Supplementary Table 1. Characteristics of study participants included and excluded from the analyses

|  |  |  |  |
| --- | --- | --- | --- |
|  | Included | Excluded |  |
| Characteristics | n = 183,490 | n = 43,509 | P-value |
| Age, years | 64.3 (12.6) | 65.1 (12.6) | <0.001 |
| Female, n (%) | 71,660 (39.1) | 16,973 (39.0) | 0.9 |
| BMI, kg/m2 | 22.0 (4.0) | 21.8 (3.9) | <0.001 |
| Dialysis vintage, years | 5 [2–10] | 5 [2–10] | 0.002 |
| Hemodialysis duration, hours/week | 11.6 (1.8) | 11.5 (1.9) | <0.001 |
| Blood flow, mL/min | 198 (32) | 196 (35) | <0.001 |
| Type of vascular access at the initiation of hemodialysis |  |  | <0.001 |
|  AVF | 5,244 (73.4) | 635 (66.1) |  |
|  AVG | 133 (1.9) | 19 (2.0) |  |
|  AS | 61 (0.9) | 9 (0.9) |  |
|  TC-CVC | 84 (1.2) | 12 (1.2) |  |
|  NT-CVC | 1,618 (22.7) | 286 (29.8) |  |
| Cause of ESKD, n (%) |  |  | <0.001 |
|  Glomerulonephritis | 74,160 (40.5) | 17,312 (40.2) |  |
|  Diabetes | 55,414 (30.2) | 13,191 (30.6) |  |
|  Nephrosclerosis | 11,758 (6.4) | 2,524 (5.9) |  |
|  Polycystic kidney disease | 6,137 (3.3) | 1,160 (2.7) |  |
|  Others | 23,513 (12.8) | 5,379 (12.5) |  |
|  Unknown | 12,271 (6.7) | 3,542 (8.2) |  |
| History, n (%) |  |  |  |
| Myocardial infarction | 10,184 (6.1) | 881 (8.3) | <0.001 |
| Cerebral infarction | 20,904 (12.6) | 1,675 (15.7) | <0.001 |
| Cerebral hemorrhage | 6,495 (3.9) | 465 (4.4) | 0.01 |
|  Limb amputation | 4,123 (2.5) | 431 (3.9) | <0.001 |
| Laboratory tests |  |  |  |
| Hemoglobin, g/dL | 10.3 (1.3) | 10.1 (1.4) | <0.001 |
| Albumin, g/dL | 3.8 (0.4) | 3.7 (0.5) | <0.001 |
| Albumin-adjusted calcium, mg/dL | 9.3 (0.9) | 9.4 (1.0) | <0.001 |
| Phosphate, mg/dL | 5.4 (1.5) | 5.3 (1.5) | 0.01 |
| Intact PTH, pg/mL | 135 [63–243] | 135 [62–245] | 0.6 |
| Ferritin, ng/mL | 137 [54–284] | 134 [51–277] | 0.06 |
| Proportion of AVFs within the four types of vascular access in each facility, % | 92.9 [87.5–96.3] | 94.4 [88.2–100.0] | <0.001 |

Values are presented as means (standard deviation) or medians [interquartile range] unless otherwise indicated.

Abbreviations: BMI, body mass index; ESKD, end-stage kidney disease; PTH, parathyroid hormone.

Supplementary Table 2. Hazard ratios and 95% confidence intervals by covariates, fully adjusted model

