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Urgent-start peritoneal dialysis in elderly patients with end-stage renal disease

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Urgent-start peritoneal dialysis in elderly patients with end-stage renal disease

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ABSTRACT

Objectives: To investigate the complications and survival of elderly patients with end-stage renal disease (ESRD) that received urgent-start peritoneal dialysis (USPD) or urgent-start hemodialysis (USHD), and to explore the value of peritoneal dialysis (PD) as the emergent dialysis method for elderly patients with ESRD.

Design: Retrospective cohort study.

Setting: Two tertiary care hospitals in Shanghai, China.

Participants: Chinese patients (n=542) >65 years of age with estimated glomerular filtration rate ≤ 15 ml/min/m² that received urgent-start dialysis between 01/01/2005 and 12/31/2015, and with at least 3 months of treatment. Patients who converted to other dialysis methods, regardless of the initial dialysis method were excluded, as well as those with comorbidities that could significantly affect their dialysis outcomes.

Primary and secondary outcome measures: Dialysis-related complications and survival were compared. Patients were followed until death, stopped PD, transfer to other dialysis centers, loss to follow-up, or 12/31/2016.

Results: There were 309 patients in the USPD group and 233 in the USHD group. The rate of dialysis-related complications within 30 days after catheter implantation was significant lower in the USPD group compared with the USHD group (4.5% vs. 10.7%, P=0.031). The 6-month and 1-, 2-, and 3-year survival rates were 95.3%, 91.4%, 86.6%, and 64.8% in the USPD group, and 92.2%, 85.7%, 70.2%, and 57.8% in the USHD group, respectively (P=0.023). The multivariable Cox regression analysis showed that USHD (relative risk (RR)= 2.220, 95% confidence interval (CI): 1.298-3.790; P=0.004), age (RR=1.025, 95%CI: 1.013-1.043, P<0.001), and hypokalemia (RR=0.678, 95%CI: 0.487-0.970; P=0.032) were independently

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3 associated with death.
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5 **Conclusions:** Survival was slightly better for USPD compared with USHD. USPD
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7 was associated with fewer complications and better survival than USHD in elderly
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9 patients with ESRD.
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14 **Key words:** peritoneal dialysis; hemodialysis; prognosis; elderly; end-stage renal
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16 disease
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21 **Strengths and limitations of this study**
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24 - Relatively small sample size from only two hospitals.
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26 - Retrospective study, with all the inherent biases.
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28 - The data were limited to those available from the medical charts.
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30 - A strength of this study is the relatively long follow-up.
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INTRODUCTION

End-stage renal disease (ESRD) is the end stage of chronic kidney disease (CKD), which is an important public health problem worldwide with high incidence, poor prognosis, high health care costs, and high socio-economic burden¹⁻¹⁰. With the overall aging of the population, the prevalence of ESRD is on the rise worldwide. Dialysis often needs to be performed urgently in patients with ESRD due to silent disease, low health awareness, and late referral¹¹⁻¹⁴. According to USRDS data reports, in 2010, 43% of the patients had been referred to a nephrologist for the first time at the time of initiating dialysis. Therefore, 30%-50% of patients needing dialysis start the procedure urgently, despite planned dialysis known as an ideal dialysis modality¹².

The elderly represents a special population for dialysis. In addition to having the highest prevalence of dialysis among all age groups^{15, 16}, elderly with ESRD can have dramatic consequences because of frailty, comorbidities, and less resistance to health issues, complicating the management of ESRD¹⁷. In addition, the hemodynamic stability of elderly individuals is relatively poor¹⁷. Previous studies showed that using peritoneal dialysis (PD) as the first dialysis method does not increase the risk of short-term complications in elderly patients with ESRD; in addition, the survival rate of the patients is also not evidently affected¹⁸⁻²⁰.

Urgent-start PD (USPD) refers to the initiation of PD treatment within 2 weeks after catheter implantation²¹. USPD is commonly applied by physicians in China²². USPD avoids temporary central venous catheter (CVC) and vascular access surgery in urgent-start hemodialysis (USHD), and thus reduces the risks of USHD and simplifies the treatment processes. The comparison between USPD and USHD has shown that

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2
3 the risks of bacteremia and death are higher in the patients receiving USHD than in
4 those receiving USPD^{23, 24}. Nevertheless, there is a lack of such comparison for
5 elderly patients.
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10 Therefore, the aim of the present study was to investigate the complications and
11 survival of elderly patients with ESRD that received USPD or USHD, and to explore
12 the value of PD as the emergent dialysis method for elderly patients with ESRD.
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16 17 18 19 **PATIENTS AND METHODS**

20 21 **Study design and patients**

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23 This was a retrospective cohort study of patients >65 years of age that received
24 urgent-start dialysis at the Shanghai Changzheng Hospital and Songjiang District
25 Central Hospital between January 1st, 2005 and December 31st, 2015. The study was
26 approved by the ethics committees of the Shanghai Changzheng Hospital and
27 Songjiang District Central Hospital (No. 2019SL005).
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35 ESRD was defined as an estimated glomerular filtration rate (eGFR) <15
36 ml/min/1.73 m²¹⁵. USPD was defined as PD that started within 2 weeks after catheter
37 implantation. USHD was defined as dialysis that started without the establishment of
38 long-term dialysis access or within 30 days after the establishment of long-term
39 dialysis.
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47 The inclusion criteria were: 1) >65 years of age; 2) eGFR \leq 15 ml/min/m²; and 3)
48 received HD or PD for \geq 3 months. The exclusion criteria were: 1) <65 years of age; 2)
49 died within 3 months of dialysis or lost to follow up; 3) converted to other dialysis
50 methods, regardless of the initial dialysis method; or 4) combined with severe
51 respiratory diseases, severe acute heart failure, severe hyperkalemia (serum potassium
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3 levels >6.5 mmol/L), or severe acidosis (bicarbonate radical levels <12 mmol/L).

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5 USPD or USHD was selected according to the willingness of the patients and the
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7 decision of the physicians at the Nephrology Department according to the condition of
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9 the patients (vital signs, cardiac functions, and biochemical indexes). The patients
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11 were categorized into the USPD and USHD groups.
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14 15 16 17 **Dialysis methods**

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19 For the patients in the USPD group, a PD catheter was used as the access. All
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21 catheters were implanted by trained physicians after local anesthesia (5-10 ml of 1%
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23 lidocaine hydrochloride was applied layer by layer). After the catheter was implanted,
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25 the time of the dialysis initiation was decided by the physicians according to the
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27 clinical manifestations (vital signs, cardiac functions, and biochemical indexes). For
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29 all patients on PD, a swan-neck straight catheter was implanted, and glucose-based
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31 dialysate was used in all patients.
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35 For the patients in the HD group, CVC was used as the access. All CVCs were
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37 implanted into the internal jugular vein or femoral vein by trained physicians. The
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39 patients in the USHD group received HD (4 h/time, volume of blood flow was
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41 250-300 ml/min) or continuous renal replacement treatment (CRRT; 6-8 h/time,
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43 volume of blood flow was 180-300 ml/min).
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49 **Data collection**

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51 All the included patients were followed until loss to follow-up, death, or
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53 December 31, 2016. The demographic characteristics (sex, age, primary disease, and
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55 complications), residual renal function before dialysis, and clinical biochemical
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3 indexes of patients were collected. The date of catheter implantation, time of dialysis
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5 initiation, and dialysis-related complications including infection-related complications
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7 (such as catheter-related infection and peritonitis) and non-infection-related
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9 complications (leakage, bleeding, catheter malposition, embolism, catheter
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11 obstruction, and hernia) were recorded. The outcomes (including death, conversion to
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13 HD, kidney transplantation, and transferred to other treatment centers), time of the
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15 outcomes, causes of the outcomes, time of the first peritonitis, times of peritonitis, and
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17 the catheter dysfunction events that required surgical interventions or conversion to
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19 HD within 3 months after the operation were recorded.
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23 24 25 26 **Statistical analysis**

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28 SPSS 19.0 (IBM, Armonk, NY, USA) was used for statistical analysis.
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30 Continuous data with normal distribution are presented as means \pm standard deviation,
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32 while continuous data without normal distribution are described as percentiles (P25,
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34 P75). The Mann-Whitney test or the Student t test was used, as appropriate. The
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36 Kaplan-Meier method and the log-rank test were used to analyze the survival of the
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38 patients. The factors that have been widely acknowledged to affect the survival of the
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40 patients, as well as the factors that were significantly different between the two groups
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42 at baseline, were entered in a multivariable models (logistic regression and Cox
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44 models). $P < 0.05$ was considered statistically significant.
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51 **Patient and public involvement**

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53 The patients and the public were not involved in the design of this study, in the
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55 selection of the outcomes, in the conduct of the study, or in result dissemination.
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RESULTS

Characteristics of the patients

Finally, 542 patients (283 males and 259 females) were included, 309 in the USPD group and 233 in the USHD group. Mean age of the patients was 73.1 ± 5.6 years. The patients in the USPD accounted for 57% of all the dialysis patients, and the median time from catheter implantation to the start of dialysis was 4 (2-6) days. The patients in the USHD group received dialysis on the day of or the day after catheter implantation. Age, sex, and primary diseases were not significantly different between the two groups. The numbers of patients with coronary artery-related events or heart failure (NYHA III, grade IV) were not significantly different between the two groups. The Charlson comorbidity index (CCI) was also not significantly different between the two groups (Table 1). The duration of HD was 24.6 ± 5.2 months and the duration of PD was 22.9 ± 5.1 months. The eGFR, serum calcium levels, serum phosphorus levels, serum intact parathyroid hormone (iPTH), and blood lipid levels before dialysis were not significantly different between the two groups (Table 2).

Complications

Compared with the USHD group, the rate of dialysis-related complications within 30 days after catheter implantation was significantly lower in the USPD group (4.5% vs. 10.7%, $P=0.031$). The rates of dialysis-related complications requiring re-catheterization (1.6% vs. 9.4%; $P<0.001$) and bacteremia (1.2% vs. 5.5%; $P=0.006$) were significantly lower in the USPD group than in the USHD group (Table 3). Logistic regression showed that after adjusting for demographic characteristics and

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3 baseline data, USHD was an independent risk factor for dialysis-related complications
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5 compared with USPD (OR=2.121, 95% CI: 1.058-4.273, P=0.031).
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10 **Survival**

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12 The 6-month and 1-, 2-, and 3-year survival rates were 95.3%, 91.4%, 86.6%, and
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14 64.8% in the USPD group, and 92.2%, 85.7%, 70.2%, and 57.8% in the USHD group,
15
16 respectively (P=0.023) (Figure 1). The multivariable Cox regression analysis showed
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18 that after adjusting for demographic characteristics and baseline data, USHD was an
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20 independent risk factor of death compared with USPD (relative risk (RR)= 2.220,
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22 95% CI: 1.298-3.790; P=0.004). In addition, age (RR=1.025, 95%CI: 1.013-1.043,
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24 P<0.001) and hypokalemia (RR=0.678, 95%CI: 0.487-0.970; P=0.032) were also
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26 independently associated with death (Table 4).
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33 **DISCUSSION**

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35 Studies suggest that USPD is associated with better patient outcomes than USHD
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37 ^{23, 24}, but there is a lack of comparison between USPD and USHD for elderly patients
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39 with ESRD. Therefore, this study aimed to investigate the complications and survival
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41 of elderly patients with ESRD that received USPD or USHD, and to explore the value
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43 of PD as the emergent dialysis method for elderly patients with ESRD. The results
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45 strongly suggest that survival was slightly better for USPD compared with USHD.
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47 USPD was associated with fewer complications and better survival than USHD in
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49 elderly patients with ESRD.
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55 Elderly ESRD patients have several special features, including delayed initiation
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57 of dialysis, more complications, poor nutritional status, cognitive impairment, and
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3 relatively low quality of life, which could lead to difficulties in the management of
4 ESRD ¹⁷. The mortality rate in elderly patients with ESRD is higher than in relatively
5 younger patients receiving dialysis; in addition, the mortality rate is increasing with
6 the increase of age ^{6, 17}. A previous study has already reported that the mortality rate
7 increases by about 1.7 folds with every 10 years increase of the age in Chinese
8 patients ⁶. Previous studies have compared the mortality rates of elderly patients on
9 HD or PD, but the results are inconsistent. Collins et al. ²⁵ compared the data of
10 patients on HD (n=99,048) and PD (n=18,110), and they observed that the survival of
11 the patients >55 years old was significantly higher among those on PD compared with
12 HD, after stratification for age and diabetes. The data in the 2009 USRDS database
13 showed that after adjusting for age, gender, ethnicity, and comorbidities, the 1, 3, and
14 5-year survival rates of patients on PD were significantly higher than those on HD ²⁶.

