Bone Mineral Density in Kuwaiti Patients with End-Stage Renal Disease

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Key Words

Bone mineral density • End-stage renal disease • Chronic renal failure • Kuwaiti patients

Abstract

Objective: This study compared an ethnically uniform group of end-stage renal disease (ESRD) Kuwaiti patients with a control group of healthy Kuwaiti subjects, in terms of their bone mineral density (BMD) and anthropometric measurements. **Subjects and Methods:** Included in the study were 94 males and 129 females with a mean age of 48 ± 10 years. Forty-five males and 53 females had ESRD. The remaining 49 males and 26 females were the control subjects. BMD was measured at total lumbar spine (L1–L4) and total left hip, using dual energy X-ray absorptiometry (HOLOGIC, QRS series, Europe, Belgium). The data were analyzed using SPSS, version 15 (SPSS Inc., Chicago, Ill., USA). The difference in BMD and the anthropometric measurements between the ESRD patients and the controls was assessed. Multivariate linear regression models were used to examine independent effects of ESRD on BMD while adjusting for relevant covariates. **Results:** The ESRD patients had a lower BMD than the controls at the hip (0.81 ± 0.11 vs. 0.92 ± 0.16) and the spine (0.84 ± 0.12 vs. 0.92 ± 0.16), $p < 0.001$. They also had a lower body mass index (27.80 ± 6.03 vs. 30.85 ± 6.54 ; $p < 0.001$) and were taller (162.56 ± 15.31 vs. $156.94 \text{ cm} \pm 10.03$; $p < 0.01$). The reduced BMD persisted after controlling for confounding effects of sex, age and anthropometric measure-

ments ($p < 0.001$). **Conclusion:** Kuwaiti patients with ESRD had a lower BMD and, therefore, an increased risk of osteoporosis and bone fractures. Copyright © 2011 S. Karger AG, Basel

Introduction

The ultimate consequence of chronic renal failure is end-stage renal disease (ESRD), defined as total, or nearly total, permanent kidney failure. ESRD is managed by dialysis until a suitable donor for renal transplantation is available. In Kuwait the incidence rate for ESRD was reported to be 72 and 38.2 patients per million of population per year in adults [1] and in children [2], respectively.

During progressive renal failure, phosphate retention causes secondary hyperparathyroidism. Hyperparathyroidism leads to hypoplastic bone, characterized by increased bone turnover [3]. Furthermore, ESRD patients undergoing dialysis most often are elderly, with numerous comorbid conditions and in a poor nutritional health state [4]. They can also have low body weight and body mass index (BMI) [5, 6], and an increased risk of osteoporosis [7] and hip fracture [8]. This study compared an ethnically uniform group of ESRD patients from Kuwait with a control group of healthy Kuwaiti subjects, in terms of their bone mineral density (BMD) and anthropometric measurements.

Subjects and Methods

The study included 223 Kuwaiti patients with a mean age of 48 ± 10 years (range from 28 to 74). Of these, 94 were males and 129 females, who had a menstrual period during the previous 3 months (premenopausal women). 45 males and 53 females had ESRD. The remaining 49 males and 26 females were the control subjects retrieved from the departmental database.

The patients were referred to the Department of Radiology, Mubarak Al-Kabeer Hospital, Kuwait, from several tertiary health centers for assessment of BMD as a step in the management and preparation for renal transplantation when they had chronic renal disease at stage 4 or 5. Patients who had rheumatic bone disease, rickets or osteomalacia before the onset of chronic renal failure, congenital kidney diseases and a history of corticosteroid therapy for >6 months were excluded from the study. The patients had serum creatinine of 450–900 $\mu\text{mol/l}$ (normal range: 68–98), serum calcium of 2.1–2.5 mmol/l (normal range: 2.1–2.8), serum phosphorus of 1.1–1.6 mmol/l (normal range: 1–1.5) and intact parathyroid hormone of 8–60 pg/ml (range: 10–65). Three patients were on steroids but discontinued around 12–14 months before the study. Informed consent was obtained from the subjects and the study protocol was in conformity with ethical guidelines of the Faculty of Medicine, Kuwait University, Kuwait, and according to Helsinki's declaration.

BMD was measured at total lumbar spine (L1–L4) and total left hip, using dual-energy X-ray absorptiometry (HOLOGIC, QRS series, Europe, Belgium) with a coefficient of variation of 0.51%. The data were analyzed using SPSS, version 15 (SPSS Inc., Chicago, Ill., USA). When appropriate, frequency distribution and descriptive statistics were obtained and the values were expressed as number of cases, percentage of cases and mean $\pm$ standard deviation. The difference in BMD and the anthropometric measurements (height, weight and BMI) between ESRD patients and the control group was assessed using the t test for parametric data and Mann-Whitney test for nonparametric data. Multivariate linear regression models examined independent effects of ESRD on BMD while adjusting for relevant covariates.

Results

The ESRD patients had a significantly lower BMD than the controls at the hip (0.81 ± 0.11 vs. 0.92 ± 0.16 ; $p < 0.001$) and the spine (0.84 ± 0.12 vs. 0.92 ± 0.16 ; $p < 0.001$). They were also younger (45 ± 18 vs. 50 ± 16 years; $p < 0.01$), had a lower BMI (27.80 ± 6.03 vs. 30.85 ± 6.54 ; $p < 0.001$) and were taller (162.56 ± 15.31 vs. 156.94 ± 10.03 cm; $p < 0.01$).

The reduced BMD at the hip and spine in the ESRD patients, compared to that of the controls, persisted after controlling for confounding effects of sex, age and anthropometric measurements using a multivariate linear regression model. The ESRD patients, compared to the controls, had a BMD at the hip by 0.122 g/cm^2 (95% CI: -0.159 to -0.085 ; $p < 0.001$) and a lower BMD at the spine

by 0.08 g/cm^2 (95% CI: -0.188 to -0.043 ; $p < 0.001$). Though small in size, the combined effect of ESRD and gender on hip BMD (2.4%, $p < 0.01$) and that of height on spine BMD (1.3%, $p < 0.05$) were significant. None of the other examined factors had a significant confounding effect on BMD.

Discussion

The study showed that the ESRD patients had a significantly lower hip and spine BMD than the controls. Multivariate linear regression analysis, which was used to control for possible confounding effects of age, gender and anthropometric measurements, revealed that the reduced BMD at the hip and spine was not affected by any of the examined factors, suggesting that ESRD was a significant independent correlate of lower BMD.

Compared to the controls, the BMI was significantly lower in the ESRD patients due to the sequelae of the disease. The BMI is known to correlate positively with the BMD, as in this study, the BMD was lower in the ESRD patients, who had lower BMI, than in the controls, who had a higher BMI. A reduced BMD indicates the poor nutritional health status of ESRD patients, as suggested in previous studies [4–6].

In chronic renal failure, phosphate retention causes secondary hyperparathyroidism, which leads to hypoplastic bone, characterized by increased bone turnover [3, 9]. Lower BMD at all sites have been associated with lower values of glomerular filtration rate in ESRD patients and in some studies with elevated intact parathyroid hormone levels [10, 11].

Reduced BMD exposes ESRD patients to increased risk of osteoporosis [7] and fracture [8], as previously pointed out by Marshall et al. [12]. Fractures in ESRD patients usually occur at sites of constant or heavy stress such as the vertebrae, ribs and, most commonly, femoral necks [13]. Mortality has also been shown to correlate with abnormally low BMI [14].

Conclusion

This study showed that Kuwaiti patients with ESRD have a lower BMD at the hip and spine and are therefore at increased risk of osteoporosis and bone fractures.

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