|  |  |
| --- | --- |
|  | Adjusted HR (95% CI) |
| Characteristics | All-cause mortalityn = 104,913 | Infection-related mortalityn = 104,913 | Cardiovascular mortalityn = 104,913 |
| Vascular access |  |  |  |
| AVF | ref | ref | ref |
| AVG | 1.30 (1.20–1.41) | 1.47 (1.18–1.84) | 1.35 (1.17–1.55) |
|  AS | 1.56 (1.39–1.76) | 1.75 (1.29–2.36) | 1.50 (1.22–1.85) |
| TC-CVC | 2.15 (1.77–2.61) | 2.75 (1.75–4.33) | 2.58 (1.87–3.56) |
| Age, years (per 1-year increase) | 1.04 (1.04–1.05) | 1.06 (1.05–1.06) | 1.04 (1.04–1.05) |
| Female, n (%) | 0.73 (0.70–0.77) | 0.70 (0.61–0.81) | 0.81 (0.74–0.88) |
| BMI, kg/m2 (per 1-kg/m2 increase) | 0.91 (0.90–0.92) | 0.88 (0.86–0.90) | 0.91 (0.89–0.92) |
| Dialysis vintage, years (per 1-year increase) | 1.01 (1.01–1.01) | 1.01 (1.00–1.02) | 1.01 (1.00–1.02) |
| Hemodialysis duration, hours/week (per 1-hour increase) | 0.94 (0.93–0.95) | 0.94 (0.90–0.97) | 0.93 (0.91–0.95) |
| Cause of ESKD, n (%) |  |  |  |
|  Glomerulonephritis | ref | ref | ref |
|  Diabetes | 1.43 (1.35–1.52) | 1.41 (1.19–1.67) | 1.59 (1.43–1.76) |
|  Nephrosclerosis | 1.03 (0.94–1.13) | 0.86 (0.66–1.12) | 1.10 (0.94–1.29) |
|  Polycystic kidney disease | 0.88 (0.75–1.03) | 1.08 (0.71–1.64) | 0.76 (0.56–1.03) |
|  Others | 1.01 (0.93–1.10) | 1.16 (0.93–1.46) | 1.09 (0.94–1.26) |
|  Unknown | 1.13 (1.02–1.24) | 1.00 (0.76–1.32) | 1.13 (0.95–1.34) |
| History, n (%) |  |  |  |
| Myocardial infarction | 1.42 (1.32–1.54) | 1.09 (0.86–1.38) | 1.79 (1.59–2.02) |
| Cerebral infarction | 1.42 (1.34–1.50) | 1.43 (1.23–1.66) | 1.46 (1.33–1.60) |
| Cerebral hemorrhage | 1.32 (1.20–1.45) | 1.62 (1.27–2.07) | 1.41 (1.20–1.65) |
|  Limb amputation | 1.72 (1.55–1.91) | 1.60 (1.18–2.15) | 2.18 (1.85–2.57) |
| Laboratory tests |  |  |  |
| Hemoglobin, g/dL (per 1-g/dL increase) | 0.91 (0.90–0.93) | 0.92 (0.88–0.97) | 0.90 (0.88–0.93) |
| Albumin, g/dL (per 1-g/dL increase) | 0.31 (0.29–0.32) | 0.25 (0.21–0.28) | 0.40 (0.36–0.44) |
| Albumin-adjusted calcium, mg/dL |  |  |  |
| <8.4 | 1.00 (0.92–1.08) | 1.16 (0.92–1.46) | 1.02 (0.89–1.17) |
| 8.4–9.2 | ref | ref | ref |
|  9.3–10.0 | 1.11 (1.04–1.17) | 1.14 (0.96–1.35) | 1.11 (1.00–1.23) |
|  10.1–10.9 | 1.24 (1.15–1.33) | 1.36 (1.11–1.67) | 1.21 (1.06–1.37) |
|  ≥11.0 | 1.34 (1.20–1.49) | 1.21 (0.89–1.64) | 1.49 (1.24–1.79) |
| Phosphate, mg/dL |  |  |  |
| <3.5  | 1.28 (1.19–1.37) | 1.26 (1.04–1.52) | 1.22 (1.07–1.39) |
|  3.5–4.7 | ref | ref | ref |
|  4.8–6.0 | 0.96 (0.91–1.02) | 0.89 (0.75–1.06) | 1.00 (0.90–1.10) |
|  6.1–7.3 | 1.13 (1.05–1.22) | 0.92 (0.72–1.16) | 1.17 (1.02–1.33) |
|  ≥7.4 | 1.57 (1.42–1.73) | 1.31 (0.97–1.75) | 1.91 (1.63–2.23) |
| Intact PTH, pg/mL |  |  |  |
| <60 | 1.03 (0.97–1.09) | 1.15 (0.98–1.34) | 0.99 (0.89–1.10) |
|  60–180 | ref | ref | ref |
|  181–240 | 0.98 (0.91–1.07) | 0.86 (0.67–1.10) | 1.01 (0.88–1.16) |
|  241–499 | 1.11 (1.04–1.19) | 0.99 (0.80–1.23) | 1.18 (1.04–1.33) |
|  ≥500 | 1.34 (1.20–1.50) | 1.02 (0.70–1.48) | 1.42 (1.18–1.72) |
| Ferritin, ng/mL |  |  |  |
| <50 | 1.00 (0.92–1.09) | 1.26 (0.99–1.61) | 0.92 (0.80–1.06) |
|  50–99 | ref | ref | ref |
|  100–199 | 0.99 (0.91–1.07) | 1.09 (0.86–1.38) | 0.88 (0.77–1.01) |
|  ≥200 | 1.12 (1.05–1.21) | 1.36 (1.10–1.68) | 1.03 (0.92–1.16) |
| Proportion of AVFs within the four types of vascular access in each facility, % (per 1% increase) | 1.00 (1.00–1.00) | 1.00 (0.99–1.00) | 1.00 (1.00–1.01) |

Cox proportional hazards models were adjusted for age, sex, body mass index, cause of end-stage kidney disease, dialysis vintage, hemodialysis duration, history of myocardial infarction, cerebral infarction, cerebral hemorrhage and amputation of limbs, laboratory data (albumin, hemoglobin, albumin-adjusted calcium, phosphate, intact PTH, and ferritin) and proportion of AVFs within the four types of vascular access in each facility.

