and consequently had to be removed from the list. This patient, however, was mentally subnormal, and since most of her admissions were arranged via her general practitioner this isolated failure cannot be used to discredit the concept of the service.

It is not possible to state categorically that the service has saved lives, but it is most likely that it has. If it has not, it has certainly enabled severely ill patients to be treated at an earlier

stage of their illness than would otherwise have been possible using conventional admission procedures. The organisation of the service was simple and the system has functioned well for almost seven years. We believe that the results justify its continuation, since every death from asthma is potentially avoidable, and the only way to reduce mortality at present is to admit ill patients rapidly to units with specialised facilities and skills for the treatment of severe asthma. Many hospitals in Britain could organise a service similar to the one described here, and we hope that our results will encourage them to do so. Facilities already exist in almost every general hospital in Britain. Coronary care units, and emergency ambulances serving them, have been organised in many hospitals. It would take little reorganisation to use these facilities for high-risk asthmatic patients, whose prognosis after resuscitation from a severe attack is usually infinitely better than that of a patient with myocardial infarction.

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Renal masses and ultrasound

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Summary

Among the first 111 patients with renal masses examined by ultrasound most renal cysts (98%) and carcinomas (86%) were correctly detected. Diagnostic accuracy was high when ultrasound predicted a renal cyst (97%), but renal carcinoma accounted for only 60% of the complex echo masses found. Ultrasound was used as the primary, non-invasive test for the selection of outpatients with simple renal cysts for diagnostic puncture and for the selection of those with complex renal masses for more elaborate and expensive inpatient investigation. Ultrasound is not infallible but a safe diagnostic pathway may be drawn up in which ultrasound errors are not allowed to lead to diagnostic disasters. This approach reduced the use of arteriography for renal masses by two-thirds. With care the diagnosis of the common chance finding of a renal mass can be made simpler, safer, and cheaper.

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Introduction

Renal masses are commonly found by chance on intravenous urography done for other reasons. Since such asymptomatic lesions may be curable carcinomas they must be accurately diagnosed. In the past this has meant a large and expensive investigative effort, including the frequent use of arteriography. The introduction of ultrasound scanning has made for simpler diagnosis, even in inexperienced hands.

Patients and methods

A standard commercial A and B mode ultrasound unit (Picker Echoview) was acquired at the end of 1972, and its use over 28 months on the first 111 patients is reported here. Only the first month of trial and error is excluded. A single operator with no special training performed almost all the scans. He was also the radiologist responsible for the patients' further investigation, which was an undoubted spur to making the best possible use of ultrasound. Careful scanning in two planes¹ took at least 15 minutes and often 30 minutes or longer.

The usual diagnostic pathway for patients with a renal mass is shown in the fig. Ultrasound was used to distinguish between patients with probable simple cystic lesions, who were then subjected to renal puncture, and the few with complex masses, who were admitted for more elaborate investigations. Lesions thought to be renal cysts were generally punctured at once under fluoroscopic control, allowing a complete diagnosis to be made during one outpatient visit. For various reasons 16 out of 56 such patients did not have their renal cysts

needed, usually because of additional confirmatory evidence from previous intravenous urograms. Patients with an obvious renal carcinoma sometimes came to operation without having undergone arteriography.

It was decided at the outset to review the ultrasound results when over 100 patients had been examined.

Diagnostic pathway for patients with renal mass. Final diagnosis or management is shown in *italics*.

Results

Among the 57 patients with simple renal cysts (41 needed) in this series 56 (98%) were correctly diagnosed by ultrasound. There were 21 patients with renal carcinomas, and of these 18 (86%) showed complex echo masses. These findings suggest a satisfactory accuracy rate for ultrasound when viewed retrospectively from the final diagnosis. The table makes a more informative prospective comparison with the final outcome at the stage of the ultrasound diagnosis. Most ultrasound predictions of renal cysts (97%) were correct, but complex echo masses clearly included lesions other than renal carcinoma, which accounted for only 60% of these masses. Three renal carcinomas were misdiagnosed as cyst and normal kidneys.

