Acta Paediatrica Academiae Scientiarum Hungaricae, Vol. 22 (3), pp. 229—236 (1981)

Echography of the kidneys in infancy and childhood

by

Z. HARKÁNYI, I. TÖRÖK

Department of Radiology, Semmelweis University Medical School, Budapest

Received January 5, 1981

In 56 newborns, infants and children, 90 renal ultrasonic examinations have been performed during the last two years. Grey-scale echography proved to be a useful diagnostic tool in renal cystic diseases, in hydronephrosis and tumours of the kidney, and also for the evaluation of neonatal kidneys.

During the last decade a great number of papers have shown the usefulness of grey-scale echography in the investigation of renal disorders in adults and recently in children [1, 2a, 6, 10, 11, 13, 14, 20, 21]. The grey-scale technique and the high-frequency focussed transducers led to a better understanding of normal anatomy and pathological conditions [18]. Echography is the only really non-invasive method, not applying ionizing radiation, in renal imaging, thus it has special importance in the paediatric age group. The advantages of ultrasonic examination are well-known, and it can be stated that it is not only a complementary method but in certain cases the primary means for diagnosing and evaluating renal diseases.

We have performed 90 echographic examinations in 56 newborns, infants and children whose kidneys were the primary region of interest. We report on our experience together with a short review of the pertaining literature.

METHOD AND PATIENTS

Ultrasonic examination was performed by a compound analogue grey-scale scanner (Picker Echoview 80L) fitted with either 3.5 MHz, or 5.0 MHz transducers. Time-gain compensation was adjusted

TABLE I

Final diagnosis of paediatric patients examined by echography

Final diagnosis	No. cases
Hydronephrosis	10
Multicystic kidney	1
Polycystic kidney	3
Wilms tumour	3
Renal abscess	1
Renal agenesis	5
Renal injury	1
Urolithiasis	1
Transplanted kidney	1
Other renal diseases*	7
Negative	23
Total	56

* glomerulonephritis, pyelonephritis, nephrosis syndrome.

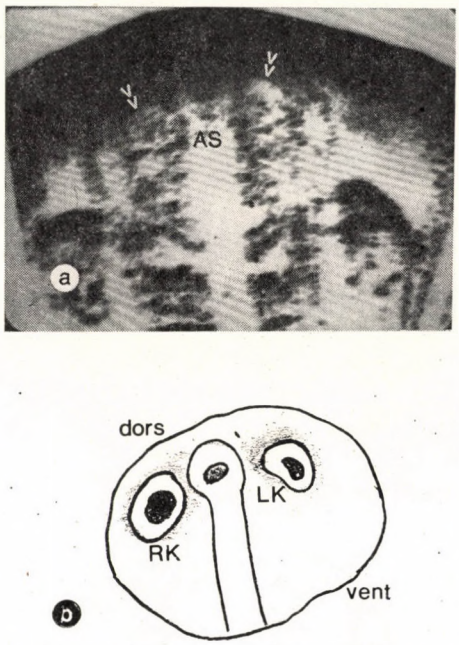

FIG. 1. Transverse section of fetal abdomen in echogram and schematic drawing (a-b.) The fetal back (dors) is seen adjacent to the mother's abdominal wall, the vertebral body provides a sharp acoustic shadow (AS). The transverse section of normal size fetal kidneys are clearly visible on both sides of the spine. (RK = right kidney, LK = left kidney, double white arrowheads. The distance between two black points represents 1 cm in all echograms)

individually to provide optimal echograms. For recording, Polaroid film or Kodak Double X negative film was used. As to methodological details, see references 3, 10, 13 and 19. The 56 patients ranged in age from 3 days to 15 years; 13 were newborns. No sedatives were applied, but it must be known that the patient's motion and lack of respiratory cooperation may affect the quality of the scan [2A, 3]. We met this problem especially in children of 1 to 2 years. Additional excretory urography was performed in 42 cases, renal scintigraphy in 15 cases and angiography in 3 cases.

RESULTS

Results of our 90 examinations are summarized in Table I. In 23 cases we could not detect any renal abnormality, while in 33 patients pathological findings were obtained, but only those cases were evaluated in which the diagnosis was confirmed by radiology or at surgery.

DISCUSSION

The fetal kidneys of normal size are demonstrable by echography (Fig. 1), and congenital anomalies, poly- and multicystic kidneys, hydronephrosis can usually be detected antenatally, too [2, 8, 9].

Renal echography of newborns demonstrates the size, shape, position and structure of the kidneys (Fig. 2).