Abbreviations: AS, arterial superficialization; AVF, arteriovenous fistula; AVG, arteriovenous graft; BMI, body mass index; CI, confidence interval; ESKD, end-stage kidney disease; ref, reference; HR, hazard ratio; PTH, parathyroid hormone; TC-CVC, tunneled and cuffed central venous catheter.

Supplementary Table 3. All-cause and cause-specific mortality according to vascular access type after multiple imputation

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcomes | Unadjusted HR(95% CI)n = 183,490 | P-value |  | Adjusted HR(95% CI)n = 183,490 | P-value |  | Adjusted SHR(95% CI)n = 183,490 | P-value |
| All-cause mortality |  |  |  |  |  |  |  |  |
| AVF | ref | — |  | ref | — |  | — | — |
| AVG | 1.61 (1.53–1.71) | <0.001 |  | 1.29 (1.21–1.37) | <0.001 |  | — | — |
|  AS | 2.32 (2.13–2.52) | <0.001 |  | 1.49 (1.37–1.63) | <0.001 |  | — | — |
| TC-CVC | 5.64 (4.94–6.43) | <0.001 |  | 1.93 (1.68–2.21) | <0.001 |  | — | — |
| Infection-related mortality |  |  |  |  |  |  |  |  |
| AVF | ref | — |  | ref | — |  | ref | — |
| AVG | 1.99 (1.72–2.31) | <0.001 |  | 1.47 (1.25–1.72) | <0.001 |  | 1.46 (1.24–1.72) | <0.001 |
|  AS | 3.09 (2.49–3.83) | <0.001 |  | 1.82 (1.46–2.27) | <0.001 |  | 1.71 (1.36–2.15) | <0.001 |
| TC-CVC | 7.42 (5.28–10.43) | <0.001 |  | 2.01 (1.41–2.86) | <0.001 |  | 1.88 (1.31–2.71) | 0.001 |
| Cardiovascular mortality |  |  |  |  |  |  |  |  |
| AVF | ref | — |  | ref | — |  | ref | — |
| AVG | 1.56 (1.41–1.72) | <0.001 |  | 1.26 (1.13–1.39) | <0.001 |  | 1.25 (1.13–1.39) | <0.001 |
|  AS | 2.37 (2.06–2.74) | <0.001 |  | 1.53 (1.33–1.77) | <0.001 |  | 1.48 (1.28–1.72) | <0.001 |
| TC-CVC | 6.02 (4.82–7.51) | <0.001 |  | 2.17 (1.73–2.72) | <0.001 |  | 2.03 (1.60–2.57) | <0.001 |

Both Cox proportional hazards models and the Fine and Gray models were adjusted for age, sex, body mass index, cause of end-stage kidney disease, dialysis vintage, hemodialysis duration, history of myocardial infarction, cerebral infarction, cerebral hemorrhage and amputation of limbs, laboratory data (albumin, hemoglobin, albumin-adjusted calcium, phosphate, intact PTH, and ferritin), and proportion of AVFs within the four types of vascular access in each facility.

Abbreviations: AS, arterial superficialization; AVF, arteriovenous fistula; AVG, arteriovenous graft; CI, confidence interval; ref, reference; HR, hazard ratio; SHR, subdistribution hazard ratio; TC-CVC, tunneled and cuffed central venous catheter.

Supplementary Table 4. Baseline characteristics according to vascular access type before and after propensity score matching

