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Computed tomography of renal cell carcinoma in patients with terminal renal impairment

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Abstract

Purpose: An increased incidence of renal tumors has been observed in patients with end-stage-renal-disease (ESRD). The very strong association with acquired renal cystic disease (ACRD) and increased incidence of the renal tumors (conventional renal cell carcinoma (CRCC), papillary renal cell carcinoma (PRCC) or papillary renal cell adenoma (PRCA)) was reported. This study discusses the role of computed tomography (CT) in detecting renal tumors in patients with renal impairment: pre-dialysis, those receiving dialysis or with renal allograft transplants.
Materials and methods: Ten patients (nine male, one female) with renal cell tumors were enrolled into a retrospective study; two were new dialysis patients, three on long-term dialysis, and five were renal transplant recipients with history of dialysis. All patients underwent helical CT, a total of 11 procedures were performed. Sixteen-row detector system was used five times, and a 64-row detector system for the six examinations. All patients underwent nephrectomy of kidney with suspected tumor, 15 nephrectomies were performed, and 1 kidney was assessed during autopsy. CT findings were compared with macroscopic and microscopic assessments of the kidney specimen in 16 cases.
Results: Very advanced renal parenchyma atrophy with small cysts corresponding to ESRD was found in nine patients, chronic pyelonephritis in remained one. A spontaneously ruptured tumor was detected incidentally in one case, patient died 2 years later. In the present study, 6.25% (1/16) were multiple PRCA, 12.5% (2/16) were solitary PRCC, 12.5% tumors (2/16) were solitary conventional renal cell carcinomas (CRCC's), 12.5% tumors (2/16) were multiple conventional renal cell carcinomas (CRCC's), 25% (4/16) were CRCC's combined with multiple papillary renal cell carcinomas with adenomas (PRCC's and PRCA's), and 25% (4/16) of the tumors were multiple PRCC's combined with PRCA's without coexisting CRCC's. Bilateral renal tumors were found in our study in 60% (6/10) confirmed in six cases, one kidney left on follow-up due to the small tumors.
Conclusions: With the use of a multi-detector row system, it is possible to detect smaller foci suspected to originate in multiple tumors, especially when up to 3-mm thin multi-planar reconstructions are used. Two cases demonstrated the possibility the development of RCC in impaired kidneys may start before dialysis initiation.

Keywords: Computed tomography; Renal impairment; Hemodialysis; Kidney; Renal cell carcinoma

1. Introduction

An increased incidence of renal tumors has been reported in patients with end-stage-renal-disease (ESRD) [1,2]. Renal cell carcinoma (RCC) presents with a frequency three to six times higher in patients receiving dialysis than in the general population [1,2]. Observations provide histological evidence that renal cell neoplasms are prone to develop in relatively young renal failure patients when their uremia is treated by long-term dialysis. The studies further indicate that the stimulus for neoplastic growth accompanies with cystic transformation of the kidneys [2,3]. A very strong association with acquired renal cystic disease (ACRD) and an increased incidence of papillary renal tumors was observed in many studies. ARCD develops in about

Abbreviations: Tx, renal allograft transplantation; CRCC, conventional renal cell carcinoma; PRCC, papillary renal cell carcinoma; PRCA, papillary renal cell adenoma

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one-half of ESRD patients and increases the likelihood of a renal tumor. As these tumors are multiple and very often small in size, the ratio of histological RCC sub-types is shifted towards papillary renal carcinoma and papillary renal cell adenoma [1,2]. Most of the cancers are identified incidentally at autopsy or during examination of kidneys after bilateral nephrectomies and are of little clinical significance, but occasional cases present aggressive neoplasms that metastasize and ultimately result in death of the patient [4]. Visualization of tumors using imaging methods is difficult given their size and multiplicity. Most studies evaluating the prevalence of ARCD and RCC in the ESRD population are based on ultrasound detection [5–7]. However, ultrasound techniques may underestimate the true prevalence of ARCD and RCC due to limitations in resolution. After reviewing 160 nephrectomy reports, only Denton et al. explored the prevalence of renal cell carcinoma in patients with ESRD before transplantation [1]. This study emphasizes the potential of CT to identify renal tumors in dialysis patients with advanced renal failure.

