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Dialysis Case Volume Associated With In-Hospital Mortality in Maintenance Dialysis Patients

Shintaro Mandai[1], Hidehiko Sato[1], Soichiro Iimori[1], Shotaro Naito[1], Takayasu Mori[1], Daiei Takahashi[1], Moko Zeniya[1], Naohiro Nomura[1], Eisei Sohara[1], Tomokazu Okado[1], Shinichi Uchida[1], Kiyohide Fushimi[2] and Tatemitsu Rai[1]

[1]Department of Nephrology, Graduate School of Medical and Dental Sciences, Tokyo Medical and Dental University, Tokyo, Japan; and [2]Department of Health Policy and Informatics, Graduate School of Medical and Dental Sciences, Tokyo Medical and Dental University, Tokyo, Japan

Introduction: Accumulating evidence suggests that a large hospital volume (HV) is associated with favorable outcomes in various diseases or surgical procedures. The aim of this study is to clarify the correlation of HV and dialysis case volume (DCV) with in-hospital death in patients on maintenance dialysis.

Methods: The study cohort was derived from the Diagnosis Procedure Combination database, a national inpatient database in Japan, from 2012 to 2014. We included 382,689 admissions of maintenance dialysis patients over the age of 20 years in the analysis. HV was defined as the mean number of daily hospitalized patients, and DCV was defined as the mean number of annually hospitalized patients on maintenance dialysis. The primary outcome was in-hospital all-cause mortality, evaluated using multivariable logistic regression models across the respective quartiles of HV and DCV.

Results: The mean age of participants was 69 $\pm$ 12 years; 94% were receiving hemodialysis, and 21,182 patients (5.5%) died after hospitalization. In unadjusted models, larger HV and DCV were both associated with lower in-hospital mortality. However, this association remained significant only for DCV after adjustment for potential confounders, with multivariable-adjusted odds ratios of 0.82 (95% confidence interval [CI], 0.79–0.85), 0.76 (95% CI, 0.73–0.80), and 0.68 (95% CI, 0.65–0.72) for DCV 249 to 432, 433 to 713, and $\geq$714 (vs. $\leq$ 248) admissions per year, respectively. Multivariable subgroup analyses determined that this association was independent of age, sex, dialysis modality, Charlson Comorbidity Index, and emergency admission.

Conclusion: Selective admission to hospitals with a large DCV may improve outcomes of dialysis patients.

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End-stage kidney disease (ESKD) is highly associated with morbidity and mortality, accounting for a substantial proportion of the social and economic burden worldwide.[1–3] Despite much advancement in dialysis care and techniques over the past several decades, mortality risk remains considerably high in patients on maintenance dialysis at approximately 10% to 15% per year, which is 7- to 8-fold higher than in the general population.[2–5] The hospitalization rate of dialysis patients also remains high, with 1.5 to 2.0 admissions per person-year; this rate is nearly 3- to 4-fold that of the general population when age adjusted.[3,6] Therefore, the much greater risk of in-hospital mortality of dialysis patients would explain the greater overall risk of mortality.

Recent attempts to clarify the association between hospital volume (HV) and in-hospital mortality showed that a larger HV is associated with increased survival in various diseases such as sepsis, breast cancer, chronic obstructive pulmonary disease, acute myeloid leukemia, peripheral arterial disease, and deep vein thrombosis,[7–13] as well as after surgical procedures.[14,15] HV is usually defined as the number of hospitalization cases[7–11] or specific procedures[12–15] at each hospital. Thus, a larger HV is associated with a greater number of case

Correspondence: Tatemitsu Rai, Department of Nephrology, Graduate School of Medical and Dental Sciences, Tokyo Medical and Dental University, 1-5-45 Yushima, Bunkyo, Tokyo 113-8519, Japan. E-mail: trai.kid@tmd.ac.jp

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experiences, doctors with expertise in treating the disease, hospital infrastructure, and resources. These factors ultimately result in higher-quality patient care, leading to improved outcomes. Thus, these results suggest that selective admission or referrals to large HV hospitals could potentially improve outcomes, particularly when the disease is severe and requires more expertise for treatment. However, it has not been elucidated whether HV is associated with outcomes in maintenance dialysis patients. Moreover, dialysis case volume (DCV), when defined as the number of hospitalized patients on maintenance dialysis at each hospital, would be a previously unrecognized hospital volume factor specifically related to dialysis patients, indicating dialysis care quality of the hospital. Thus, we hypothesized that DCV also has an impact on clinical outcomes in this population. The aim of the present study was to investigate whether HV and DCV are associated with in-hospital mortality in patients undergoing maintenance dialysis, using a Japanese nationwide database.

