**SUPPORTING INFORMATION**

**Association of Hyperkalemia and Hypokalemia with Patient Characterstics and Clinical Outcomes in Japanese Hemodialysis (HD) Patients**

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**Table S1. List of comorbidities**

| Comorbidity | Definition in ICD-10 code |
|---|---|
| Heart Failure (HF) | I50, I110 |
| Diabetes (DM) | E10-E14 |
| Diabetic nephropathy | E102, E112, E122, E132, E142 |
| Hypertension | I10-I15 |
| Glomerular diseases | N05-N08 |
| COPD | J44 |
| Stroke | I60, I61, I63, I64 |
| Myocardial Infarction (MI) | I21, I22 |
| Atherosclerotic heart disease of native coronary artery | I25.1 |
| Chronic ischaemic heart disease | I25.2, I25.8, I25.9 |
| Other acute ischaemic heart diseases | I24.0 |
| Unstable angina | I20.0 |
| Angina pectoris, unspecified | I20.9 |
| Peripheral vascular diseases | I70-I74, I77 |
| Cerebrovascular diseases | I60-I69, G45 |
| Dementia | F00-F03, F051, G30 |
| Chronic pulmonary diseases | J40-J47, J60-J67, J684, J701, J703, J841, J920, J961, J982, J983 |
| Connective tissue diseases | M05, M06, M08, M09, M30, M31, M32, M33, M34, M35, M36, D86 |
| Ulcer diseases | K221, K25-K28 |
| Mild liver diseases | B18, K700-K703, K709, K71, K73, K74, K760 |
| Hemiplegia | G81, G82 |
| Any Malignant tumour | C00-C75 |

| Comorbidity | Definition in ICD-10 code |
|---|---|
| Leukaemia | C91-C95 |
| Moderate to severe liver diseases | B150, B160, B162, B190, K704, K72, K766, I85 |
| Metastatic solid tumour | C76-C80 |
| HIV diseases | B21-B24 |
| Atrial flutter | I483, I484 |
| Atrial fibrillation | I480, I481, I482 |
| Cardiomyopathy | I42 |
| Heart valve diseases | I34, I35, I05, I06, I07, I08, I091, I099, I36-39 |
| Alcoholism-related or other substance-abuse related disorders | F10-F19 |
| Obesity | E66 |
| Cardiac arrhythmia | I44, I45, I47-I49 |
| Atrioventricular block | I440, I441, I442, I443 |
| Bundle branch block | I444, I445, I446, I447, I451, I452, I453, I454 |
| Cardiac arrest | I46 |
| Paroxysmal supraventricular tachycardia, Atrial tachycardia, Re-entrant arrhythmia, WPW syndrome | I470, I471, I456 |
| Ventricular tachycardia | I472 |
| Torsade de pointes, Ventricular fibrillation | I490 |
| Premature atrial contraction | I491 |
| Premature ventricular contraction | I493 |
| Sick sinus syndrome | I495 |
| Oedema | R60 |
| Sarcopenia | M625 |
| Presence of cardiac pacemaker | Z950 |

| Comorbidity | Definition in ICD-10 code |
|---|---|
| Polycystic kidney | Q612-Q613 |
| Transplanted organ and tissue status | Z94 |

Abbreviation: ICD-10, International Classification of Diseases 10th revision

**Table S2. Definitions of clinical outcomes**

| Outcome | Definition |
|---|---|
| All cause mortality | either in hospital death or in DPC hospital death |
| All cause Hospitalization | Record at least one hospitalization by any causes during the follow-up period. |
| Major adverse cardiovascular disease | Any of all cause mortality, myocardial infarction, or stroke |
|  | Myocardial infarction is defined as ICD-10 code I21 or I22. |
|  | Stroke is defined as ICD-10 code I61 or I63. |
| Cardiac arrest | ICD-10 code I46 |
| Fatal arrhythmia | Ventricular tachycardia, Torsade de pointes, Ventricular fibrillation as ICD-10 code I472 or I490 |
| Death related to arrhythmia | death within 3 days of fatal arrythmia |

Abbreviations: HF, heart failure; ICD-10, International Classification of Diseases 10th revision

**Table S3. Cumulative incidence of clinical outcomes in outpatient managed patients undergoing HD 3 times/week during baseline period**

