

## Prevalence of Acquired Renal Cystic Disease in Patients With End-Stage Renal Disease Receiving Hemodialysis

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### ABSTRACT

**INTRODUCTION:** The effect of hemodialysis on acquired cystic renal disease (ARCD) in patients with end-stage renal disease (ESRD) is not fully understood. The purpose of the study was to determine the prevalence of ARCD in patients with ESRD from our institution and to investigate the relationship between ARCD and the duration of hemodialysis.

**METHODS:** This prospective cross-sectional study was conducted between August 2008 and August 2009. We evaluated a total of 410 patients with ESRD; 182 patients were still undergoing hemodialysis at the end of the study period and 228 patients had hemodialysis followed by renal transplantation. Patients with autosomal dominant polycystic kidney disease were excluded. Patients had renal sonography evaluations before and during hemodialysis. Chi-square was used to compare the categorical distribution of the total number of patients with ESRD with the subset of patients with ARCD for the outcome measures of age, sex, duration of hemodialysis, and causes of ESRD.

**RESULTS:** A total of 34 cases were excluded due to lack of cooperation. From the remaining 376 patients, 31 (8.2%) had ARCD, 80 (21.3%) had a simple renal cyst, and the remaining 265 (70.5%) had noncystic ESRD. The mean age was 45 years (SD = 17; range, 10-85 years). The largest percentage of the total population of patients with ESRD was 20-39 years old; the largest percentage of patients with ARCD was > 60 years old ( $P < .001$ ). There was no significant difference in the sex distribution of the total group and the subset of patients with ARCD. The mean duration of hemodialysis for all patients in the study was 27 months (SD = 14; range, 1 month to 17 years). Most of the total population of patients with ESRD were on dialysis for < 1 year; most patients with ARCD were on dialysis for > 5 years ( $P < .001$ ). The majority of both the total number of patients and the patients with ARCD had hypertension or hypertension plus diabetes mellitus.

**CONCLUSION:** Patients who are on long-term hemodialysis should be monitored for the development of ARCD.

**KEYWORDS:** Chronic renal failure; End-stage renal disease; Hemodialysis; Acquired kidney cyst

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#### Abbreviations and Acronyms

ARCD, acquired cystic renal disease

CT, computed tomography

ESRD, end-stage renal disease

## INTRODUCTION

Cystic degeneration of the kidneys in patients with end-stage renal failure was first reported in 14 patients of a postmortem series of 30 patients undergoing hemodialysis [1] and is now generally considered common [2-7]. Acquired cystic renal disease (ARCD) refers to a specific disorder in which renal cysts develop in the kidneys of patients with end-stage renal disease (ESRD) due to a noncystic renal disorder. ARCD has been reported to occur in patients on long-term renal replacement therapy, either in the form of chronic maintenance hemodialysis or continuous ambulatory peritoneal dialysis [8,9]. It has been described in patients with chronic renal failure with slow progression [10].

ARCD is usually asymptomatic and is diagnosed incidentally by the radiologist after ultrasound or computed tomography (CT) scanning or by the pathologist after nephrectomy or autopsy [11]. Occasionally, ARCD may be complicated by frank hematuria [12], retroperitoneal hemorrhage [13], or malignant transformation [1,14,15]. Flank pain, renal colic, fever, palpable renal mass, and rising hematocrit levels may be presenting symptoms [16]. There is an increased risk of neoplasm development in patients with these cysts [11,17,18]. Malignancy has been estimated to be 50 times more frequent in patients with ARCD who need dialysis than in the general population [11,18].

Because ARCD is associated with an increased risk of malignant transformation and other complications, early detection of this problem in patients with ESRD is important. The exact prevalence and risk factors for developing ARCD are not yet well known.

The purpose of the present prospective study was to determine the prevalence of ARCD in the population of patients with ESRD in our medical institution, and to investigate the relationship between ARCD and the duration of hemodialysis.

## METHODS

The present cross-sectional, prospective study was conducted in the urology and nephrology department of our educational center between August 2008 and August 2009. The protocol was approved by an ethics committee from the authors' institution. All patients provided informed consent.

### Participants

We evaluated a total of 410 patients with ESRD; 182 patients were still undergoing hemodialysis at the end of the study period and 228 patients had hemodialysis followed by renal transplantation. Patients with autosomal dominant

polycystic kidney disease (ADPKD) were excluded from the study. All patients with ESRD had at least 2 renal sonography evaluations: 1 before and 1 during hemodialysis. The sonogram during hemodialysis was the most recent study; for patients with a kidney transplant, it was the last sonogram before transplantation.