Arteriograms—During the 28 months immediately before the ultrasound study arteriography for renal masses was performed on 59 occasions, most renal cysts being punctured on the strength of the intravenous urographic findings alone. During the present 28 months the referral rate of patients with renal masses was if anything higher because of our known interest in ultrasound scanning but arteriography was performed on only 20 occasions.

Accuracy of ultrasound scanning of 111 patients with renal masses

Ultrasound diagnosis	No of patients	Comments on final outcome
Cyst	58	56 (97%) correct; 1 renal carcinoma; 1 renal abscess
Complex mass (possible tumour)	30	18 (60%) renal carcinomas; 3 renal abscesses; 2 cysts with blood clot; 1 each of calcified cyst, simple cyst, localised polycystic disease, renal haematoma, ureteric obstructing tumour, renal sinus fat, normal kidney
Hydronephrosis	8	Correct, with 1 pyonephrosis
Polycystic disease	2	Correct
Absent kidney	2	Correct
Normal	11	Included 2 renal carcinomas; others correct

Discussion

Like angiography, ultrasound scanning is not infallible in the investigation of renal masses,² though its diagnostic accuracy

is high.^{3,4} Its importance in the diagnosis of renal masses discovered by intravenous urography is not in the arrival of yet another fairly reliable investigation in this field but that the diagnostic pathway may be simplified. If ultrasound scanning is used as the primary investigation after a mass has been discovered a critical decision on management—whether to puncture a simple renal cyst as an outpatient procedure or admit the patient for further investigation—may be made on the basis of a non-invasive test. This study suggests that ultrasound scanning is well fitted for this job, even when performed without special training.

It is important to consider what may happen if the ultrasound diagnosis is wrong. If a patient with a simple renal cyst is mistakenly thought to have a complex lesion arteriography will be performed unnecessarily (one patient in this series). If an ultrasound diagnosis of simple cyst is made in error the lesion will be punctured. In this way a renal carcinoma may be needed (1 patient in this series) or other complex lesions such as renal abscesses or haemorrhagic cysts may be discovered. In any event the clinicoradiological team is safely alerted that there is a problem that needs further action.⁵ The diagnostic pathway, which may be elaborated,⁶ therefore serves as a safety net, so that patients with a serious lesion are not allowed to slip into diagnostic limbo because of an ultrasound error. Particular difficulty was found when apparently normal ultrasound scans were obtained in the presence of a wholly intrarenal mass on the intravenous urogram. Two renal carcinomas were in this group, and we do not accept ultrasound findings that negate such evidence.

Standard renal ultrasound scanning is poorly reproducible between operators, though grey-scale techniques may overcome this. As in this study it is probably an advantage for the person who does the scanning to be responsible for the further investigations that arise.

There is concern about the conservative management of patients with apparently simple renal cysts.⁵ A breaking down, cystic renal carcinoma is unlikely to be mistaken on needle puncture, but a small tumour in the wall of a cyst could be missed. The extreme rarity of this lesion⁷ must be weighed against the inevitable morbidity and mortality of exploring every renal cyst surgically.⁸ In this, needle puncture has much to offer, not least in economic cost. Its risks are not to be compared with those of renal biopsy, which by design is a more damaging procedure. With a fine needle used with care, diagnostic renal puncture appears to be a safe outpatient investigation.⁵

In this series the use of the expensive, potentially hazardous inpatient procedure of arteriography—its total cost at present being not far short of £100—was reduced by two-thirds. The ultrasound approach to renal masses demands lively and critical clinicoradiological teamwork and a readiness to reconsider cherished provisional diagnoses. Given this framework, the common problem of what to do about the patient with a renal mass may be resolved more simply, more safely, and more cheaply.

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