Satisfactory visualization by ecxretory urography is not obtainable in many infants on the first days of life. The combination of ultrasonic and isotope scanning appears superior to urography in newborns with impaired renal function [5]. The leading causes of palpable abdominal tumours in

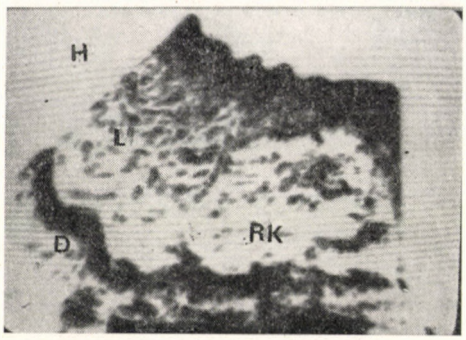

FIG. 2. Normal kidney of a 3-day-old male newborn in supine longitudinal echogram. The renal parenchyma and the echos of the collecting system of the right kidney (RK) can be seen separately. (L = liver, D = diaphragm, H = head)

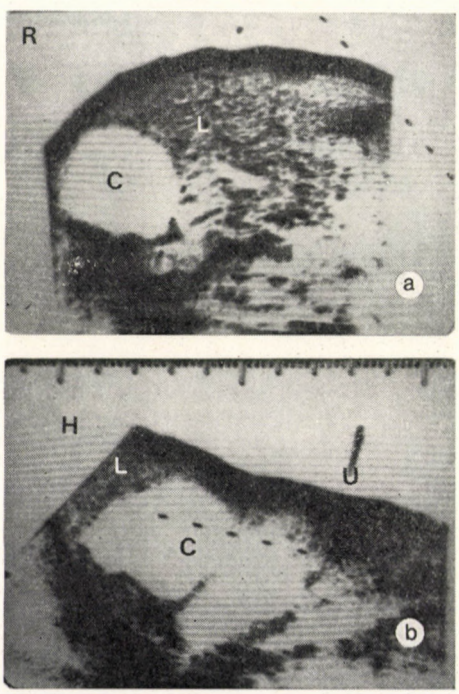

FIG. 3. Hydronephrosis in a 5-day-old female newborn in transverse (3/a) and longitudinal (3/b) echograms. Below the liver (L) a sharply defined, lobulated cystic mass represents the enlarged, hydronephrotic right kidney. A surgically proven case. (R = right, H = = head, U = umbilicus)

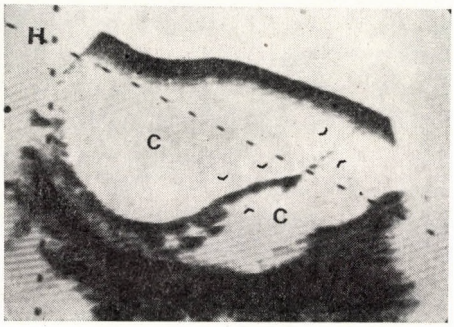

FIG. 4. A 6-day-old male baby with right flank mass. In the longitudinal plane the large cystic mass (C) is divided into several parts by septa (arrowheads). The liver is dislocated to the left. A multicystic kidney was removed. (H = head)

FIG. 5. Prone transverse echogram of an 8-year-old boy. The left kidney (LK) is slightly enlarged, the right kidney is not demonstrable in its normal place. (R = right)

neonates are hydronephrosis and *multicystic kidney* [13]; both have a characteristic echographic appearance, as demonstrated by our 6 cases (Figs 3 and 4). Metreweli and Garel [15] described the ultrasonic features of infantile type polycystic disease. Without seeing obvious cysts on the echograms, the diagnosis could be established. In *renal vein thrombosis* the kidney will appear morphologically normal with the exception of an enlargement, and nuclear study shows the absence or a diminution of its function [15, 16]. Extrarenal cystic masses (duplication, choledochal and ovarian cysts, etc.) can also be visualized but determination of the exact origin of these masses usually requires some other examination besides echography. In the cases of *renal agenesis*, the ultrasound does not show any kidney, either in the typical or in the dystopic place (Fig 5).