### Procedures

All patients received an evaluation that included a detailed history, physical examination, and review of the sonographic investigations. Causes of renal failure, duration of hemodialysis, age, sex, and history of previous renal cysts were recorded.

Data were analyzed with SPSS software, version 11 (IBM Corp; Sommers, NY). Descriptive statistics were calculated. Data were divided into distribution categories for the outcome measures of age, sex, duration of hemodialysis, and causes of ESRD. Chi-square was used to compare the distribution of the total number of patients with ESRD with the distribution of the subset of patients with ARCD. Significant differences were indicated by  $P < .05$ .

## RESULTS

Of the 410 patients with end stage renal disease (ESRD), 34 patients were lost due to lack of cooperation. From the remaining 376 patients who were included in study, 31 (8.2%) had ARCD, 80 (21.3%) had a simple renal cyst, and the remaining 265 (70.5%) had noncystic ESRD.

Table 1 contains the distribution of age and sex for the total number of patients with ESRD in the study and for the subset of

Table 1. Distribution of Age and Sex for the Total Number of Patients With ESRD and the Subset of Patients With ARCD. doi: 10.3834/uj.1944-5784.2011.06.12t1

| Variable          | All Patients With ESRD (N = 376) |      | Subset of Patients With ARCD (n = 31) |      |
|-------------------|----------------------------------|------|---------------------------------------|------|
|                   | n                                | % N  | n                                     | % N  |
| <b>Age, years</b> |                                  |      |                                       |      |
| < 20              | 17                               | 4.5  | 0                                     | 0    |
| 20-29             | 140                              | 37.2 | 5                                     | 3.6  |
| 40-59             | 128                              | 34   | 10                                    | 7.8  |
| > 60              | 91                               | 24.2 | 16                                    | 17.6 |
| <b>Sex</b>        |                                  |      |                                       |      |
| Male              | 227                              | 60.3 | 17                                    | 7.5  |
| Female            | 149                              | 39.7 | 14                                    | 9.4  |

Table 2. Duration of Hemodialysis for the Total Number of Patients With ESRD and the Subset of Patients With ARCD.

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| Variable                           | All Patients With ESRD<br>(N = 376) |      | Subset of Patients<br>With ARCD (n = 31) |      |
|------------------------------------|-------------------------------------|------|--|------|
|                                    | n                                   | % N  | n  | % N  |
| <b>Duration of dialysis, years</b> |                                     |      |  |      |
| < 1                                | 185                                 | 49.2 | 4  | 2.1  |
| 1-3                                | 87                                  | 23.1 | 5  | 5.7  |
| 3-5                                | 46                                  | 12.2 | 3  | 6.4  |
| > 5                                | 58                                  | 15.4 | 19                                       | 36.8 |

patients with ARCD. The mean age of all patients in the study was 45 years (SD = 17; range, 10-85 years). The largest percentage of the total population of patients with ESRD was 20-39 years old. However, the largest percentage of patients with ARCD was greater than 60 years old. There was a significant difference in the age distribution of the total group and the subset of patients with ARCD ( $P < .001$ ). A total of 227 patients (60.3%) were male and 149 patients (39.7%) were female. There was no significant difference in the sex distribution of the total group and the subset of patients with ARCD.

Table 2 contains the duration of hemodialysis for the total number of patients with ESRD in the study and for the subset of patients with ARCD. The mean duration of hemodialysis for all patients in the study was 27 months (SD = 14; range, 1 month to 17 years). Nearly half of the total population of patients with ESRD were on dialysis for less than 1 year. However, 37% of the patients with ARCD were on dialysis for more than 5 years. There was a significant difference in the number of years of dialysis for the total group and the subset of patients with ARCD ( $P < .001$ ).

Table 3 contains the causes of ESRD for the total number of patients in the study and for the subset of patients with ARCD. The majority of both the total number of patients and the patients with ARCD had hypertension or hypertension plus diabetes mellitus. There was no significant difference in the distribution of ESRD causes for the total group and the subset of patients with ARCD. One tumor was detected in a patient with ARCD.

## DISCUSSION

In 1977, Dunnill et al [1] conducted an autopsy study and reported ARCD in 46.6% of patients who were on long-term dialysis. Grantham et al [11] reported a prevalence of 43.6%

in their study of 601 patients undergoing dialysis. Similar prevalence was reported in other studies using ultrasound or CT scan [12,17,18].