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31 Several studies have demonstrated that PD could be used for emergent dialysis in
32 patients with ESRD ²⁷⁻²⁹. Early PD involves high risks of leakage, bleeding, and
33 peritonitis within a short time after catheter implantation, which limit the application
34 of PD in emergent dialysis. Nevertheless, the PD techniques have advanced greatly in
35 recent years with the development of the Tenckhof catheter, closed liquid supply
36 system with Y-type connection, advancement of catheterization methods, and
37 application of automatic PD ^{30, 31}. Recent studies have shown that PD is safe and
38 applicable as the emergent dialysis for the ESRD patients ³²⁻³⁷.

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49 In the present study, the results showed that the occurrence of complications in
50 the USPD group was significantly lower than in the USHD group. After adjustment
51 for demographic characteristics and clinical data, USHD was independently
52 associated with dialysis-related complications, compared with USPD. Using USPD in
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3 elderly patients with ESRD could effectively reduce the risk of dialysis-related
4 complications within 2 weeks after catheter implantation. No serious complications
5 such as major bleeding, leakage, or organ rupture were found in the PD group,
6 suggesting that the catheter implantation for USPD conducted by trained physicians
7 was probably safe, but additional studies should be performed for confirmation.
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15 Some previous studies showed that comparing with USHD, the survival rate of
16 patients on USPD is not significantly different^{18, 38}. Lobbedez et al.¹⁸ observed that
17 the survival and re-hospitalization rates were not significantly different between
18 USPD and USHD. In the present study, USPD was associated with a slightly better
19 overall survival at 3 years compared with USHD. Additional studies are necessary to
20 examine this issue.
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29 This study has limitations. The sample size was relatively small and from only
30 two hospitals. The study was retrospective, with all the inherent biases, and the data
31 was limited to those available in the medical charts. Prospective trials could be
32 necessary to determine the exact benefits of USPD vs. USHD.
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38 In conclusion, survival was slightly better for USPD compared with USHD.
39 USPD was associated with fewer complications and better survival than USHD in
40 elderly patients with ESRD.
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47 **Author contributions**

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49 Xiujuan Zang and Xiu Du carried out the studies, participated in collecting data,
50 and drafted the manuscript. Lin Li and Changlin Mei performed the statistical analysis
51 and participated in its design. All authors read and approved the final manuscript.
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Disclosure Statement

All authors declare that they have no competing interests.

REFERENCES

1. Desai RM. Nephrology Update: End-Stage Renal Disease and Renal Replacement Therapy. *FP Essentials* 2016;444:23-9.
2. Collins AJ, Foley RN, Gilbertson DT, *et al.* United States Renal Data System public health surveillance of chronic kidney disease and end-stage renal disease. *Kidney Int Suppl (2011)* 2015;5(1):2-7.
3. *United States Renal Data System. USRDS 2014 Annual Data Report: Atlas of Chronic Kidney Disease and End-Stage Renal Disease in the United States. Vol. 2. Ch. 1: Incidence, prevalence, patient characteristics, and treatment modalities.* Bethesda: National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, 2014.
4. Liyanage T, Ninomiya T, Jha V, *et al.* Worldwide access to treatment for end-stage kidney disease: a systematic review. *Lancet* 2015;385(9981):1975-82.
5. Zuo L, Wang M, Chinese Association of Blood Purification Management of Chinese Hospital A. Current burden and probable increasing incidence of ESRD in China. *Clin Nephrol* 2010;74 Suppl 1:S20-2.
6. Zhang L, Wang F, Wang L, *et al.* Prevalence of chronic kidney disease in China: a cross-sectional survey. *Lancet* 2012;379(9818):815-22.
7. Harris DCH, Davies SJ, Finkelstein FO, *et al.* Increasing access to integrated ESKD care as part of universal health coverage. *Kidney Int* 2019;95(4S):S1-S33.
8. Wang V, Vilme H, Maciejewski ML, *et al.* The Economic Burden of Chronic Kidney Disease and End-Stage Renal Disease. *Semin Nephrol* 2016;36(4):319-30.

- 1
2
3 9. Abbasi MA, Chertow GM, Hall YN. End-stage renal disease. *BMJ Clin Evid*
4
5 2010;2010
6
7
8 10. Perry MM, Howell S, Patel N. Protocols for treating patients with end-stage renal
9
10 disease: a survey of nephrology fellowships. *Spec Care Dentist*
11
12 2017;37(2):57-61.
13
14
15 11. *U.S. Renal Data System: Chapter 1 Incidence, prevalence, patient characteristics*
16
17 *and modality. In: USRDS 2012 Annual Data Report: Atlas of Chronic Kidney*
18
19 *Disease and End-Stage Renal Disease in the United States.* Bethesda: National
20
21 Institutes of Health, Bethesda MD, National Institute of Diabetes and
22
23 Digestive and Kidney Diseases, 2012.
24
25
26 12. Machowska A, Alscher MD, Vanga SR, *et al.* Offering Patients Therapy Options
27
28 in Unplanned Start: Development and Implementation of an Education
29
30 Program for Unplanned-Start Patients. *Adv Perit Dial* 2015;31:69-73.
31
32
33 13. Brown PA, Akbari A, Molnar AO, *et al.* Factors Associated with Unplanned
34
35 Dialysis Starts in Patients followed by Nephrologists: A Retrospective Cohort
36
37 Study. *PLoS One* 2015;10(6):e0130080.
38
39
40 14. Marron B, Martinez Ocana JC, Salgueira M, *et al.* Analysis of patient flow into
41
42 dialysis: role of education in choice of dialysis modality. *Perit Dial Int*
43
44 2005;25 Suppl 3:S56-9.
45
46
47 15. *Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group.*
48
49 *KDIGO 2012 clinical practice guideline for the evaluation and management*
50
51 *of chronic kidney disease, 2013.*
52
53
54 16. Murphree DD, Thelen SM. Chronic kidney disease in primary care. *J Am Board*
55
56 *Fam Med* 2010;23(4):542-50.
57
58
59
60

17. Stevens LA, Viswanathan G, Weiner DE. Chronic kidney disease and end-stage renal disease in the elderly population: current prevalence, future projections, and clinical significance. *Adv Chronic Kidney Dis* 2010;17(4):293-301.
18. Lobbedez T, Lecouf A, Ficheux M, *et al.* Is rapid initiation of peritoneal dialysis feasible in unplanned dialysis patients? A single-centre experience. *Nephrol Dial Transplant* 2008;23(10):3290-4.
19. Ghaffari A. Urgent-start peritoneal dialysis: a quality improvement report. *Am J Kidney Dis* 2012;59(3):400-8.
20. Alkatheeri AM, Blake PG, Gray D, *et al.* Success of Urgent-Start Peritoneal Dialysis in a Large Canadian Renal Program. *Perit Dial Int* 2016;36(2):171-6.
21. Webster AC, Nagler EV, Morton RL, *et al.* Chronic Kidney Disease. *Lancet* 2017;389(10075):1238-52.
22. Li WY, Wang YC, Hwang SJ, *et al.* Comparison of outcomes between emergent-start and planned-start peritoneal dialysis in incident ESRD patients: a prospective observational study. *BMC Nephrol* 2017;18(1):359.
23. Ivarsen P, Povlsen JV. Can peritoneal dialysis be applied for unplanned initiation of chronic dialysis? *Nephrol Dial Transplant* 2014;29(12):2201-6.
24. Koch M, Kohnle M, Trapp R, *et al.* Comparable outcome of acute unplanned peritoneal dialysis and haemodialysis. *Nephrol Dial Transplant* 2012;27(1):375-80.
25. Collins AJ, Hao W, Xia H, *et al.* Mortality risks of peritoneal dialysis and hemodialysis. *Am J Kidney Dis* 1999;34(6):1065-74.
26. Liem YS, Wong JB, Hunink MG, *et al.* Comparison of hemodialysis and peritoneal dialysis survival in The Netherlands. *Kidney Int* 2007;71(2):153-8.

- 1
2
3 27. Fenton SS, Schaubel DE, Desmeules M, *et al.* Hemodialysis versus peritoneal
4 dialysis: a comparison of adjusted mortality rates. *Am J Kidney Dis*
5 1997;30(3):334-42.
6
7
8
9
10 28. Jaar BG, Coresh J, Plantinga LC, *et al.* Comparing the risk for death with
11 peritoneal dialysis and hemodialysis in a national cohort of patients with
12 chronic kidney disease. *Ann Intern Med* 2005;143(3):174-83.
13
14
15
16 29. Weinhandl ED, Foley RN, Gilbertson DT, *et al.* Propensity-matched mortality
17 comparison of incident hemodialysis and peritoneal dialysis patients. *J Am Soc*
18 *Nephrol* 2010;21(3):499-506.
19
20
21
22 30. Bargman JM, Girsberger M. Visions in a Crystal Ball: The Future of Peritoneal
23 Dialysis. *Blood Purif* 2018;45(1-3):218-23.
24
25
26 31. Bargman JM. New technologies in peritoneal dialysis. *Clin J Am Soc Nephrol*
27 2007;2(3):576-80.
28
29
30
31 32. Zang XJ, Yang B, Du X, *et al.* Urgent-start peritoneal dialysis and patient
32 outcomes: a systematic review and meta-analysis. *Eur Rev Med Pharmacol*
33 *Sci* 2019;23(5):2158-66.
34
35
36
37 33. Wojtaszek E, Grzejszczak A, Grygiel K, *et al.* Urgent-Start Peritoneal Dialysis as
38 a Bridge to Definitive Chronic Renal Replacement Therapy: Short- and
39 Long-Term Outcomes. *Front Physiol* 2018;9:1830.
40
41
42
43 34. Ponce D, Brabo AM, Balbi AL. Urgent start peritoneal dialysis. *Curr Opin*
44 *Nephrol Hypertens* 2018;27(6):478-86.
45
46
47 35. Blake PG, Jain AK. Urgent Start Peritoneal Dialysis: Defining What It Is and
48 Why It Matters. *Clin J Am Soc Nephrol* 2018;13(8):1278-9.
49
50
51
52 36. Jin H, Ni Z, Mou S, *et al.* Feasibility of Urgent-Start Peritoneal Dialysis in Older
53
54
55
56
57
58
59
60

