P228

# *Prognostic factors affecting postoperative activities of daily living in patients with osteoporotic vertebral collapse with neurological deficits*


*M. Kashii [1)], R. Yamazaki [2)], T. Yamashita [3)], S. Okuda [2)], T. Fujimori [1)]*
*Y. Nagamoto [1)], T. Tamura [4)], T. Oda [2)], T. Ohwada [3)], H. Yoshikawa [1)], M. Iwasaki [1)]*

1) Dept. of Orthopedic Surgery, Osaka University Graduate School of Medicine, JAPAN
2) Dept. of Orthopedic Surgery, Osaka Rousai Hospital , JAPAN
3) Dept. of Orthopedic Surgery, Kansai Rousai Hospital , JAPAN
4) Dept. of Orthopedic Surgery, Toyonaka Municipal Hospital , JAPAN

*Correspondence to Masafumi Kashii, M.D., Ph.D.*
*e-mail: mkashii-osk@umin.ac.jp*

# Disclosure


- *This work was supported by Health and Labor Sciences Research Grants for Comprehensive Research on Aging and Health from the Ministry of Health, Welfare, and Labor of Japan.*


- *None of the authors has any financial interest with any of the commercial entities.*
- *Conflicts of Interest : none*

# Introduction

**The strategic target for osteoporotic vertebral collapse (OVC) with neurological deficits is the functional improvement of activities of daily living (ADL).**

Our previous study reported clinical results of three typical surgical procedures for OVC with neurological deficits, and showed that there were no significant differences in clinical results including improvement of activities of daily living (ADL) among surgical procedures. *(O296, Euro Spine 2012)*

We hypothesized that clinical outcomes of surgery in these patients strongly depend on the extent of comorbidities that induce secondary osteoporosis and affect the severity of osteoporosis. We conducted the study to determine the factors that predict postoperative functional decline in ADLs for these patients.

## *Purpose*

**To examine the effects of medical history, comorbidities, and severity of osteoporosis on surgical outcomes for these patients, along with the factors that predict postoperative functional decline in ADL.**

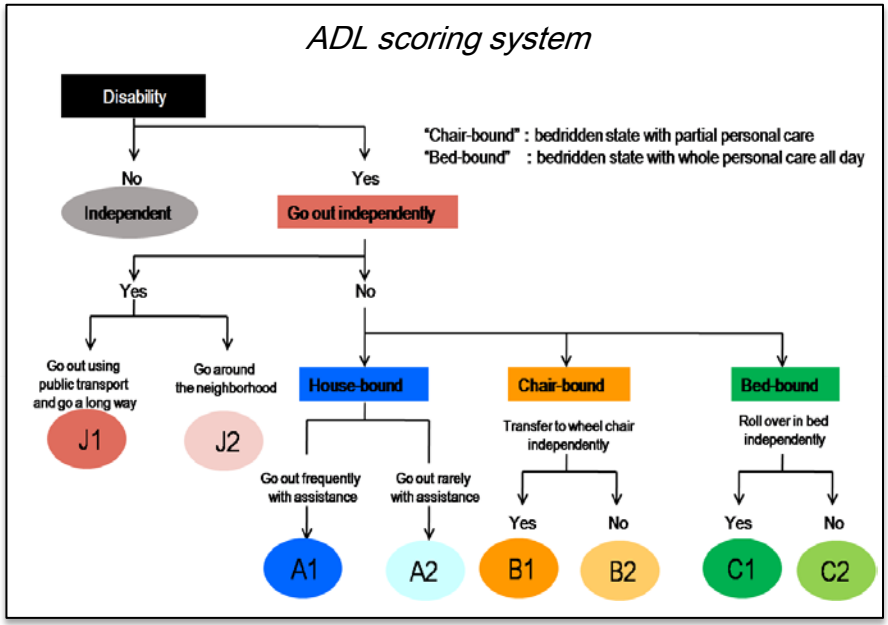
# Materials & Methods

## Study design

- ***Retrospective multicenter study*** (Osaka Univ & three affiliated hospitals)
- Patients with OVC and neurological deficits: **88 cases (2000-2009)**
- Univariate and Multivariate analysis to examine prognostic factors for postoperative ADL function