The prevalence of ARCD in our study population was 8.2%, which is much lower than the percentages reported previously. This may have been due to the very small number of patients with ESRD in our study who were on long-term dialysis; 185 (49.2%) of our patients were on dialysis for less than 1 year and 58 (15.4%) were on dialysis for more than 5 years. However, 19 of the 58 patients on long-term dialysis developed ARCD and there was a significant difference between the age distribution of the total group and the subset of patients with ARCD. Prolonged hemodialysis has been reported as an important risk factor for the development of this disorder [8-11,17,18].

Age may also be a factor in the development of ARCD. The patients with ESRD in our study had a wide age distribution, but most of those who developed ARCD were older than 60 years.

There has been no reported relationship between the underlying cause of ESRD and the occurrence of ARCD [18], although some authors have described a low prevalence of ARCD in patients with ESRD due to diabetic nephropathy [10]. Our results also showed no significant difference in the distribution of causes of ESRD between patients with and without ARCD. There were only 16 patients with diabetes mellitus in our study, but it should be noted that 5 of them had ARCD.

Renal tumors have been described in 16.4% of patients with ARCD. Most of these tumors are adenomas; some are malignant and distant metastasis may be present in a few cases [19,20]. Symptoms associated with neoplasm are gross hematuria, fever, back pain, changing hematocrit levels, and complications from

Table 3. Causes of ESRD for the Total Number of Patients With ESRD and the Subset of Patients With ARCD.

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| Variable              | All Patients With ESRD<br>(N = 376) |      | Subset of Patients<br>With ARCD (n = 31) |      |
|-----------------------|-------------------------------------|------|--|------|
|                       | n                                   | % N  | n  | % N  |
| <b>Cause of ESRD</b>  |                                     |      |  |      |
| Hypertension          | 150                                 | 39.9 | 14                                       | 45.1 |
| DM + hypertension     | 53                                  | 14.1 | 6  | 19.3 |
| Stone + hypertension  | 23                                  | 6.1  | 4  | 12.9 |
| Diabetes mellitus     | 16                                  | 4.3  | 5  | 16.1 |
| Stone                 | 16                                  | 4.3  | 2  | 6.4  |
| Reflux                | 9                                   | 2.4  | 0  | 0    |
| GN + hypertension     | 9                                   | 2.4  | 0  | 0    |
| Gout, Alport syndrome | 6                                   | 1.6  | 0  | 0    |
| Glomerulonephritis    | 3                                   | 0.8  | 0  | 0    |
| Others                | 91                                  | 24.2 | 0  | 0    |

Abbreviations: DM, diabetes mellitus; GN, glomerulonephritis.

metastasis. Ultrasonography is more useful in detection of a neoplasm when compared with intravenous urography, due to renal failure [12,21]. CT with or without contrast is a preferred diagnostic technique for ruling out neoplastic changes in these cysts [19-21]. Magnetic resonance imaging (MRI) with or without gadolinium enhancement may be useful [16,19-22]. Malignancy has been estimated to be 50 times more frequent in patients with ARCD who are undergoing dialysis than in the general population [11,14,18,23]. In our study, 1 tumor was detected in a patient with ARCD.

The exact cause of cystic transformation is unknown, but loss of the functional renal mass probably stimulates production of renotropic factors that promote the development of ARCD [20,24,25]. The reported risk factors for the development of ARCD include the duration of renal failure, number of years on dialysis, and (in some series) male gender and African-American racial/ethnic origin [23,26]. ARCD was reported to occur in 7-22% of patients with chronic renal failure who were not on dialysis [27]. A successful renal transplant leads to regression of ARCD [28].

The present study has a number of limitations. The total number of patients with ARCD was small and all patients came from a single institution. The majority of patients with ESRD had dialysis for less than 1 year, so it is impossible to determine

if a longer period of dialysis would have resulted in a larger percentage of patients with ARCD. It is difficult to calculate reliable statistics or draw conclusions from this sample and further study is needed. However, reports from different patient populations can help to achieve useful data when considered in the total schema of previous studies.

## CONCLUSION

The patients with ARCD in the present study were significantly older than patients with ESRD without ARCD, and they were on dialysis for a significantly longer period of time. Patients who are on long-term hemodialysis should be monitored for the development of ARCD.

**Conflict of Interest:** none declared.

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