1
2
3 Patients with End-Stage Renal Disease: A Single-Center Experience. *Perit*
4
5 *Dial Int* 2018;38(2):125-30.
6
7

8 37. Jin H, Fang W, Zhu M, *et al.* Urgent-Start Peritoneal Dialysis and Hemodialysis
9
10 in ESRD Patients: Complications and Outcomes. *PLoS One*
11
12 2016;11(11):e0166181.
13
14

15 38. Patel PR, Kallen AJ, Arduino MJ. Epidemiology, surveillance, and prevention of
16
17 bloodstream infections in hemodialysis patients. *Am J Kidney Dis*
18
19 2010;56(3):566-77.
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3 **Figure legends**
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5 **Figure 1.** Survival rates of the patients in the peritoneal dialysis and hemodialysis
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8 groups. Kaplan-Meier survival analysis.
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Table 1. Comparisons of the baseline data

Parameter	USPD (n=309)	USHD (n=233)	P
Males [n (%)]	179 (57.9)	123 (52.8)	0.248
Age (years)	73.1±5.6	72.6±7.5	0.622
Primary disease			
Chronic glomerulonephritis [n (%)]	116 (37.4)	119 (51.1)	0.065
Diabetic nephropathy [n (%)]	105 (34.00)	170 (7.3)	0.002
Hypertensive renal lesion [n (%)]	161 (5.2)	114 (4.9)	1.000
Lupus nephritis [n (%)]	65 (2.1)	30 (1.3)	1.000
Polycystic kidney [n (%)]	176 (5.7)	28 (12.2)	0.260
Unknown causes [n (%)]	67 (21.8)	43 (18.4)	0.502
Comorbidities			
Coronary artery-related events [n (%)]	76 (24.5)	74 (31.7)	0.440
Diabetes [n (%)]	152 (49.1)	74 (31.7)	0.090
Hypertension [n (%)]	175 (56.5)	131 (56.1)	0.816
Heart failure [n (%)]	128 (41.5)	142 (61.0)	0.061
Cerebrovascular events [n (%)]	35 (11.3)	45 (19.5)	0.209

USPD: urgent-start peritoneal dialysis; USHD: urgent-start hemodialysis.

Table 2. Comparisons of the baseline biochemical indexes

Index	USPD (n=309)	USHD (n=233)	P
eGFR (ml/min.1.73m ²)	5.3 (4.6,6.4)	5.6 (3.6,7.8)	0.738
Potassium (mmol/L)	3.9 (3.5,4.9)	4.0 (3.6,4.5)	0.427
Calcium (mmol/L)	1.89 (1.69,2.06)	1.99 (1.78,2.08)	0.212
Phosphorus (mmol/L)	1.91 (1.71,2.23)	1.62 (1.29,2.19)	0.010
iPTH (ng/L)	355.0 (217.5,504.0)	219.0 (127.5,449.0)	0.083
Serum albumin (g/L)	33.2±5.1	31.7±5.9	0.203
B-type natriuretic peptide (pg/mL)	299.0 (134.0,900.5)	479.0 (249.0,1480.0)	0.054
Hemoglobin (g/L)	82.0 (72.5,95.0)	82.0 (66.5,98.0)	0.888

All data are presented as median (P25, P75), except albumin (mean ± standard deviation).

USPD: urgent-start peritoneal dialysis; USHD: urgent-start hemodialysis; eGFR: estimated glomerular filtration rate; iPTH: intact parathyroid hormone.

Table 3. Complications within 30 days after catheter implantation

Complications	USPD (n=309)	USHD (n=233)	P
Dialysis-related complications [n (%)]	14 (4.5)	25 (10.7)	0.031
Infectious complications [n (%)]	4 (1.2)	9 (3.8)	0.014
Non-infectious complications [n (%)]	9 (2.9)	13 (5.5)	0.395
Complications requiring re-catheterization [n (%)]	5 (1.6)	22 (9.4)	<0.001
Bacteremia [n (%)]	4 (1.2)	13 (5.5)	0.006

Table 4. Multivariable Cox analysis of the independent factors for survival

Factor	RR	95%CI	P
Age (every 1 year increase)	1.025	1.013-1.043	<0.001
Serum potassium	0.678	0.487-0.970	0.032
Diabetes	1.705	0.978-2.967	0.067
USHD (comparing with USPD)	2.220	1.298-3.790	0.004

USHD: urgent-started hemodialysis; USPD: urgent-started peritoneal dialysis.

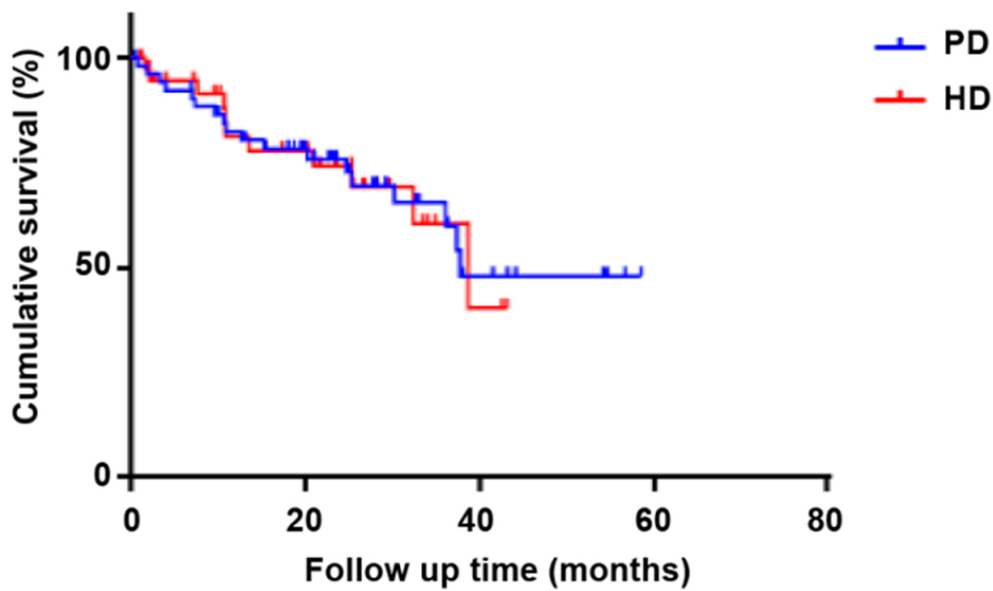


Figure 1. Survival rates of the patients in the peritoneal dialysis and hemodialysis groups. Kaplan-Meier survival analysis.

80x47mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	1 2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6-7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	7 7 7 7 7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	8-9
Outcome data	15*	Report numbers of outcome events or summary measures over time	8-9

1	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-9
2			(b) Report category boundaries when continuous variables were categorized	
3			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
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9	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-9
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11	Discussion			
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13	Key results	18	Summarise key results with reference to study objectives	9-11
14	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
15				
16	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-11
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19	Generalisability	21	Discuss the generalisability (external validity) of the study results	9-11
20				
21	Other information			
22	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12
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*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

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Urgent-start peritoneal dialysis in elderly patients with end-stage renal disease

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3 **Urgent-start peritoneal dialysis in elderly patients with end-stage renal disease**
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35 **Running title:** Urgent-start peritoneal dialysis
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ABSTRACT

Objectives: To investigate the complications and survival of elderly patients with end-stage renal disease (ESRD) that received urgent-start peritoneal dialysis (USPD) or urgent-start hemodialysis (USHD), and to explore the value of peritoneal dialysis (PD) as the emergent dialysis method for elderly patients with ESRD.

Design: Retrospective cohort study.

Setting: Two tertiary care hospitals in Shanghai, China.

Participants: Chinese patients (n=542) >65 years of age with estimated glomerular filtration rate ≤ 15 ml/min/m² that received urgent-start dialysis between 01/01/2005 and 12/31/2015, and with at least 3 months of treatment. Patients who converted to other dialysis methods, regardless of the initial dialysis method, were excluded, as well as those with comorbidities that could significantly affect their dialysis outcomes.

Primary and secondary outcome measures: Dialysis-related complications and survival were compared. Patients were followed until death, stopped PD, transfer to other dialysis centers, loss to follow-up, or 12/31/2016.

Results: There were 309 patients in the USPD group and 233 in the USHD group. The rate of dialysis-related complications within 30 days after catheter implantation was significantly lower in the USPD group compared with the USHD group (4.5% vs. 10.7%, P=0.031). The 6-month and 1-, 2-, and 3-year survival rates were 95.3%, 91.4%, 86.6%, and 64.8% in the USPD group, and 92.2%, 85.7%, 70.2%, and 57.8% in the USHD group, respectively (P=0.023). The multivariable Cox regression analysis showed that USHD (hazard ratio (HR)= 2.220, 95% confidence interval (CI): 1.298-3.790; P=0.004), age (HR=1.025, 95%CI: 1.013-1.043, P<0.001), and

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3 hypokalemia (HR=0.678, 95%CI: 0.487-0.970; P=0.032) were independently
4 associated with death.
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7 **Conclusions:** USPD was associated with slightly better survival compared with
8 USHD. USPD was associated with fewer complications and better survival than
9 USHD in elderly patients with ESRD.
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17 **Key words:** peritoneal dialysis; hemodialysis; prognosis; elderly; end-stage renal
18 disease
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23 **Strengths and limitations of this study**

- 24 - Relatively small sample size from only two hospitals.
 - 25 - Retrospective study, with all the inherent biases.
 - 26 - The data were limited to those available from the medical charts.
 - 27 - A strength of this study is the relatively long follow-up.
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INTRODUCTION

End-stage renal disease (ESRD) is the end stage of chronic kidney disease (CKD), which is an important public health problem worldwide with high incidence, poor prognosis, high health care costs, and high socio-economic burden.¹⁻¹⁰ With the overall aging of the population, the prevalence of ESRD is on the rise worldwide. Dialysis often needs to be performed urgently in patients with ESRD due to silent disease, low health awareness, and late referral.¹¹⁻¹⁴ According to USRDS data reports, in 2010, 43% of the patients had been referred to a nephrologist for the first time at the time of initiating dialysis. Therefore, 30%-50% of patients needing dialysis start the procedure urgently, despite planned dialysis known as an ideal dialysis modality.¹²

The elderly represent a special population for dialysis. In addition to having the highest prevalence of dialysis among all age groups^{15,16}, the elderly with ESRD can have dramatic consequences because of frailty, comorbidities, and less resistance to health issues, complicating the management of ESRD.¹⁷ In addition, the hemodynamic stability of elderly individuals is relatively poor.¹⁷ Previous studies showed that using peritoneal dialysis (PD) as the first dialysis method does not increase the risk of short-term complications in elderly patients with ESRD; in addition, the survival rate of the patients is also not evidently affected.¹⁸⁻²⁰