## Assessment

- ***Osteoporosis assessment***
  - ***Comorbidities*** *responsible for secondary osteoporosis*
  - ***Treatments or medical events*** *that affect bone metabolism*
  - ***Lifestyle habits***
- ***Clinical assessment***
  - ***Pain (Back & Leg pain)***
  - ***Neurological impairment*** *: modified Frankel grading system (A to E: seven-grade)*
  - ***Function in ADL*** *: ADL scoring system (J1 to C2: eight-grade)*
- ***Biochemical examination of blood and urine (Preop)***
- ***Radiological findings***



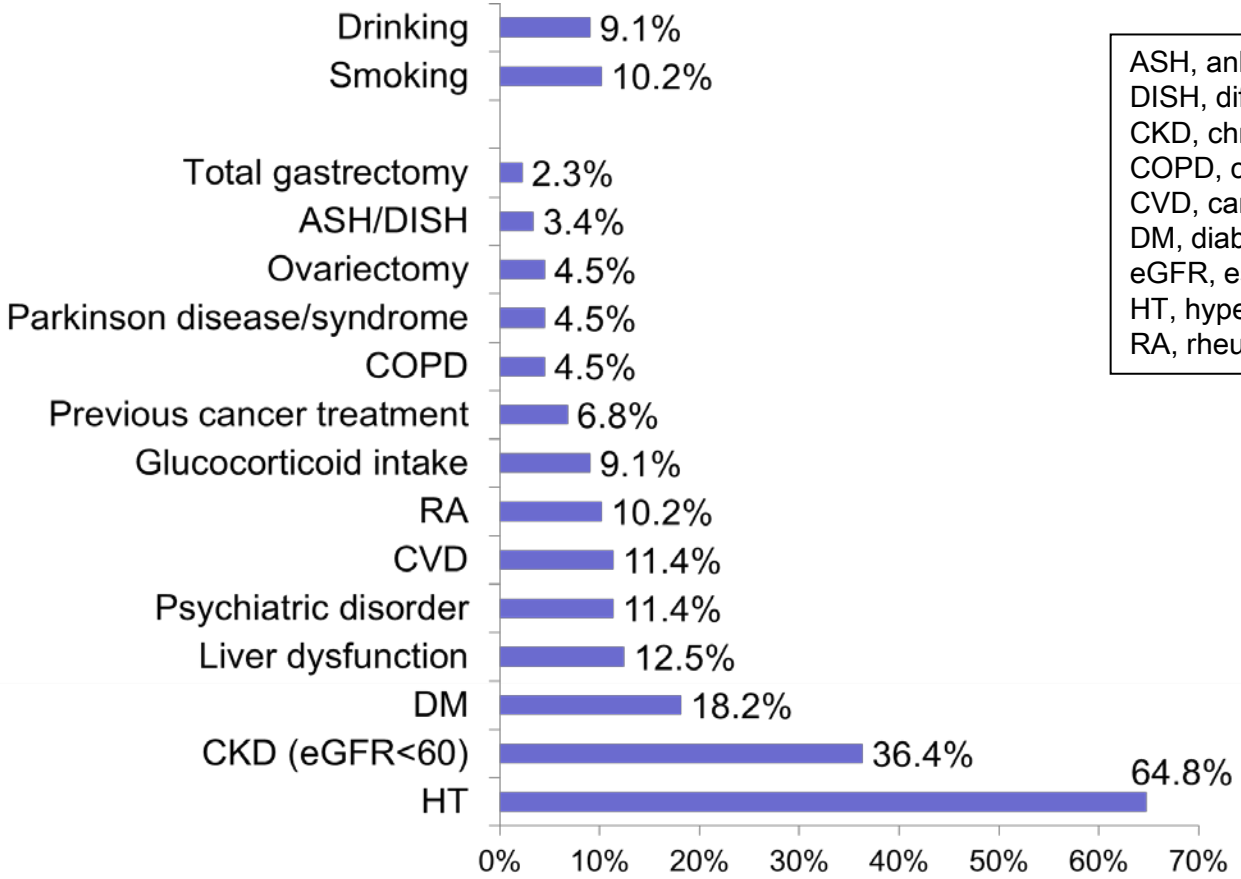
# Results

## *Patients' demographics*

| Variables | Values |
|---|---|
| Age (y) | 75.2 ± 6.4 |
| Sex: Male/female (n) | 29/59 |
| BMI (kg/cm$^2$) | 21.8 ± 3.1 |
| Duration of follow-up period (mo.) | 35.5 ± 27.2 |
| Duration of hospitalization (mo.) | 3.4 ± 2.6 |
| Incidence of traumatic events (%) | 62.5 |
| Incidence of previous fractures (%) | 57.9 |
| Number of the collapsed vertebrae (T7-L4) | T7:2, T10: 2, T11:11, T12:42, L1: 28, L2:5, L3:3, L4:1 *T11 - L2 : 92.0%* |
| Presence of old VFs(%) | 47.7 |
| Incidence for location of affected vertebra (%) | Adjacent 56 / Nonadjacent 44 |
| Incidence for number of concurrent old VFs (%) | 1: 61 / >2: 39 |

*Values are shown as means ± SD.* *BMI, body mass index; VF, vertebral fracture*

# *Preoperative osteoporosis assessment of patients with OVC and neurological deficits*




ASH, ankylosing spinal hyperostosis
DISH, diffuse idiopathic skeletal hyperostosis
CKD, chronic kidney disease
COPD, chronic obstructive pulmonary disease
CVD, cardiovascular disease
DM, diabetes mellitus
eGFR, estimated glomerular filtration rate
HT, hypertension
RA, rheumatoid arthritis

# *Clinical outcomes for patients with OVC and neurological deficits*

| Variables | Preoperative Score (Points) | Postoperative Score (Points) | *Improvement Rate (%)* |