| Clinical outcomes | Overall (n=22,846) | | Normo-K (n=1,624) | | Hyper-K (n=909) | | | | Hypo-K (n=313) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | 100 PY | N | 100 PY | N | 100PY | Crude HR (95% C.I) | Adjusted[a] HR (95% C.I) | N | 100PY | Crude HR (95% C.I) | Adjusted[a] HR (95% C.I) |
| **All cause mortality** | | | | | | | | | | | | |
| at 6 months | 58 | 4.16 | 32 | 4.02 | 15 | 3.36 | | | 11 | 7.22 | | |
| at 1 years | 166 | 6.10 | 89 | 5.73 | 49 | 5.62 | | | 28 | 9.48 | | |
| at 3 years | 498 | 7.21 | 273 | 6.92 | 158 | 7.02 | | | 67 | 9.37 | | |
| at 5 years | 727 | 7.60 | 392 | 7.21 | 240 | 7.55 | | | 95 | 9.99 | | |
| over entire follow-up | 947 | 7.78 | 513 | 7.41 | 314 | 7.50 | 1.01 (0.87, 1.16) | 0.92 (0.78, 1.09) | 120 | 11.29 | 1.58 (1.30, 1.94) | 1.47 (1.13, 1.92) |
| **MACE** | | | | | | | | | | | | |
| at 6 months | 125 | 9.08 | 60 | 7.61 | 37 | 8.39 | | | 28 | 18.90 | | |
| at 1 years | 287 | 10.80 | 140 | 9.18 | 96 | 11.27 | | | 51 | 18.10 | | |
| at 3 years | 727 | 11.10 | 392 | 10.41 | 236 | 11.11 | | | 99 | 15.07 | | |
| at 5 years | 995 | 11.19 | 529 | 10.39 | 333 | 11.30 | | | 133 | 15.61 | | |
| over entire follow-up | 1238 | 11.20 | 671 | 10.63 | 415 | 10.88 | 1.02 (0.91, 1.16) | 0.97 (0.84, 1.12) | 152 | 16.29 | 1.57 (1.31, 1.87) | 1.48 (1.17, 1.86) |
| **Hospitalization** | | | | | | | | | | | | |
| at 6 months | 666 | 54.28 | 354 | 50.36 | 230 | 58.85 | | | 82 | 61.58 | | |
| at 1 years | 1,068 | 49.12 | 582 | 46.33 | 360 | 52.63 | | | 126 | 53.89 | | |
| at 3 years | 1,814 | 42.05 | 996 | 39.34 | 615 | 45.62 | | | 203 | 46.77 | | |
| at 5 years | 2,076 | 40.52 | 1,151 | 38.22 | 704 | 43.70 | | | 221 | 44.12 | | |
| over entire follow-up | 2,194 | 39.20 | 1,216 | 37.00 | 751 | 41.97 | 1.14 | 1.09 | 227 | 43.54 | 1.13 | 1.13 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | (1.04, 1.24) | (0.98, 1.22) | | | (0.98, 1.31) | (0.94, 1.37) |
| **Cardiac arrest** | | | | | | | | | | | | |
| at 6 months | 7 | 0.50 | 4 | 0.50 | 2 | 0.45 | | | 1 | 0.66 | | |
| at 1 years | 19 | 0.70 | 9 | 0.58 | 9 | 1.03 | | | 1 | 0.34 | | |
| at 3 years | 56 | 0.81 | 27 | 0.68 | 23 | 1.02 | | | 6 | 0.84 | | |
| at 5 years | 75 | 0.79 | 35 | 0.64 | 30 | 0.95 | | | 10 | 1.05 | | |
| over entire follow-up | 105 | 0.86 | 54 | 0.78 | 41 | 0.98 | 1.24 (0.83, 1.86) | 1.30 (0.80, 2.12) | 10 | 0.94 | 1.31 (0.66, 2.60) | 1.41 (0.58, 3.38) |
| **Fatal arrythmia** | | | | | | | | | | | | |
| at 6 months | 8 | 0.57 | 3 | 0.38 | 5 | 1.12 | | | 0 | 0.00 | | |
| at 1 years | 17 | 0.63 | 8 | 0.52 | 9 | 1.04 | | | 0 | 0.00 | | |
| at 3 years | 43 | 0.63 | 19 | 0.48 | 24 | 1.08 | | | 0 | 0.00 | | |
| at 5 years | 60 | 0.63 | 32 | 0.59 | 26 | 0.83 | | | 2 | 0.21 | | |
| over entire follow-up | 77 | 0.64 | 43 | 0.63 | 32 | 0.78 | 1.25 (0.79, 1.97) | 1.44 (0.86, 2.39) | 2 | 0.19 | 0.31 (0.08, 1.30) | 0.28 (0.04, 2.16) |
| **Death related to arrythmia** | | | | | | | | | | | | |
| at 6 months | 1 | 0.07 | 0 | 0.00 | 1 | 0.22 | | | 0 | 0.00 | | |
| at 1 years | 3 | 0.11 | 1 | 0.06 | 2 | 0.23 | | | 0 | 0.00 | | |
| at 3 years | 12 | 0.17 | 3 | 0.08 | 9 | 0.40 | | | 0 | 0.00 | | |
| at 5 years | 15 | 0.16 | 5 | 0.09 | 9 | 0.28 | | | 1 | 0.11 | | |
| over entire follow-up | 19 | 0.16 | 7 | 0.10 | 11 | 0.26 | 2.65 (1.03, 6.84) | 3.11 (1.03, 9.33) | 1 | 0.09 | 0.98 (0.12, 8.07) | 2.65 (0.31, 22.89) |

To estimate the hazard ratio, the Normo-K group will be used as the reference level.
a Adjustments: age, gender, dialysis vintage, index year, body mass index (BMI), albumin, C-reactive protein (CRP), urea reduction ratio (URR), serum Ca, serum phos-phorus (centralized by subtracting mean), serum phosphorus squared (squared after centralized), hemoglobin (HGB), HD treatment time, Charlson Comorbidity Index (CCI), and history of comorbidities: heart failure, diabetes, cardiovascular comorbidities, myocardial Infarction, other acute ischemic heart diseases, atherosclerotic heart disease of native coronary artery, chronic ischemic heart disease, stroke, unstable angina, angina pectoris unspecified, hear failure, and diabetes.