Urgent-start PD (USPD) refers to the initiation of PD treatment within 2 weeks after catheter implantation.²¹ USPD is commonly applied by physicians in China.²² USPD avoids temporary central venous catheter (CVC) and vascular access surgery in urgent-start hemodialysis (USHD), and thus reduces the risks of USHD and simplifies the treatment processes. The comparison between USPD and USHD has shown that the risks of bacteremia and death are higher in the patients receiving USHD than in

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3 those receiving USPD.^{23, 24} Nevertheless, there is a lack of such comparison for
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5 elderly patients.
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8 Therefore, the aim of the present study was to investigate the complications and
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10 survival of elderly patients with ESRD that received USPD or USHD and to explore
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12 the value of PD as the emergent dialysis method for elderly patients with ESRD.
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15 16 17 **PATIENTS AND METHODS**

18 19 **Study design and patients**

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21 This was a retrospective cohort study of patients >65 years of age that received
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23 urgent-start dialysis at the Shanghai Changzheng Hospital and Songjiang District
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25 Central Hospital between January 1st, 2005, and December 31st, 2015. The study was
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27 approved by the ethics committees of the Shanghai Changzheng Hospital and
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29 Songjiang District Central Hospital (No. 2019SL005).
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33 ESRD was defined as an estimated glomerular filtration rate (eGFR)<15
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35 ml/min/1.73 m².¹⁵ USPD was defined as PD that started within 2 weeks after catheter
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37 implantation. USHD was defined as dialysis that started without the establishment of
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39 long-term dialysis access or within 30 days after the establishment of long-term
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41 dialysis.
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45 The inclusion criteria were: 1) >65 years of age; 2) eGFR ≤15 ml/min/m²; and 3)
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47 received HD or PD for ≥3 months. The exclusion criteria were: 1) <65 years of age; 2)
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49 died within 3 months of dialysis or lost to follow up; 3) converted to other dialysis
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51 methods, regardless of the initial dialysis method; or 4) combined with severe
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53 respiratory diseases, severe acute heart failure, severe hyperkalemia (serum potassium
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55 levels >6.5 mmol/L), or severe acidosis (bicarbonate radical levels <12 mmol/L).
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3 USPD or USHD was selected according to the willingness of the patients and the
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5 decision of the physicians at the Nephrology Department according to the condition of
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7 the patients (vital signs, cardiac functions, and biochemical indexes). The patients
8
9 were categorized into the USPD and USHD groups.

12 **Dialysis methods**

14 For the patients in the USPD group, a PD catheter was used as access. All
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16 catheters were implanted by trained physicians after local anesthesia (5-10 ml of 1%
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18 lidocaine hydrochloride was applied layer by layer). After the catheter was implanted,
19
20 the time of the dialysis initiation was decided by the physicians according to the
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22 clinical manifestations (vital signs, cardiac functions, and biochemical indexes). For
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24 all patients on PD, a swan-neck straight catheter was implanted, and glucose-based
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26 dialysate was used in all patients.

28 For the patients in the HD group, CVC was used as access. All CVCs were
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30 implanted into the internal jugular vein or femoral vein by trained physicians. The
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32 patients in the USHD group received HD (4 h/time, volume of blood flow was
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34 250-300 ml/min) or continuous renal replacement treatment (CRRT; 6-8 h/time,
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36 volume of blood flow was 180-300 ml/min).

42 **Data collection**

44 All the included patients were followed until loss to follow-up, death, or
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46 December 31, 2016. The demographic characteristics (sex, age, primary disease, and
47
48 complications), residual renal function before dialysis, and clinical and biochemical
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50 indexes of patients were collected. The date of catheter implantation, time of dialysis
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52 initiation, and dialysis-related complications, including infection-related
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54 complications (such as catheter-related infection and peritonitis) and
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3 non-infection-related complications (leakage, bleeding, catheter malposition,
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5 embolism, catheter obstruction, and hernia) were recorded. The outcomes (including
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7 death, conversion to HD, kidney transplantation, and transferred to other treatment
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9 centers), time of the outcomes, causes of the outcomes, time of the first peritonitis,
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11 times of peritonitis, and the catheter dysfunction events that required surgical
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13 interventions or conversion to HD within 3 months after the operation were recorded.
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16 17 **Statistical analysis**

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19 SPSS 19.0 (IBM, Armonk, NY, USA) was used for statistical analysis.
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21 Continuous data with normal distribution are presented as means \pm standard deviation,
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23 while continuous data without normal distribution are described as percentiles (P25,
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25 P75). The Mann-Whitney test or the Student t-test was used, as appropriate. The
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27 Kaplan-Meier method and the log-rank test were used to analyze the survival of the
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29 patients. The factors that have been widely acknowledged to affect the survival of the
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31 patients, as well as the factors that were significantly different between the two groups
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33 at baseline, were entered in a multivariable models (logistic regression and Cox
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35 models); the results are presented as odds ratio (OR) and 95% confidence interval
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37 (CI). $P < 0.05$ was considered statistically significant.
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42 43 **Patient and public involvement**

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45 The patients and the public were not involved in the design of this study, in the
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47 selection of the outcomes, in the conduct of the study, or in result dissemination.
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50 51 **RESULTS**

52 53 **Characteristics of the patients**

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55 Finally, 542 patients (283 males and 259 females) were included, 309 in the
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3 USPD group, and 233 in the USHD group. The mean age of the patients was 73.1±5.6
4 years. The patients in the USPD accounted for 57% of all the dialysis patients, and the
5 median time from catheter implantation to the start of dialysis was 4 (2-6) days. The
6 patients in the USHD group received dialysis on the day of or the day after catheter
7 implantation. Age, sex, and primary diseases were not significantly different between
8 the two groups. The numbers of patients with coronary artery-related events or heart
9 failure (NYHA III, grade IV) were not significantly different between the two groups.
10 The Charlson comorbidity index (CCI) was also not significantly different between
11 the two groups (Table 1). The duration of HD was longer than that of PD (24.6+5.2
12 months vs. 22.9+5.1 months, $P<0.001$). The eGFR, serum calcium levels, serum
13 phosphorus levels, serum intact parathyroid hormone (iPTH), and blood lipid levels
14 before dialysis were not significantly different between the two groups (Table 2).

31 **Complications**

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33 Compared with the USHD group, the rate of dialysis-related complications within
34 30 days after catheter implantation was significantly lower in the USPD group (4.5%
35 vs. 10.7%, $P=0.031$). The rates of dialysis-related complications requiring
36 re-catheterization (1.6% vs. 9.4%; $P<0.001$) and bacteremia (1.2% vs. 5.5%; $P=0.006$)
37 were significantly lower in the USPD group than in the USHD group (Table 3).
38 Logistic regression showed that after adjusting for demographic characteristics and
39 baseline data, USHD was an independent risk factor for dialysis-related complications
40 compared with USPD (OR=2.121, 95% CI: 1.058-4.273, $P=0.031$).

51 **Survival**

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53 The 6-month and 1-, 2-, and 3-year survival rates were 95.3%, 91.4%, 86.6%, and
54 64.8% in the USPD group, and 92.2%, 85.7%, 70.2%, and 57.8% in the USHD group,
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3 respectively (P=0.023) (Figure 1). The multivariable Cox regression analysis showed
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5 that after adjusting for demographic characteristics and baseline data, USHD was an
6
7 independent risk factor of death compared with USPD (hazard ratio (HR)= 2.220, 95%
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9 CI: 1.298-3.790; P=0.004). In addition, age (HR=1.025, 95%CI: 1.013-1.043,
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11 P<0.001) and hypokalemia (HR=0.678, 95%CI: 0.487-0.970; P=0.032) were also
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13 independently associated with death (Table 4). A subgroup analysis showed that
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15 USHD had a worse prognosis than USPD in elderly diabetic patients (HR=2.81,
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17 95%CI: 1.09-7.33, P=0.03) (Table 5).
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23 24 **DISCUSSION**

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26 Studies suggest that USPD is associated with better patient outcomes than USHD
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28 ^{23,24}, but there is a lack of comparison between USPD and USHD for elderly patients
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30 with ESRD. Therefore, this study aimed to investigate the complications and survival
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32 of elderly patients with ESRD that received USPD or USHD and to explore the value
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34 of PD as the emergent dialysis method for elderly patients with ESRD. The results
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36 strongly suggest that USPD was associated with slightly better survival compared
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38 with USHD. USPD was associated with fewer complications and better survival than
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40 USHD in elderly patients with ESRD.
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45 Elderly ESRD patients have several special features, including delayed initiation
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47 of dialysis, more complications, poor nutritional status, cognitive impairment, and
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49 relatively low quality of life, which could lead to difficulties in the management of
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51 ESRD.¹⁷ The mortality rate in elderly patients with ESRD is higher than in relatively
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53 younger patients receiving dialysis; in addition, the mortality rate is increasing with
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55 the increase of age.^{6, 17} A previous study has already reported that the mortality rate
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3 increases by about 1.7 folds with every 10 years increase of the age in Chinese
4 patients.⁶ Previous studies have compared the mortality rates of elderly patients on
5 HD or PD, but the results are inconsistent. Collins et al.²⁵ compared the data of
6 patients on HD (n=99,048) and PD (n=18,110), and they observed that the survival of
7 the patients >55 years old was significantly higher among those on PD compared with
8 HD, after stratification for age and diabetes. The data in the 2009 USRDS database
9 showed that after adjusting for age, gender, ethnicity, and comorbidities, the 1, 3, and
10 5-year survival rates of patients on PD were significantly higher than those on HD.²⁶
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22 Several studies have demonstrated that PD could be used for emergent dialysis in
23 patients with ESRD.²⁷⁻²⁹ Early PD involves high risks of leakage, bleeding, and
24 peritonitis within a short time after catheter implantation, which limits the application
25 of PD in emergent dialysis. Nevertheless, the PD techniques have advanced greatly in
26 recent years with the development of the Tenckhof catheter, closed liquid supply
27 system with Y-type connection, advancement of catheterization methods, and
28 application of automatic PD.^{30, 31} Recent studies have shown that PD is safe and
29 applicable as the emergent dialysis for ESRD patients.³²⁻³⁷
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40 In the present study, the results showed that the occurrence of complications in
41 the USPD group was significantly lower than in the USHD group. After adjustment
42 for demographic characteristics and clinical data, USHD was independently
43 associated with dialysis-related complications, compared with USPD. Using USPD in
44 elderly patients with ESRD could effectively reduce the risk of dialysis-related
45 complications within 2 weeks after catheter implantation. No serious complications
46 such as major bleeding, leakage, or organ rupture were found in the PD group,
47 suggesting that the catheter implantation for USPD conducted by trained physicians
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3 was probably safe, but additional studies should be performed for confirmation.
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6 Some previous studies showed that comparing with USHD, the survival rate of
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8 patients on USPD is not significantly different.^{18, 38} Lobbedez et al.¹⁸ observed that
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10 survival and re-hospitalization rates were not significantly different between USPD
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12 and USHD. In the present study, USPD was associated with a slightly better overall
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14 survival at 3 years compared with USHD. In addition, the present study showed that
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16 USHD had a worse prognosis than USPD in elderly diabetic patients. More
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18 complications within 30 days after catheter implantation in HD than PD might be a
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20 part of explanation. Previous studies reported conflicting results concerning the
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22 mortality of HD vs. PD. Indeed, a study showed that mortality was lower for PD in
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24 than for HD in non-diabetics, men <55 years of age, and in diabetics <55 years of age,
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26 but higher in diabetic women >55 years of age.²⁵ Lukowsky et al.³⁹ reported that PD
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28 led to better survival than HD in those patients, while a number of studies reported no
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30 significant survival difference between HD and PD.⁴⁰⁻⁴⁶ On the other hand, a
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32 meta-analysis suggested that elderly diabetic patients might benefit more from HD
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34 than PD⁴⁷. There is still controversy in this area. Additional studies are necessary to
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36 examine this issue, especially since the present study specifically examined USPD
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38 and USHD, while those previous studies examined all patients.
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45 This study has limitations. The sample size was relatively small and from only
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47 two hospitals. The study was retrospective, with all the inherent biases, and the data
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49 was limited to those available in the medical charts. Because of the retrospective
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51 nature of the study, and the regulations in China, the exact cause of death can be
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53 known only if written in the patient chart. Otherwise, such data might be available
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55 upon request to the central State database, but access to those data requires special
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3 authorization. As of now, the exact cause of death is missing for most patients. The
4 patients on CRRT were included, but those patients are known to have high mortality
5 rates, probably affecting the results. Furthermore, the usual rate of catheter
6 dysfunction depends upon the method of implantation and is usually around 5%-8%.⁴⁸
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8 We agree that this rate is low, but not so far than that of a study that reported a rate of
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10 5.9% before a continuous quality improvement program and 1.5% after the program.
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12 ⁴⁹ In our hospitals, even there is no official continuous quality improvement program,
13 a strict protocol is followed, which could explain the low rate. Finally, as a
14 retrospective study, no causality relationship could be established between the type of
15 dialysis and the outcomes. These limitations might account, at least in part, for the
16 differences observed between the present study and previous ones. Prospective trials
17 could be necessary to determine the exact benefits of USPD vs. USHD.
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31 In conclusion, USPD was associated with slightly better survival compared with
32 USHD. USPD was associated with fewer complications and better survival than
33 USHD in elderly patients with ESRD.
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40 **Contributors**