METHODS

Data Source

The study cohort was derived from the Diagnosis Procedure Combination (DPC) database, a nationwide inpatient database in Japan, as well as a case-mix classification system linked with a payment system. Additional details of the database have been described elsewhere.[16] Briefly, more than 1000 hospitals in Japan, including all 82 teaching hospitals, participate in the database. The annual number of admissions added to the database is approximately 7 million, accounting for about 50% of all admissions in Japan. The database contains administrative claims and discharge abstract data, including the following: a unique hospital identifier; patient age and sex; diagnoses and comorbidities at the time of admission, coded according to the International Classification of Diseases and Related Health Problems, 10th Revision (ICD-10)[17]; Charlson Comorbidity Index (CCI)[18] updated for use in ESKD patients[19] at the time of admission; and discharge status. Although the updated CCI in ESKD[19] divided the original CCI category "any malignancy, including leukemia and lymphoma" into neoplasia, leukemia, and lymphoma, data for each of these subsets were unavailable in our datasets. Thus, for the category "any malignancy, including leukemia and lymphoma," we applied the score from the original CCI score.[18] The database also includes information on patient care processes, including drug administration, surgical procedures, or devices used.

This study was approved by the ethics committee of Tokyo Medical and Dental University, and the research was conducted in accordance with the ethical principles of the Declaration of Helsinki. The requirement for informed consent was waived because of the anonymous nature of the data.

Patient Selection and Data

Among the 22,433,171 admissions of patients who were hospitalized from 2012 to 2014, we retrieved records for all patients ≥20 years of age who had received maintenance dialysis sessions during hospitalization (Figure 1). Each maintenance hemodialysis or peritoneal dialysis session was identified based on the code of patient care procedures: chronic maintenance hemodialysis with <4 hours per session, ≥4 hours and <5 hours per session, ≥5 hours per session, chronic maintenance hemodiafiltration, or continuous peritoneal dialysis. Incident dialysis patients who were admitted for initiation of dialysis are not included in this data extraction. Patients were excluded if their hospital length of stay was <24 hours, and therefore patients for day stay procedures and dialysis sessions are not included. Patients were also excluded if they lacked body mass index (BMI) data or admission type (elective or emergency admission). Overall, 382,689 admissions were included in the analysis (Figure 1).

Patient-level data included age, sex, BMI, dialysis modality (hemodialysis, peritoneal dialysis, or both), CCI score on admission, admission type, fiscal year of admission, length of stay, and in-hospital death. The hospital-level characteristics included HV, DCV, and hospital type (advanced treatment hospital approved by the Minister of Health, Labor and Welfare in Japan or not). HV was defined as the mean daily number of hospitalized patients with and without ESKD. DCV was defined as the mean annual number of hospitalized patients receiving maintenance dialysis.

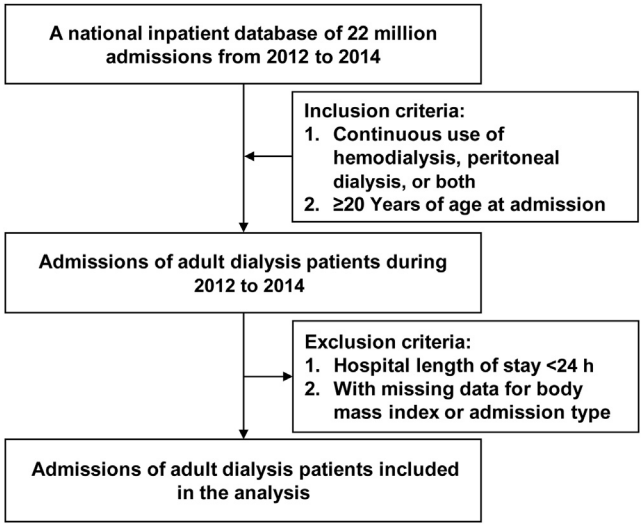

Figure 1. Flowchart of patient selection.