|---|---|---|---|
| **Pain** (on a scale of 0 [severe] to 3 [none or negligible])<br>1. Low back pain or back pain<br>2. Leg pain | <br>1.21 ± 0.94<br>1.83 ± 1.14 | <br>1.92 ± 0.66<br>2.68 ± 0.66 | <br>*39.7*<br>*72.6* |
| **Neurological impairment**<br>(according to the modified Frankel grading system) | 2.91 ± 1.15<br>(D1) | 4.77 ± 1.03<br>(D2–D3) | *60.2* |
| **Scores for function in ADL**<br>(on the scale of the Ministry of Health, Welfare, and Labor of Japan) | 1.98 ± 1.29<br>(B2) | 4.74 ± 1.64<br>(A1–A2) | *55.0* |

*Values are shown as means ± SD.*

Nine patients who had a deep infection after spinal instrumentation surgery were excluded from the study, as were 2 other patients who sustained cerebral infarctions after surgery. The remaining 77 patients were divided into two groups: good ADL (ADL score of J1–A2; 59 patients [75.4%]) and poor ADL (ADL score of B1–C2; 18 patients [24.6%]).

# Results of univariate analysis (good vs poor ADL function) [a]

| Variables | Good [b] (n = 59) | Poor [c] (n = 18) | OR (95% CI) | p Value |
|---|---|---|---|---|
| Age/1 year | 74.8 | 76.4 | 0.96 (0.87–1.04) | 0.32 |
| Sex (M/F) | 16/43 | 8/10 | 0.47 (0.16–1.41) | 0.17 |
| Presence of HT | 59% | 94% | 11.7 (2.16–217.0) | 0.002 |
| Presence of DM | 11.9% | 33.3% | 3.71 (1.03–13.3) | 0.044 |
| Preop ADL score | 3.20 | 2.39 | 1.80 (1.13–3.15) | 0.013 |
| Hb/1 unit | 12.1 | 11.0 | 1.53 (1.10–2.23) | 0.011 |
| CK/1 unit | 79.4 | 129.0 | 0.99 (0.98–1.00) | 0.02 |
| Alb/1 unit | 3.69 | 3.35 | 3.07 (1.08–9.50) | 0.03 |
| ALP/1 unit | 276.4 | 389.1 | 0.994 (0.989–0.999) | 0.014 |
| Cr/1 unit | 0.72 | 0.99 | 0.060 (0.007–0.365) | 0.0009 |
| eGFR/1 unit | 72.3 | 52.3 | 1.05 (1.02–1.10) | 0.0007 |