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42 XJZ , XD, LL and CLM carried out the studies, participated in collecting data, and
43 drafted the manuscript. LL and CLM performed the statistical analysis and
44 participated in its design. All authors read and approved the final manuscript.
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5 Chinese and Western Medicine Foundation (SH201737).
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12 **Competing interests**
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14 None declared.
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19 **Patient consent for publication**
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21 Not required.
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26 **Ethics approval**
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28 The study was approved by the ethics committees of the Shanghai Changzheng
29 Hospital and Songjiang District Central Hospital (No. 2019SL005).
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35 **Data availability statement**
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37 Data are available upon reasonable request.
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REFERENCES

1. Desai RM. Nephrology Update: End-Stage Renal Disease and Renal Replacement Therapy. *FP Essentials* 2016; **444**:23-29.
2. Collins AJ, Foley RN, Gilbertson DT, *et al.* United States Renal Data System public health surveillance of chronic kidney disease and end-stage renal disease. *Kidney Int Suppl (2011)* 2015; **5**:2-7.
3. *United States Renal Data System. USRDS 2014 Annual Data Report: Atlas of Chronic Kidney Disease and End-Stage Renal Disease in the United States. Vol. 2. Ch. 1: Incidence, prevalence, patient characteristics, and treatment modalities.* Bethesda: National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, 2014.
4. Liyanage T, Ninomiya T, Jha V, *et al.* Worldwide access to treatment for end-stage kidney disease: a systematic review. *Lancet* 2015; **385**:1975-82.
5. Zuo L, Wang M, Chinese Association of Blood Purification Management of Chinese Hospital A. Current burden and probable increasing incidence of ESRD in China. *Clin Nephrol* 2010; **74 Suppl 1**:S20-2.
6. Zhang L, Wang F, Wang L, *et al.* Prevalence of chronic kidney disease in China: a cross-sectional survey. *Lancet* 2012; **379**:815-22.
7. Harris DCH, Davies SJ, Finkelstein FO, *et al.* Increasing access to integrated ESKD care as part of universal health coverage. *Kidney Int* 2019; **95**:S1-S33.
8. Wang V, Vilme H, Maciejewski ML, *et al.* The Economic Burden of Chronic Kidney Disease and End-Stage Renal Disease. *Semin Nephrol* 2016; **36**:319-30.
9. Abbasi MA, Chertow GM, Hall YN. End-stage renal disease. *BMJ Clin Evid* 2010; **2010**

- 1
2
3 10. Perry MM, Howell S, Patel N. Protocols for treating patients with end-stage renal
4 disease: a survey of nephrology fellowships. *Spec Care Dentist* 2017; **37**:57-61.
5
6
7 11. *U.S. Renal Data System: Chapter 1 Incidence, prevalence, patient characteristics*
8 *and modality. In: USRDS 2012 Annual Data Report: Atlas of Chronic Kidney Disease*
9 *and End-Stage Renal Disease in the United States.* Bethesda: National Institutes of
10 Health, Bethesda MD, National Institute of Diabetes and Digestive and Kidney
11 Diseases, 2012.
12
13 12. Machowska A, Alscher MD, Vanga SR, *et al.* Offering Patients Therapy Options
14 in Unplanned Start: Development and Implementation of an Education Program for
15 Unplanned-Start Patients. *Adv Perit Dial* 2015; **31**:69-73.
16
17 13. Brown PA, Akbari A, Molnar AO, *et al.* Factors Associated with Unplanned
18 Dialysis Starts in Patients followed by Nephrologists: A Retrospective Cohort Study.
19 *PLoS One* 2015; **10**:e0130080.
20
21 14. Marron B, Martinez Ocana JC, Salgueira M, *et al.* Analysis of patient flow into
22 dialysis: role of education in choice of dialysis modality. *Perit Dial Int* 2005; **25**
23 **Suppl 3**:S56-9.
24
25 15. *Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group.*
26 *KDIGO 2012 clinical practice guideline for the evaluation and management of*
27 *chronic kidney disease.* 2013.
28
29 16. Murphree DD, Thelen SM. Chronic kidney disease in primary care. *J Am Board*
30 *Fam Med* 2010; **23**:542-50.
31
32 17. Stevens LA, Viswanathan G, Weiner DE. Chronic kidney disease and end-stage
33 renal disease in the elderly population: current prevalence, future projections, and
34 clinical significance. *Adv Chronic Kidney Dis* 2010; **17**:293-301.
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53
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2
3 18. Lobbedez T, Lecouf A, Ficheux M, *et al.* Is rapid initiation of peritoneal dialysis
4 feasible in unplanned dialysis patients? A single-centre experience. *Nephrol Dial*
5
6 *Transplant* 2008; **23**:3290-4.
7
8
- 9
10 19. Ghaffari A. Urgent-start peritoneal dialysis: a quality improvement report. *Am J*
11
12 *Kidney Dis* 2012; **59**:400-8.
13
- 14 20. Alkatheeri AM, Blake PG, Gray D, *et al.* Success of Urgent-Start Peritoneal
15
16 Dialysis in a Large Canadian Renal Program. *Perit Dial Int* 2016; **36**:171-6.
17
- 18 21. Webster AC, Nagler EV, Morton RL, *et al.* Chronic Kidney Disease. *Lancet* 2017;
19
20 **389**:1238-52.
21
22
- 23 22. Li WY, Wang YC, Hwang SJ, *et al.* Comparison of outcomes between
24
25 emergent-start and planned-start peritoneal dialysis in incident ESRD patients: a
26
27 prospective observational study. *BMC Nephrol* 2017; **18**:359.
28
29
- 30 23. Ivarsen P, Povlsen JV. Can peritoneal dialysis be applied for unplanned initiation
31
32 of chronic dialysis? *Nephrol Dial Transplant* 2014; **29**:2201-6.
33
34
- 35 24. Koch M, Kohnle M, Trapp R, *et al.* Comparable outcome of acute unplanned
36
37 peritoneal dialysis and haemodialysis. *Nephrol Dial Transplant* 2012; **27**:375-80.
38
39
- 40 25. Collins AJ, Hao W, Xia H, *et al.* Mortality risks of peritoneal dialysis and
41
42 hemodialysis. *Am J Kidney Dis* 1999; **34**:1065-74.
43
44
- 45 26. Liem YS, Wong JB, Hunink MG, *et al.* Comparison of hemodialysis and
46
47 peritoneal dialysis survival in The Netherlands. *Kidney Int* 2007; **71**:153-8.
48
49
- 50 27. Fenton SS, Schaubel DE, Desmeules M, *et al.* Hemodialysis versus peritoneal
51
52 dialysis: a comparison of adjusted mortality rates. *Am J Kidney Dis* 1997; **30**:334-42.
53
54
- 55 28. Jaar BG, Coresh J, Plantinga LC, *et al.* Comparing the risk for death with
56
57 peritoneal dialysis and hemodialysis in a national cohort of patients with chronic
58
59
60

- 1
2
3 kidney disease. *Ann Intern Med* 2005; **143**:174-83.
4
5
6 29. Weinhandl ED, Foley RN, Gilbertson DT, *et al.* Propensity-matched mortality
7
8 comparison of incident hemodialysis and peritoneal dialysis patients. *J Am Soc*
9
10 *Nephrol* 2010; **21**:499-506.
11
12 30. Bargman JM, Girsberger M. Visions in a Crystal Ball: The Future of Peritoneal
13
14 Dialysis. *Blood Purif* 2018; **45**:218-23.
15
16 31. Bargman JM. New technologies in peritoneal dialysis. *Clin J Am Soc Nephrol*
17
18 2007; **2**:576-80.
19
20 32. Zang XJ, Yang B, Du X, *et al.* Urgent-start peritoneal dialysis and patient
21
22 outcomes: a systematic review and meta-analysis. *Eur Rev Med Pharmacol Sci* 2019;
23
24 **23**:2158-66.
25
26 33. Wojtaszek E, Grzejszczak A, Grygiel K, *et al.* Urgent-Start Peritoneal Dialysis as
27
28 a Bridge to Definitive Chronic Renal Replacement Therapy: Short- and Long-Term
29
30 Outcomes. *Front Physiol* 2018; **9**:1830.
31
32 34. Ponce D, Brabo AM, Balbi AL. Urgent start peritoneal dialysis. *Curr Opin*
33
34 *Nephrol Hypertens* 2018; **27**:478-86.
35
36 35. Blake PG, Jain AK. Urgent Start Peritoneal Dialysis: Defining What It Is and
37
38 Why It Matters. *Clin J Am Soc Nephrol* 2018; **13**:1278-79.
39
40 36. Jin H, Ni Z, Mou S, *et al.* Feasibility of Urgent-Start Peritoneal Dialysis in Older
41
42 Patients with End-Stage Renal Disease: A Single-Center Experience. *Perit Dial Int*
43
44 2018; **38**:125-30.
45
46 37. Jin H, Fang W, Zhu M, *et al.* Urgent-Start Peritoneal Dialysis and Hemodialysis
47
48 in ESRD Patients: Complications and Outcomes. *PLoS One* 2016; **11**:e0166181.
49
50 38. Patel PR, Kallen AJ, Arduino MJ. Epidemiology, surveillance, and prevention of
51
52
53
54
55
56
57
58
59
60