In the evaluation of *cystic renal disease*, echography is the initial procedure of choice [1]. Several cases of polycystic kidney were reported where

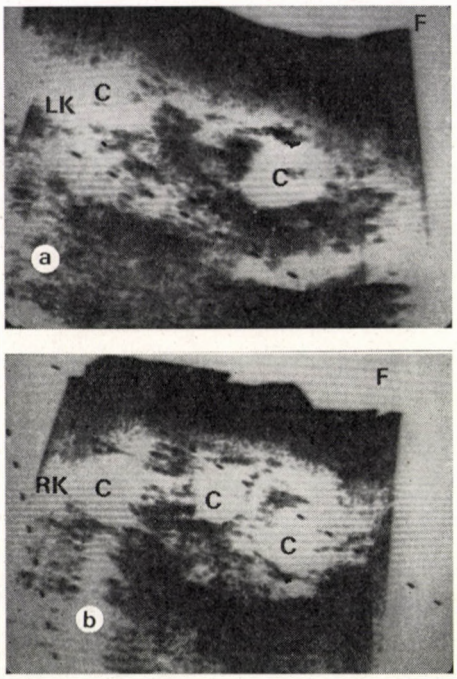

FIG. 6. Polycystic renal disease of a 13-year-old boy in prone longitudinal echograms. Both the left (LK) and the right (RK) kidneys (a-b) are enlarged and contain multiple cystic areas (C) about 2—3 cm in diameter

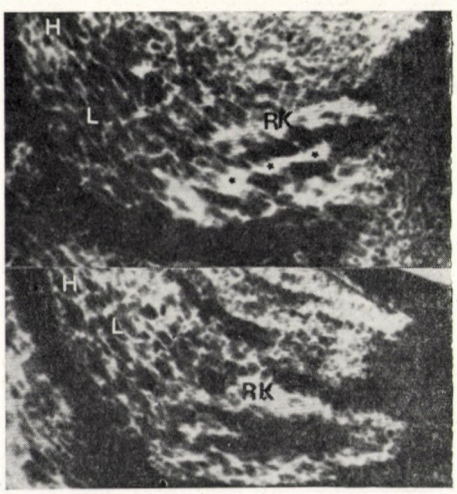

FIG. 7. Moderate hydronephrosis in a 5-year-old girl, in supine longitudinal echogram (upper part). The central echo-free stripe (black stars) indicates a dilated pelvicalyceal system of the right kidney (RK). Following surgical reconstruction of ureteral stenosis, in the control echogram made in the same plane (lower part) the echofree area is significantly decreased. (L = liver, H = head)

the ultasound detected multiple cysts with a normal urogram. In polycystic disease echography has been suggested for both screening and follow-up [17] (Fig. 6).

Renal and perirenal *abscesses* appear as fluid lesions but clinical and laboratory signs usually help to differentiate them from other cystic lesions [10].

In *hydronephrosis*, enlargement of the kidney and a central echo-free area can be seen on the echograms; the size of the echo-free area corresponds to the degree of the dilatation [7]. Urography shows a more detailed image of the pelvicalyceal system and also the cause and site of obstruction, but echography is the best method for monitoring the changes in hydronephrosis (Fig. 7); in case of a nonfunctioning kidney it is of diagnostic value by itself.

Renal tumours can usually correctly be diagnosed by urography and ultrasound [1, 10]. In Wilms tumour, echo-

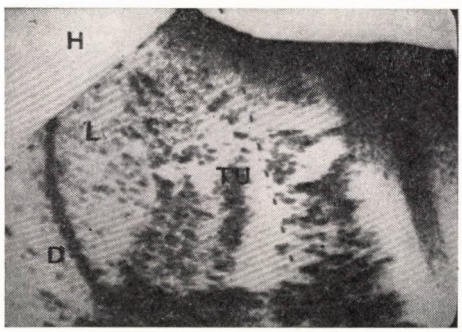

FIG. 8. Wilms tumour of the right kidney of a 2.5-year-old girl, in supine longitudinal echogram. Below the liver (L) a large solid mass (TU) can be seen, the echofree areas represent necrosis inside the tumour mass. (H = head, D = = diaphragm)

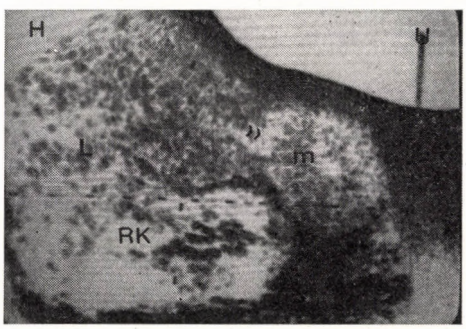

FIG. 9. Hepatic metastasis of Wilms tumour in a 5.5-year-old girl. Supine longitudinal echogram. At the free edge of the liver (L) a solid mass (m) is seen. Its echogenicity differs from the surrounding liver parenchyma. The patient had been operated upon for Wilms tumour of the left kidney one year earlier. (RK = right kidney, H = head, U = = umbilicus)

graphy depicts a solid mass generally with multiple irregular cystic areas due to necrosis (Fig. 8). Ultrasonic examination can predict the extension of the disease and can detect retroperitoneal and hepatic metastases (Fig. 9). We emphasize the role of echography in the follow-up of patients after surgery and/or chemotherapy.