*[a]Values are shown as means. [b]Good function in ADLs: scores J1–A2. [c]Poor function in ADLs: scores B1–C2. Alb, albumin; ALP, alkaline phosphatase; DM, diabetes mellitus; CI, confidence interval; CK, creatine kinase; Cr, creatinine; eGFR, estimated glomerular filtration rate; Hb, hemoglobin; HT, hypertension; OR, odds ratio.*

Stepwise methods for the multivariate analysis

**eGFR, ALP**, Hb, Presence of HT, Preop ADL score

# *Results of Multiple logistic regression analysis (good vs poor ADL function)*

| Characteristics | ADL Status | | Univariate | | Multivariate | |
|---|---|---|---|---|---|---|
| | Good (n) | Poor (n) | OR (95% CI) | *p Value* | OR (95% CI) | *p Value* |
| Age/1 year | | | 0.96 (0.87–1.04) | *0.32* | 0.97 (0.86–1.07) | *0.51* |
| Sex | | | | | | |
| Male | 16 | 8 | 1 | | 1 | |
| Female | 43 | 10 | 0.47 (0.16–1.41) | *0.17* | 0.86 (0.21–3.87) | *0.84* |
| eGFR ($ml/min/1.73m^2$) | | | | | | |
| eGFR≥60 | 43 | 6 | 1 | | 1 | |
| eGFR<60 | 16 | 12 | 5.38 (1.40–14.8) | *0.011* | 6.52 (1.65–51.5) | *0.007* |
| ALP (IU/L) | | | | | | |
| ALP <300 | 39 | 7 | 1 | | 1 | |
| ALP ≥300 | 20 | 11 | 3.06 (1.10–10.1) | *0.03* | 5.77 (1.42–28.6) | *0.014* |

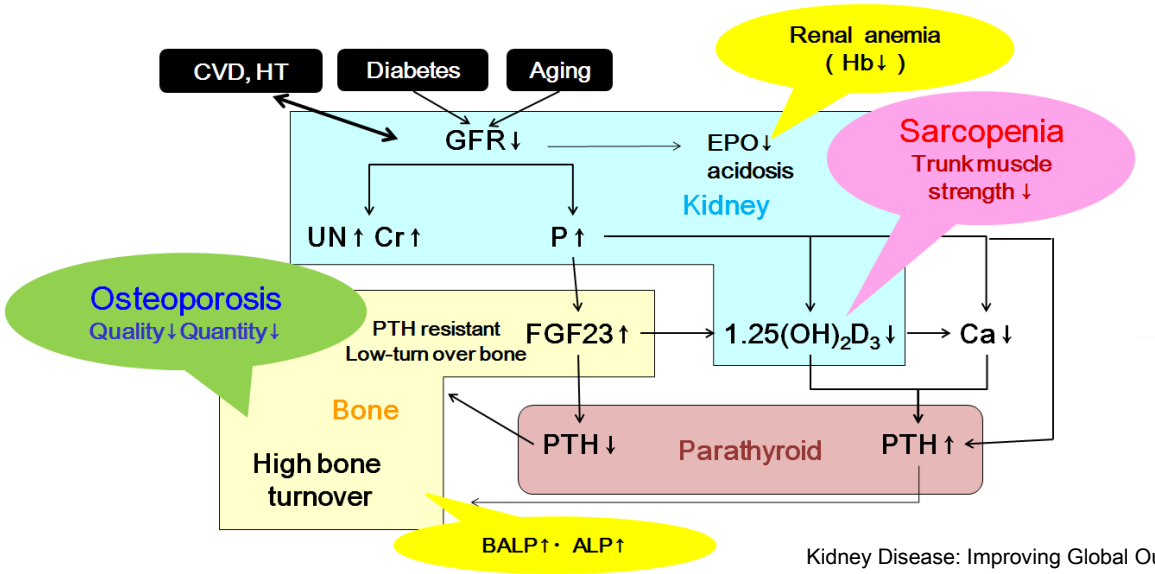
The results of multiple logistic regression analysis using *four explanatory variables - age, sex, eGFR, and high serum ALP level* - revealed that ***a decrease in the eGFR and a high serum ALP level were the preoperative factors that best predicted poor postoperative function in ADL*** for patients with OVC and neurological deficits.