- 1
2
3 bloodstream infections in hemodialysis patients. *Am J Kidney Dis* 2010; **56**:566-77.
- 4
5 39. Lukowsky LR, Mehrotra R, Kheifets L, *et al.* Comparing mortality of peritoneal
6
7 and hemodialysis patients in the first 2 years of dialysis therapy: a marginal structural
8
9 model analysis. *Clin J Am Soc Nephrol* 2013; **8**:619-28.
- 10
11 40. Lee CC, Sun CY, Wu MS. Long-term modality-related mortality analysis in
12
13 incident dialysis patients. *Perit Dial Int* 2009; **29**:182-90.
- 14
15 41. Couchoud C, Bolignano D, Nistor I, *et al.* Dialysis modality choice in diabetic
16
17 patients with end-stage kidney disease: a systematic review of the available evidence.
18
19 *Nephrol Dial Transplant* 2015; **30**:310-20.
- 20
21 42. Heaf JG, Wehberg S. Relative survival of peritoneal dialysis and haemodialysis
22
23 patients: effect of cohort and mode of dialysis initiation. *PLoS One* 2014; **9**:e90119.
- 24
25 43. Mircescu G, Stefan G, Garneata L, *et al.* Outcomes of dialytic modalities in a
26
27 large incident registry cohort from Eastern Europe: the Romanian Renal Registry. *Int*
28
29 *Urol Nephrol* 2014; **46**:443-51.
- 30
31 44. Marshall MR, Walker RC, Polkinghorne KR, *et al.* Survival on home dialysis in
32
33 New Zealand. *PLoS One* 2014; **9**:e96847.
- 34
35 45. Waldum-Grevbo B, Leivestad T, Reisaeter AV, *et al.* Impact of initial dialysis
36
37 modality on mortality: a propensity-matched study. *BMC Nephrol* 2015; **16**:179.
- 38
39 46. van de Luijtgarden MW, Noordzij M, Stel VS, *et al.* Effects of comorbid and
40
41 demographic factors on dialysis modality choice and related patient survival in
42
43 Europe. *Nephrol Dial Transplant* 2011; **26**:2940-7.
- 44
45 47. Xue J, Li H, Zhou Q, *et al.* Comparison of peritoneal dialysis with hemodialysis
46
47 on survival of diabetic patients with end-stage kidney disease: a meta-analysis of
48
49 cohort studies. *Ren Fail* 2019; **41**:521-31.
- 50
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53
54
55
56
57
58
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2
3 48. Haggerty S, Roth S, Walsh D, *et al.* Guidelines for laparoscopic peritoneal
4 dialysis access surgery. *Surg Endosc* 2014; **28**:3016-45.
5
6
7 49. Hu J, Liu Z, Liu J, *et al.* Reducing the occurrence rate of catheter dysfunction in
8 peritoneal dialysis: a single-center experience about CQI. *Ren Fail* 2018; **40**:628-33.
9
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3 **Figure legends**
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5 **Figure 1.** Survival rates of the patients in the peritoneal dialysis and hemodialysis
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8 groups. Kaplan-Meier survival analysis.
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Table 1. Comparisons of the baseline data

Parameter	USPD (n=309)	USHD (n=233)	P
Males [n (%)]	179 (57.9)	123 (52.8)	0.248
Age (years)	73.1±5.6	72.6±7.5	0.622
Duration of dialysis (months)	22.9±5.1	24.6±5.2	<0.001
Primary disease			
Chronic glomerulonephritis [n (%)]	116 (37.4)	119 (51.1)	0.065
Diabetic nephropathy [n (%)]	105 (34.00)	170 (7.3)	0.002
Hypertensive renal lesion [n (%)]	161 (5.2)	114 (4.9)	1.000
Lupus nephritis [n (%)]	65 (2.1)	30 (1.3)	1.000
Polycystic kidney [n (%)]	176 (5.7)	28 (12.2)	0.260
Unknown causes [n (%)]	67 (21.8)	43 (18.4)	0.502
Comorbidities			
Coronary artery-related events [n (%)]	76 (24.5)	74 (31.7)	0.440
Diabetes [n (%)]	152 (49.1)	74 (31.7)	0.090
Hypertension [n (%)]	175 (56.5)	131 (56.1)	0.816
Heart failure [n (%)]	128 (41.5)	142 (61.0)	0.061
Cerebrovascular events [n (%)]	35 (11.3)	45 (19.5)	0.209

USPD: urgent-start peritoneal dialysis; USHD: urgent-start hemodialysis.

Table 2. Comparisons of the baseline biochemical indexes

Index	USPD (n=309)	USHD (n=233)	P
eGFR (ml/min.1.73m ²)	5.3 (4.6,6.4)	5.6 (3.6,7.8)	0.738
Serum potassium (mmol/L)	3.9 (3.5,4.9)	4.0 (3.6,4.5)	0.427
Calcium (mmol/L)	1.89 (1.69,2.06)	1.99 (1.78,2.08)	0.212
Phosphorus (mmol/L)	1.91 (1.71,2.23)	1.62 (1.29,2.19)	0.010
iPTH (ng/L)	355.0 (217.5,504.0)	219.0 (127.5,449.0)	0.083
Serum albumin (g/L)	33.2±5.1	31.7±5.9	0.203
B-type natriuretic peptide (pg/mL)	299.0 (134.0,900.5)	479.0 (249.0,1480.0)	0.054
Hemoglobin (g/L)	82.0 (72.5,95.0)	82.0 (66.5,98.0)	0.888

All data are presented as median (P25, P75), except albumin (mean±standard deviation).

USPD: urgent-start peritoneal dialysis; USHD: urgent-start hemodialysis; eGFR: estimated glomerular filtration rate; iPTH: intact parathyroid hormone.

Table 3. Complications within 30 days after catheter implantation

Complications	USPD (n=309)	USHD (n=233)	P
Dialysis-related complications [n (%)]	14 (4.5)	25 (10.7)	0.031
Infectious complications [n (%)]	4 (1.2)	9 (3.8)	0.014
Non-infectious complications [n (%)]	9 (2.9)	13 (5.5)	0.395
Complications requiring re-catheterization [n (%)]	5 (1.6)	22 (9.4)	<0.001
Bacteremia [n (%)]	4 (1.2)	13 (5.5)	0.006

Table 4. Multivariable Cox analysis of the independent factors for survival

Factor	HR	95%CI	P
Age (every 1 year increase)	1.025	1.013-1.043	<0.001
Serum potassium (every 1 mmol/L increase)	0.678	0.487-0.970	0.032
Diabetes	1.705	0.978-2.967	0.067
USHD (comparing with USPD)	2.220	1.298-3.790	0.004

HR: hazard ratio; USHD: urgent-started hemodialysis; USPD: urgent-started peritoneal dialysis.

Table 5. Multivariable Cox analysis of the independent factors for survival in elderly patients with diabetes.

Factor	HR	95%CI	P
Serum albumin (every 1 g/L increase)	0.926	0.861-1.00	0.049
Serum potassium (every 1 mmol/L increase)	0.258	0.126-0.538	<0.001
USHD (comparing with USPD)	2.813	1.092-7.330	0.033

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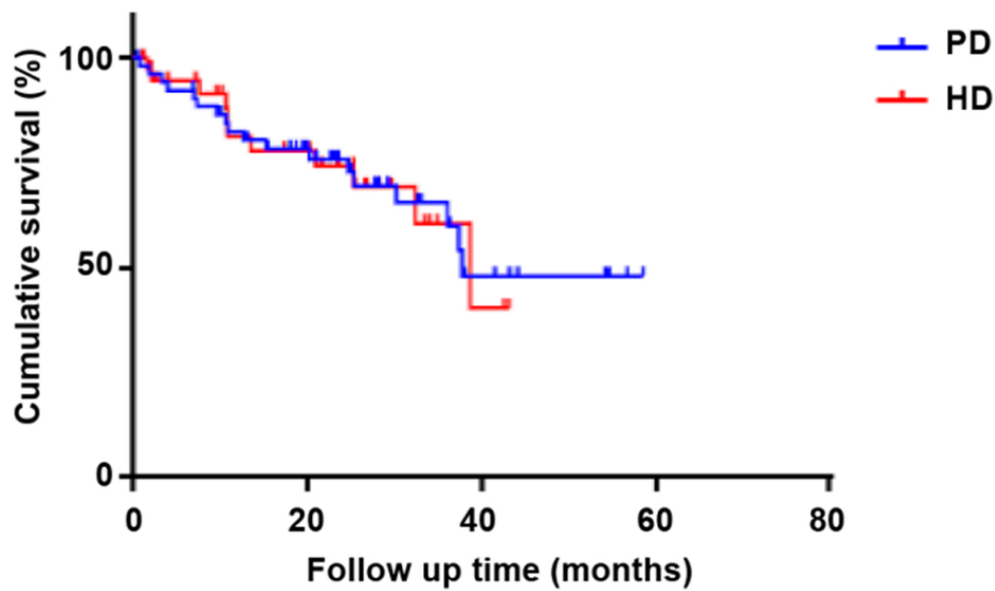


Figure 1. Survival rates of the patients in the peritoneal dialysis and hemodialysis groups. Kaplan-Meier survival analysis.

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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	1 2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6-7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	7 7 7 7 7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	8-9
Outcome data	15*	Report numbers of outcome events or summary measures over time	8-9

1	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-9
2			(b) Report category boundaries when continuous variables were categorized	
3			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
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9	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-9
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11	Discussion			
12				
13	Key results	18	Summarise key results with reference to study objectives	9-11
14	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
15				
16	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-11
17				
18				
19	Generalisability	21	Discuss the generalisability (external validity) of the study results	9-11
20				
21	Other information			
22	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12
23				
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*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

BMJ Open

Complications and outcomes of urgent-start peritoneal dialysis in elderly patients with end-stage renal disease in China: A retrospective cohort study

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Primary Subject Heading:	Renal medicine
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3 **Complications and outcomes of urgent-start peritoneal dialysis in elderly**
4 **patients with end-stage renal disease in China: A retrospective cohort study**
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38 **Running title:** Urgent-start peritoneal dialysis
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ABSTRACT

Objectives: To investigate the complications and survival of elderly patients with end-stage renal disease (ESRD) that received urgent-start peritoneal dialysis (USPD) or urgent-start hemodialysis (USHD), and to explore the value of peritoneal dialysis (PD) as the emergent dialysis method for elderly patients with ESRD.

Design: Retrospective cohort study.

Setting: Two tertiary care hospitals in Shanghai, China.

Participants: Chinese patients (n=542) >65 years of age with estimated glomerular filtration rate ≤ 15 ml/min/m² that received urgent-start dialysis between 01/01/2005 and 12/31/2015, and with at least 3 months of treatment. Patients who converted to other dialysis methods, regardless of the initial dialysis method, were excluded, as well as those with comorbidities that could significantly affect their dialysis outcomes.

Primary and secondary outcome measures: Dialysis-related complications and survival were compared. Patients were followed until death, stopped PD, transfer to other dialysis centers, loss to follow-up, or 12/31/2016.