2. Material and methods

Ten patients (nine male, one female with mean age 54 years; range 36–61) with renal tumors and terminal renal impairment were enrolled into our retrospective study. Their informed consent was routinely obtained. Two patients were in the end-stage of renal impairment and treated newly by dialysis, three were long-term dialysis patient, the other five, with a history of dialysis, underwent renal allograft transplantation. All patients underwent helical CT, a total of 11 procedures were performed. Sixteen-row detector system was used five times, and a 64-row detector system for the six examinations. Seven of the patients underwent trans-abdominal ultrasound before CT. Collimation 16 mm × 0.75 or 64 × 0.6 mm was used. An intravenous contrast agent (iopromide 370, Schering, Berlin, Germany) was injected in all cases using a volume of 80 ml with a flow rate of 3 ml/s. CT findings were compared with macroscopic and microscopic assessments of the kidney specimen after nephrectomy in 15 cases; one kidney was assessed during autopsy.

3. Results

Ten dialysis patients with suspected renal tumors underwent the nephrectomy in our institution over a period of 5 years. Tumors were visualized during routine ultrasound follow-up in nine patients and during emergency abdominal CT in the last patient. Using CT, kidney tumors were found in all 10 cases; multiple lesions in the same kidney were suggested in 5 patients. Bilateral tumors were detected in five patients during the same examination, newly developed bilateral tumors in another patient during follow-up CT.

Unilateral nephrectomy was performed in five patients, one-step bilateral nephrectomy in two, and two-step bilateral nephrectomy in three patients—total number of nephrectomies was 15. Despite the fact a kidney tumor was confirmed in all on CT suspected kidneys during nephrectomy; pathological examinations discovered smaller tumors in five patients. On the other hand, in one patient, a suspected tumor based on CT examination was not found in the specimens, but another carcinoma focus was present in each kidney—the residual parenchyma hypertrophy was found in suspected lesions. Multiple renal tumors in one kidney were detected with an accuracy of 90.1% (9/11) by CT among all cases of this study. Primary bilateral lesions were visualized with an accuracy of 86% (6/7); follow-up multi-detector row CT detected additional lesions in the contra-lateral kidney in one patient. The clinical history, CT, specimen findings are shown in the table (Table 1).

Table 1
Renal tumor histology and surgery

Patient's age	Dialysis/TX	Right kidney	Left kidney	Surgery
Male, 41 years	Newly dialysis	Pseudotumor-partial hypertrophy multiple metaplasia and PRCA	PRCC and multiple lesions carcinoma in situ, pseudohypertrophy of the renal parenchyma	Two-step bilateral translumbal nephrectomy
Female, 41 years	Tx	Solitary CRCC	Follow-up without tumor	Laparoscopic nephrectomy
Male, 42 years	Long-term dialysis	ACRD, suspected small tumors, kidney on follow-up	Ruptured PRCC, multiple smaller PRCC, lymphatic nodes metastatic involvement, local reccurency	Left-sided translumbal nephrectomy
Male, 45 years	Newly dialysis	Multi-focal CRCC	Multi-focal CRCC, one tumor invades renal vein	Two-step bilateral laparoscopic nephrectomy
Male, 49 years	Tx	Follow-up without tumor	Solitary PRCC	Left-sided laparoscopic nephrectomy
Male, 52 years	Tx	Multiple PRCC up to 2 cm	Multiple tumors up to 1 cm kidney on follow-up	Right-sided translumbal nephrectomy
Male, 57 years	Tx	Solitary CRCC, multiple PRCC up to 1 cm and PRCA	Follow-up without tumor	Right-sided translumbal nephrectomy
Male, 57 years	Tx	Multiple CRCC, PRA and PRC up to 1 cm	Solitary PRCC	Two-step bilateral translumbal nephrectomy
Male, 59 years	Long-term dialysis	Solitary CRCC, multiple PRCC up to 1 cm and PRCA	Solitary PRCC and multiple PRCA	One-step bilateral transperitoneal nephrectomy
Male, 61 years	Long-term dialysis	Without tumor	Solitary CRCC and multiple mycotic granulomata	Left-sided translumbal nephrectomy