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Before propensity score matching |  | After propensity score matching |  |
| Characteristics | ASn = 3,661 | TC-CVCn = 669 | Standardized difference, % | ASn = 332 | TC-CVCn = 332 | Standardized difference, % |
| Age, years | 68.6 (11.8) | 71.6 (12.5) | 13.9 | 69.6 (11.8) | 69.9 (13.0) | 2.1 |
| Female, n (%) | 1,770 (48.3) | 426 (63.7) | 34.7 | 217 (65.4) | 215 (64.8) | -1.3 |
| BMI, kg/m2 | 21.3 (3.8) | 20.7 (3.7) | -8.1 | 20.8 (3.9) | 21.0 (3.9) | 6.5 |
| Dialysis vintage, years | 6 [2–13] | 4 [1–10] | -14.4 | 5 [2–12] | 5 [2–11] | -2.7 |
| Hemodialysis duration, hours/week | 11.4 (2.1) | 10.8 (2.2) | -10.2 | 11.1 (1.9) | 11.2 (2.2) | 5.6 |
| Cause of ESKD, n (%) |  |  | -0.4 |  |  | -8.5 |
|  Glomerulonephritis | 1,400 (38.3) | 221 (33.1) |  | 109 (32.8) | 116 (34.9) |  |
|  Diabetes | 1,129 (30.9) | 250 (37.4) |  | 111 (33.4) | 120 (36.1) |  |
|  Nephrosclerosis | 298 (8.1) | 45 (6.7) |  | 27 (8.1) | 22 (6.6) |  |
|  Polycystic kidney disease | 133 (3.6) | 13 (1.9) |  | 13 (3.9) | 7 (2.1) |  |
|  Others | 433 (11.8) | 90 (13.5) |  | 45 (13.6) | 47 (14.2) |  |
|  Unknown | 265 (7.2) | 49 (7.3) |  | 27 (8.1) | 20 (6.0) |  |
| History, n (%) |  |  |  |  |  |  |
| Myocardial infarction | 350 (10.5) | 44 (7.5) | -11.9 | 24 (7.2) | 20 (6.0) | -4.8 |
| Cerebral infarction | 563 (16.9) | 167 (28.5) | 19.4 | 70 (21.1) | 75 (22.6) | 3.6 |
| Cerebral hemorrhage | 158 (4.7) | 57 (9.7) | 18.2 | 39 (11.7) | 32 (9.6) | -6.8 |
|  Limb amputation | 169 (5.1) | 47 (8.0) | 12.6 | 24 (7.2) | 24 (7.2) | 0 |
| Laboratory tests |  |  |  |  |  |  |
| Hemoglobin, g/dL | 10.1 (1.4) | 9.7 (1.6) | -28.9 | 9.8 (1.5) | 9.8 (1.4) | -1.8 |
| Albumin, g/dL | 3.6 (0.4) | 3.4 (0.6) | -48.8 | 3.4 (0.5) | 3.4 (0.6) | -0.5 |
| Albumin-adjusted calcium, mg/dL | 9.4 (0.9) | 9.5 (0.9) | 14.3 | 9.6 (0.9) | 9.5 (0.9) | -7.3 |
| Phosphate, mg/dL | 5.2 (1.5) | 4.8 (1.7) | -30.2 | 4.7 (1.5) | 4.8 (1.6) | 7.2 |
| Intact PTH, pg/mL | 129 [58–236] | 118 [52–220] | -8.1 | 111 [55–189] | 119 [55–221] | -2.3 |
| Ferritin, ng/mL | 127 [50–287] | 157 [59–360] | 12.3 | 154 [58–329] | 143 [54–324] | -4.2 |
| Percentage of AVFs within the four types of vascular access in each facility, % | 88.5 [83.5–92.6] | 88.5 [82.7–92.4] | -2.7 | 88.4 [82.8–92.9] | 88.3 [82.7–92.6] | -8.8 |

Values are presented as means (standard deviation) or medians [interquartile range] unless otherwise indicated.

Abbreviations: AS, arterial superficialization; BMI, body mass index; ESKD, end-stage kidney disease; PTH, parathyroid hormone; TC-CVC, tunneled and cuffed central venous catheter.

Supplementary Table 5. All-cause and cause-specific mortality according to vascular access type after propensity score matching

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Outcomes | HR (95% CI)n = 664 | P-value | SHR (95% CI)n = 664 | P-value |
| All-cause mortality |  |  |  |  |
| AS | ref | — | — | — |
| TC-CVC | 1.39 (1.03–1.88) | 0.031 | — | — |
| Infection-related mortality |  |  |  |  |
| AS | ref | — | ref | — |
| TC-CVC | 1.62 (0.79–3.34) | 0.19 | 1.59 (0.77–3.27) | 0.21 |
| Cardiovascular mortality |  |  |  |  |
| AS | ref | — | ref | — |
| TC-CVC | 1.93 (1.10–3.37) | 0.021 |  1.90 (1.09–3.31) | 0.024 |

Abbreviations: AS, arterial superficialization; CI, confidence interval; ref, reference; HR, hazard ratio; SHR, subdistribution hazard ratio; TC-CVC, tunneled and cuffed central venous catheter.