Results: There were 309 patients in the USPD group and 233 in the USHD group. The rate of dialysis-related complications within 30 days after catheter implantation was significantly lower in the USPD group compared with the USHD group (4.5% vs. 10.7%, P=0.031). The 6-month and 1-, 2-, and 3-year survival rates were 95.3%, 91.4%, 86.6%, and 64.8% in the USPD group, and 92.2%, 85.7%, 70.2%, and 57.8% in the USHD group, respectively (P=0.023). The multivariable Cox regression analysis showed that USHD (hazard ratio (HR)= 2.220, 95% confidence interval (CI): 1.298-3.790; P=0.004), age (HR=1.025, 95%CI: 1.013-1.043, P<0.001), and

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3 hypokalemia (HR=0.678, 95%CI: 0.487-0.970; P=0.032) were independently
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5 associated with death.
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7 **Conclusions:** USPD was associated with slightly better survival compared with
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9 USHD. USPD was associated with fewer complications and better survival than
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11 USHD in elderly patients with ESRD.
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17 **Key words:** peritoneal dialysis; hemodialysis; prognosis; elderly; end-stage renal
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19 disease
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22 23 24 **Strengths and limitations of this study**

- 25 - Relatively small sample size from only two hospitals.
 - 26 - Retrospective study, with all the inherent biases.
 - 27 - The data were limited to those available from the medical charts.
 - 28 - A strength of this study is the relatively long follow-up.
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INTRODUCTION

End-stage renal disease (ESRD) is the end stage of chronic kidney disease (CKD), which is an important public health problem worldwide with high incidence, poor prognosis, high health care costs, and high socio-economic burden.¹⁻¹⁰ With the overall aging of the population, the prevalence of ESRD is on the rise worldwide. Dialysis often needs to be performed urgently in patients with ESRD due to silent disease, low health awareness, and late referral.¹¹⁻¹⁴ According to USRDS data reports, in 2010, 43% of the patients had been referred to a nephrologist for the first time at the time of initiating dialysis. Therefore, 30%-50% of patients needing dialysis start the procedure urgently, despite planned dialysis known as an ideal dialysis modality.¹²

The elderly represents a special population for dialysis. In addition to having the highest prevalence of dialysis among all age groups^{15,16}, the elderly with ESRD can have dramatic consequences because of frailty, comorbidities, and less resistance to health issues, complicating the management of ESRD.¹⁷ In addition, the hemodynamic stability of elderly individuals is relatively poor.¹⁷ Previous studies showed that using peritoneal dialysis (PD) as the first dialysis method does not increase the risk of short-term complications in elderly patients with ESRD; in addition, the survival rate of the patients is also not evidently affected.¹⁸⁻²⁰

Urgent-start PD (USPD) refers to the initiation of PD treatment within 2 weeks after catheter implantation.²¹ USPD is commonly applied by physicians in China.²² USPD avoids temporary central venous catheter (CVC) and vascular access surgery in urgent-start hemodialysis (USHD), and thus reduces the risks of USHD and simplifies the treatment processes. The comparison between USPD and USHD has shown that the risks of bacteremia and death are higher in the patients receiving USHD than in

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3 those receiving USPD.^{23, 24} Nevertheless, there is a lack of such comparison for
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5 elderly patients.
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8 Therefore, the aim of the present study was to investigate the complications and
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10 survival of elderly patients with ESRD that received USPD or USHD and to explore
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12 the value of PD as the emergent dialysis method for elderly patients with ESRD.
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15 16 17 **PATIENTS AND METHODS**

18 19 **Study design and patients**

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21 This was a retrospective cohort study of patients >65 years of age that received
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23 urgent-start dialysis at the Shanghai Changzheng Hospital and Songjiang District
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25 Central Hospital between January 1st, 2005, and December 31st, 2015. The study was
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27 approved by the ethics committees of the Shanghai Changzheng Hospital and
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29 Songjiang District Central Hospital (No. 2019SL005).
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33 ESRD was defined as an estimated glomerular filtration rate (eGFR)<15
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35 ml/min/1.73 m².¹⁵ USPD was defined as PD that started within 2 weeks after catheter
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37 implantation. USHD was defined as dialysis that started without the establishment of
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39 long-term dialysis access or within 30 days after the establishment of long-term
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41 dialysis.
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45 The inclusion criteria were: 1) >65 years of age; 2) eGFR ≤15 ml/min/m²; and 3)
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47 received HD or PD for ≥3 months. The exclusion criteria were: 1) <65 years of age; 2)
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49 died within 3 months of dialysis or lost to follow up; 3) converted to other dialysis
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51 methods, regardless of the initial dialysis method; or 4) combined with severe
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53 respiratory diseases, severe acute heart failure, severe hyperkalemia (serum potassium
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55 levels >6.5 mmol/L), or severe acidosis (bicarbonate radical levels <12 mmol/L).
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3 USPD or USHD was selected according to the willingness of the patients and the
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5 decision of the physicians at the Nephrology Department according to the condition of
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7 the patients (vital signs, cardiac functions, and biochemical indexes). The patients
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9 were categorized into the USPD and USHD groups.
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14 **Dialysis methods**

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16 For the patients in the USPD group, a PD catheter was used as access. All
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18 catheters were implanted by trained physicians after local anesthesia (5-10 ml of 1%
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20 lidocaine hydrochloride was applied layer by layer). After the catheter was implanted,
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22 the time of the dialysis initiation was decided by the physicians according to the
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24 clinical manifestations (vital signs, cardiac functions, and biochemical indexes). For
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26 all patients on PD, a swan-neck straight catheter was implanted, and glucose-based
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28 dialysate was used in all patients. All patients in the USPD group received continuous
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30 ambulatory PD (CAPD), four bags/day, 2 L/bag.
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35 For the patients in the HD group, CVC was used as access. All CVCs were
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37 implanted into the internal jugular vein or femoral vein by trained physicians. The
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39 patients in the USHD group received HD (4 h/time, volume of blood flow was
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41 250-300 ml/min) or continuous renal replacement treatment (CRRT; 6-8 h/time,
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43 volume of blood flow was 180-300 ml/min).
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49 **Data collection**

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51 All the included patients were followed until loss to follow-up, death, or
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53 December 31, 2016. The demographic characteristics (sex, age, primary disease, and
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55 complications), residual renal function before dialysis, and clinical and biochemical
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3 indexes of patients were collected. The date of catheter implantation, time of dialysis
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5 initiation, and dialysis-related complications, including infection-related
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7 complications (such as catheter-related infection and peritonitis) and
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9 non-infection-related complications (leakage, bleeding, catheter malposition,
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11 embolism, catheter obstruction, and hernia) were recorded. The outcomes (including
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13 death, conversion to HD, kidney transplantation, and transferred to other treatment
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15 centers), time of the outcomes, causes of the outcomes, time of the first peritonitis,
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17 times of peritonitis, and the catheter dysfunction events that required surgical
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19 interventions or conversion to HD within 3 months after the operation were recorded.
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26 **Statistical analysis**

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28 SPSS 19.0 (IBM, Armonk, NY, USA) was used for statistical analysis.
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30 Continuous data with normal distribution are presented as means \pm standard deviation,
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32 while continuous data without normal distribution are described as percentiles (P25,
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34 P75). The Mann-Whitney test or the Student t-test was used, as appropriate. The
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36 Kaplan-Meier method and the log-rank test were used to analyze the survival of the
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38 patients. The factors that have been widely acknowledged to affect the survival of the
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40 patients, as well as the factors that were significantly different between the two groups
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42 at baseline, were entered in a multivariable models (logistic regression and Cox
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44 models); the results are presented as odds ratio (OR) and 95% confidence interval
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46 (CI). $P < 0.05$ was considered statistically significant.
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54 **Patient and public involvement**

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56 The patients and the public were not involved in the design of this study, in the
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3 selection of the outcomes, in the conduct of the study, or in result dissemination.
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7 8 **RESULTS**

9 10 **Characteristics of the patients**

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12 Finally, 542 patients (283 males and 259 females) were included, 309 in the
13
14 USPD group, and 233 in the USHD group. The mean age of the patients was 73.1 ± 5.6
15
16 years. The patients in the USPD accounted for 57% of all the dialysis patients, and the
17
18 median time from catheter implantation to the start of dialysis was 4 (2-6) days. The
19
20 patients in the USHD group received dialysis on the day of or the day after catheter
21
22 implantation. Age, sex, and primary diseases were not significantly different between
23
24 the two groups. The numbers of patients with coronary artery-related events or heart
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26 failure (NYHA III, grade IV) were not significantly different between the two groups.
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28 The Charlson comorbidity index (CCI) was also not significantly different between
29
30 the two groups (Table 1). The duration of HD was longer than that of PD (24.6 ± 5.2
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32 months vs. 22.9 ± 5.1 months, $P < 0.001$). The eGFR, serum calcium levels, serum
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34 phosphorus levels, serum intact parathyroid hormone (iPTH), and blood lipid levels
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36 before dialysis were not significantly different between the two groups (Table 2).
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45 **Complications**

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47 Compared with the USHD group, the rate of dialysis-related complications within
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49 30 days after catheter implantation was significantly lower in the USPD group (4.5%
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51 vs. 10.7%, $P = 0.031$). The rates of dialysis-related complications requiring
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53 re-catheterization (1.6% vs. 9.4%; $P < 0.001$) and bacteremia (1.2% vs. 5.5%; $P = 0.006$)
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55 were significantly lower in the USPD group than in the USHD group (Table 3).
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3 Logistic regression showed that after adjusting for demographic characteristics and
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5 baseline data, USHD was an independent risk factor for dialysis-related complications
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7 compared with USPD (OR=2.121, 95% CI: 1.058-4.273, P=0.031).
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10 11 12 **Survival**

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14 The 6-month and 1-, 2-, and 3-year survival rates were 95.3%, 91.4%, 86.6%, and
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16 64.8% in the USPD group, and 92.2%, 85.7%, 70.2%, and 57.8% in the USHD group,
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18 respectively (P=0.023) (Figure 1). The multivariable Cox regression analysis showed
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20 that after adjusting for demographic characteristics and baseline data, USHD was an
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22 independent risk factor of death compared with USPD (hazard ratio (HR)= 2.220, 95%
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24 CI: 1.298-3.790; P=0.004). In addition, age (HR=1.025, 95%CI: 1.013-1.043,
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26 P<0.001) and hypokalemia (HR=0.678, 95%CI: 0.487-0.970; P=0.032) were also
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28 independently associated with death (Table 4). A subgroup analysis showed that
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30 USHD had a worse prognosis than USPD in elderly diabetic patients (HR=2.81,
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32 95%CI: 1.09-7.33, P=0.03) (Table 5).
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40 **DISCUSSION**