The normal echogenicity of the renal parenchyma can change in a number of *diffuse renal disorders* [12]; these changes, however, are not specific. Recently some cases have been reported where echography has detected leukaemic infiltrations in the kidneys [4].

Experience suggests that echography is a useful tool in the evaluation of different paediatric renal disorders. In a certain group of diseases, the method is of diagnostic value by itself, and in other cases it completes the radiological methods. We feel that the increase of up-to-date ultrasonic instruments and sonographers will deeply influence the management of paediatric renal diseases.

References

1. Bergeri P. E., Munschauer, R. W., Kuhn, J. P.: Computed tomography and ultrasound of renal and perirenal diseases in infants and children. Pediat. Radiol. **9**, 91 (1980).
2. Friedberg, J. E., Mitnick, J. S., Davis, D. A.: Antepartum ultrasonic detection of multicystic kidney. Radiology **131**, 198 (1979).

2a Chrispin, A. R., Gordon, I., Hall, C., Metreweli, C.: Diagnostic imaging of the kidney and urinary tract in children. Springer International 1980.

3. Gates, G. F.: Atlas of abdominal ultrasonography in children. Churchill Livingstone, Edinburgh and London 1978.
4. Goh, T. S., Lequesne, G. W., Wong, K. Y.: Severe infiltration of kidneys with ultrasonic abnormalities in acute lymphoblastic leukemia. Amer. J. Dis. Child. **132**, 1204 (1978).
5. Harcke, H. T., Williams, J. L.: Evaluation of neonatal renal disorders: A comparison of excretory urography with scintigraphy and ultrasonography. Ann. Radiol. **23**, 109 (1986).
6. Hasch, F.: Ultrasound in the investigation of diseases of the kidney and urinary tract in children. Acta paediat. scand. **63**, 42 (1974).
7. Hasch, F.: Ultrasound scanning for monitoring childhood hydronephrosis J. clin. Ultrasound **6**, 156 (1978).
8. Hately, W., Nicholls, B.: The ultrasonic diagnosis in bilateral hydronephrosis in twins during pregnancy. Brit. J. Radiol. **52**, 989 (1979).
9. Henderson, S. C., Van Kolken, R. J., Rahatzad, M.: Multicystic kidney with hydramnion. J. Clin. Ultrasound **8**, 249 (1980).
10. Hünig, R.: Ultrasonic diagnosis in pediatrics, the state of the art of ultrasonic diagnosis in pediatrics today. Pediat. Radiol. **4**, 108 and 175 (1976).
11. Kristensen, J. K., Gammelgaard, P. A., Holm, H. H., Rasmussen, S. N.: Ultrasound in the demonstration of renal masses. Brit. J. Urol. **44**, 517 (1972).
12. Lequesne, G. W.: Patterns of ultrasonic abnormality in the renal parenchyma in childhood. Ann. Radiol. **21**, 225 (1978).
13. Löhr, E.: Renal and adrenal tumors. Springer Verlag, Berlin—Heidelberg—New York 1979. p. 170.
14. Lyons, E. A., Murphy, A. V., Arneil, G. C.: Sonar and its use in kidney disease in children. Arch. Dis. Childh. **47**, 777 (1972).
15. Metreweli, C., Garel, L.: The echographic diagnosis of infantile renal polycystic disease. Ann. Radiol. **23**, 103 (1980).
16. Rosenberg, E. R.: Ultrasonic diagnosis of renal vein thrombosis in neonates. Amer. J. Roentgenol. **134**, 35 (1980).
17. Rosenfield, A. T., Lipson, M. H., Wolf, B., Taylor, K. J. W., Rosenfield, N. S., Hendler, E.: Ultrasonography and nephrotomography in the presymptomatic diagnosis of dominantly inherited (adult-onset) polycystic kidney. Radiology **135**, 423 (1980).

18. Rosenfield, A. T., Taylor, K. J. W., Crade, M., DeGraaf, C. S.: Anatomy and pathology of the kidney by gray-scale ultrasound. Radiology **128**, 737 (1978).
19. Schneekloth, G., Albers, G., Frank, Th.: Sonographische Nierendiagnostik in der Pädiatrie. Röntgen Bl. **31**, 652 (1978).
20. Shkolnik, A.: B-mode ultrasound and the nonvisualizing kidney in pediatrics. Amer. J. Roentgenol. **128**, 121 (1977).
21. Sweet, E. M.: The place of nephrosonography in renal investigation in childhood. Ann. Radiol. **20**, 25 (1977).

Z. Harkányi, M. D.
Pf. 217
H-1082 Budapest, Hungary