# Discussions

The term ***chronic kidney disease–mineral and bone disorder*** (CKD-MBD) has been widely adopted to describe the clinical systemic disorder caused by the mineral and bone metabolism changes that occur in renal disease.

Patients with this systemic syndrome are described as having evidence of one or more of the following:

1) Abnormalities of calcium, phosphate, PTH, or vitamin D metabolism
2) Vascular or soft-tissue calcification
3) Abnormalities in bone turnover, mineralization, volume, linear growth, or strength




ALP, alkaline phosphatase
BALP, bony alkaline phosphatase
Cr, creatinine
CVD, cardiovascular disease
EPO, erythropoietin
FGF23, fibroblast growth factor 23
GFR, glomerular filtration rate
Hb, hemoglobin
HT, hypertension
UN, urea nitrogen

Kidney Disease: Improving Global Outcomes (KDIGO) CKD-MBD Work Group: **Kidney Int 76**: S1–S130, 2009

End-stage renal dysfunction is characterized by several metabolic and hormonal abnormalities, including hyperphosphatemia; hypocalcemia; increased secretion of PTH, which leads to high serum BALP levels and high bone turnover; and vitamin D insufficiency, which leads to sarcopenia, a defective sense of balance, and increased risk of falls.
A significant risk of mortality of all-cause mortality, cardiovascular disease, and cardiovascular events was observed in CKD patients with disturbances of bone and mineral metabolism.

Eddington H, Kalra PA. **J Ren Care 36 (Suppl 1)**:61–67, 2010

The role of ALP has been highlighted in terms of its effects in vascular disease, and its activity is often used as a molecular marker and an early indicator of vascular calcification. Vascular calcification is momentous in vascular aging and atherosclerotic process, and is known to one of the phenotype of CKD-MBD. High turnover of bone metabolism and high serum PTH levels are also powerful risk factors for mortality in fragile elderly patients. Each doubling of serum ALP and CKD was significantly associated with increased risk of all-cause mortality and QOL.

Beddhu S, et al. **Clin J Am Soc Nephrol 4**:1805–1810, 2009
Sambrook PN, et al. J Bone Miner Res 21:549–555, 2006
Blayney MJ, et al. Kidney Int 74:655–663, 2008
Johnson RC, et al. Circ Res 99: 1044–1059, 2006

We firstly showed the relationship between surgical outcomes for osteoporotic spine and CKD-MBD which influence general health and severity of osteoporosis. The majority of patients with OVC and poor postoperative function in ADLs have advanced-stage CKD with a disorder of bone metabolism as well as bone fragility. Other studies have provided collateral evidence **that a decline in renal function and a high serum ALP level are valuable indicators in evaluating both general health and the severity of osteoporosis in patients.**

# Conclusion

- *Decrease in renal function and high serum ALP levels strongly predict the functional deterioration in ADLs of patients with OVC and neurological deficits.*
- *It is important to recognize that osteoporosis is a systemic disorder and that it can be caused by CKD-MBD.*
- *Surgeons must evaluate both general health and the severity of osteoporosis in these patients to plan surgical treatment and to choose the best surgical procedure for them.*