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42 Studies suggest that USPD is associated with better patient outcomes than USHD
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44 ^{23, 24}, but there is a lack of comparison between USPD and USHD for elderly patients
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46 with ESRD. Therefore, this study aimed to investigate the complications and survival
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48 of elderly patients with ESRD that received USPD or USHD and to explore the value
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50 of PD as the emergent dialysis method for elderly patients with ESRD. The results
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52 strongly suggest that USPD was associated with slightly better survival compared
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54 with USHD. USPD was associated with fewer complications and better survival than
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3 USHD in elderly patients with ESRD.
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5 Elderly ESRD patients have several special features, including delayed initiation
6 of dialysis, more complications, poor nutritional status, cognitive impairment, and
7 relatively low quality of life, which could lead to difficulties in the management of
8 ESRD.¹⁷ The mortality rate in elderly patients with ESRD is higher than in relatively
9 younger patients receiving dialysis; in addition, the mortality rate is increasing with
10 the increase of age.^{6,17} A previous study has already reported that the mortality rate
11 increases by about 1.7 folds with every 10 years increase of the age in Chinese
12 patients.⁶ Previous studies have compared the mortality rates of elderly patients on
13 HD or PD, but the results are inconsistent. Collins et al.²⁵ compared the data of
14 patients on HD (n=99,048) and PD (n=18,110), and they observed that the survival of
15 the patients >55 years old was significantly higher among those on PD compared with
16 HD, after stratification for age and diabetes. The data in the 2009 USRDS database
17 showed that after adjusting for age, gender, ethnicity, and comorbidities, the 1, 3, and
18 5-year survival rates of patients on PD were significantly higher than those on HD.²⁶
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37 Several studies have demonstrated that PD could be used for emergent dialysis in
38 patients with ESRD.²⁷⁻²⁹ Early PD involves high risks of leakage, bleeding, and
39 peritonitis within a short time after catheter implantation, which limits the application
40 of PD in emergent dialysis. Nevertheless, the PD techniques have advanced greatly in
41 recent years with the development of the Tenckhof catheter, closed liquid supply
42 system with Y-type connection, advancement of catheterization methods, and
43 application of automatic PD.³⁰⁻³¹ Recent studies have shown that PD is safe and
44 applicable as the emergent dialysis for ESRD patients.³²⁻³⁷
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56 In the present study, the results showed that the occurrence of complications in
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3 the USPD group was significantly lower than in the USHD group. After adjustment
4 for demographic characteristics and clinical data, USHD was independently
5 associated with dialysis-related complications, compared with USPD. Using USPD in
6 elderly patients with ESRD could effectively reduce the risk of dialysis-related
7 complications within 2 weeks after catheter implantation. No serious complications
8 such as major bleeding, leakage, or organ rupture were found in the PD group,
9 suggesting that the catheter implantation for USPD conducted by trained physicians
10 was probably safe, but additional studies should be performed for confirmation.
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22 Some previous studies showed that comparing with USHD, the survival rate of
23 patients on USPD is not significantly different.^{18, 38} Lobbedez et al.¹⁸ observed that
24 survival and re-hospitalization rates were not significantly different between USPD
25 and USHD. In the present study, USPD was associated with a slightly better overall
26 survival at 3 years compared with USHD. In addition, the present study showed that
27 USHD had a worse prognosis than USPD in elderly diabetic patients. More
28 complications within 30 days after catheter implantation in HD than in PD might be a
29 part of the explanation. Previous studies reported conflicting results concerning the
30 mortality of HD vs. PD. Indeed, a study showed that mortality was lower for PD in
31 than for HD in non-diabetics, men <55 years of age, and in diabetics <55 years of age,
32 but higher in diabetic women >55 years of age.²⁵ Lukowsky et al.³⁹ reported that PD
33 led to better survival than HD in those patients, while a number of studies reported no
34 significant survival difference between HD and PD.⁴⁰⁻⁴⁶ On the other hand, a
35 meta-analysis suggested that elderly diabetic patients might benefit more from HD
36 than PD⁴⁷. There is still controversy in this area. Additional studies are necessary to
37 examine this issue, especially since the present study specifically examined USPD
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3 and USHD, while those previous studies examined all patients.
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5 This study has limitations. The sample size was relatively small and from only
6 two hospitals. The study was retrospective, with all the inherent biases, and the data
7 was limited to those available in the medical charts. Because of the retrospective
8 nature of the study, and the regulations in China, the exact cause of death can be
9 known only if written in the patient chart. Otherwise, such data might be available
10 upon request to the central State database, but access to those data requires special
11 authorization. As of now, the exact cause of death is missing for most patients. The
12 patients on CRRT were included, but those patients are known to have high mortality
13 rates, probably affecting the results. Furthermore, the usual rate of catheter
14 dysfunction depends upon the method of implantation and is usually around 5%-8%.⁴⁸
15 We agree that this rate is low, but not so far than that of a study that reported a rate of
16 5.9% before a continuous quality improvement program and 1.5% after the program.
17 ⁴⁹ In our hospitals, even there is no official continuous quality improvement program,
18 a strict protocol is followed, which could explain the low rate. Finally, as a
19 retrospective study, no causality relationship could be established between the type of
20 dialysis and the outcomes. These limitations might account, at least in part, for the
21 differences observed between the present study and previous ones. Prospective trials
22 could be necessary to determine the exact benefits of USPD vs. USHD.
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47 In conclusion, USPD was associated with slightly better survival compared with
48 USHD. USPD was associated with fewer complications and better survival than
49 USHD in elderly patients with ESRD.
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54 55 56 **Contributors** 57 58 59 60

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3 XJZ , XD, LL and CLM carried out the studies, participated in collecting data, and
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5 drafted the manuscript. LL and CLM performed the statistical analysis and
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7 participated in its design. All authors read and approved the final manuscript.
8
9

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19
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21
22 Chinese and Western Medicine Foundation (SH201737).
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28 29 **Competing interests**

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31 None declared.
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35 36 **Patient consent for publication**

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38 Not required.
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42 43 **Ethics approval**

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45 The study was approved by the ethics committees of the Shanghai Changzheng
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47 Hospital and Songjiang District Central Hospital (No. 2019SL005).
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51 52 **Data availability statement**

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54 Data are available upon reasonable request.
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REFERENCES

1. Desai RM. Nephrology Update: End-Stage Renal Disease and Renal Replacement Therapy. *FP Essentials* 2016; **444**:23-29.
2. Collins AJ, Foley RN, Gilbertson DT, et al. United States Renal Data System public health surveillance of chronic kidney disease and end-stage renal disease. *Kidney Int Suppl (2011)* 2015; **5**:2-7.
3. *United States Renal Data System. USRDS 2014 Annual Data Report: Atlas of Chronic Kidney Disease and End-Stage Renal Disease in the United States. Vol. 2. Ch. 1: Incidence, prevalence, patient characteristics, and treatment modalities.* Bethesda: National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, 2014.
4. Liyanage T, Ninomiya T, Jha V, et al. Worldwide access to treatment for end-stage kidney disease: a systematic review. *Lancet* 2015; **385**:1975-82.
5. Zuo L, Wang M, Chinese Association of Blood Purification Management of Chinese Hospital A. Current burden and probable increasing incidence of ESRD in China. *Clin Nephrol* 2010; **74 Suppl 1**:S20-2.
6. Zhang L, Wang F, Wang L, et al. Prevalence of chronic kidney disease in China: a cross-sectional survey. *Lancet* 2012; **379**:815-22.
7. Harris DCH, Davies SJ, Finkelstein FO, et al. Increasing access to integrated ESKD care as part of universal health coverage. *Kidney Int* 2019; **95**:S1-S33.
8. Wang V, Vilme H, Maciejewski ML, et al. The Economic Burden of Chronic Kidney Disease and End-Stage Renal Disease. *Semin Nephrol* 2016;

- 1
2
3
4 **36:319-30.**
5
6
7 9. Abbasi MA, Chertow GM, Hall YN. End-stage renal disease. *BMJ Clin Evid* 2010;
8
9 **2010**
10
11
12 10. Perry MM, Howell S, Patel N. Protocols for treating patients with end-stage renal
13
14 disease: a survey of nephrology fellowships. *Spec Care Dentist* 2017;
15
16 **37:57-61.**
17
18
19 11. *U.S. Renal Data System: Chapter 1 Incidence, prevalence, patient characteristics*
20
21 *and modality. In: USRDS 2012 Annual Data Report: Atlas of Chronic Kidney*
22
23 *Disease and End-Stage Renal Disease in the United States.* Bethesda:
24
25 National Institutes of Health, Bethesda MD, National Institute of Diabetes and
26
27 Digestive and Kidney Diseases, 2012.
28
29
30
31
32 12. Machowska A, Alscher MD, Vanga SR, et al. Offering Patients Therapy Options
33
34 in Unplanned Start: Development and Implementation of an Education
35
36 Program for Unplanned-Start Patients. *Adv Perit Dial* 2015; **31:69-73.**
37
38
39
40 13. Brown PA, Akbari A, Molnar AO, et al. Factors Associated with Unplanned
41
42 Dialysis Starts in Patients followed by Nephrologists: A Retrospective Cohort
43
44 Study. *PLoS One* 2015; **10:e0130080.**
45
46
47
48 14. Marron B, Martinez Ocana JC, Salgueira M, et al. Analysis of patient flow into
49
50 dialysis: role of education in choice of dialysis modality. *Perit Dial Int* 2005;
51
52 **25 Suppl 3:S56-9.**
53
54
55
56 15. *Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group.*
57
58
59
60

- 1
2
3
4 *KDIGO 2012 clinical practice guideline for the evaluation and management*
5
6 *of chronic kidney disease. 2013.*
7
8
- 9 16. Murphree DD, Thelen SM. Chronic kidney disease in primary care. *J Am Board*
10
11 *Fam Med* 2010; **23**:542-50.
12
13
- 14 17. Stevens LA, Viswanathan G, Weiner DE. Chronic kidney disease and end-stage
15
16 renal disease in the elderly population: current prevalence, future projections,
17
18 and clinical significance. *Adv Chronic Kidney Dis* 2010; **17**:293-301.
19
20
- 21 18. Lobbedez T, Lecouf A, Ficheux M, et al. Is rapid initiation of peritoneal dialysis
22
23 feasible in unplanned dialysis patients? A single-centre experience. *Nephrol*
24
25 *Dial Transplant* 2008; **23**:3290-4.
26
27
- 28 19. Ghaffari A. Urgent-start peritoneal dialysis: a quality improvement report. *Am J*
29
30 *Kidney Dis* 2012; **59**:400-8.
31
32
- 33 20. Alkathheeri AM, Blake PG, Gray D, et al. Success of Urgent-Start Peritoneal
34
35 Dialysis in a Large Canadian Renal Program. *Perit Dial Int* 2016; **36**:171-6.
36
37
- 38 21. Webster AC, Nagler EV, Morton RL, et al. Chronic Kidney Disease. *Lancet* 2017;
39
40 **389**:1238-52.
41
42
- 43 22. Li WY, Wang YC, Hwang SJ, et al. Comparison of outcomes between
44
45 emergent-start and planned-start peritoneal dialysis in incident ESRD patients:
46
47 a prospective observational study. *BMC Nephrol* 2017; **18**:359.
48
49
- 50 23. Ivarsen P, Povlsen JV. Can peritoneal dialysis be applied for unplanned initiation
51
52 of chronic dialysis? *Nephrol Dial Transplant* 2014; **29**:2201-6.
53
54
55
56
57
58
59
60

- 1
2
3
4 24. Koch M, Kohnle M, Trapp R, et al. Comparable outcome of acute unplanned
5
6 peritoneal dialysis and haemodialysis. *Nephrol Dial Transplant* 2012;
7
8
9 27:375-80.
10
11 25. Collins AJ, Hao W, Xia H, et al. Mortality risks of peritoneal dialysis and
12
13 hemodialysis. *Am J Kidney Dis* 1999; **34**:1065-74.
14
15
16 26. Liem YS, Wong JB, Hunink MG, et al. Comparison of hemodialysis and
17
18 peritoneal dialysis survival in The Netherlands. *Kidney Int* 2007; **71**:153-8.
19
20
21 27. Fenton SS, Schaubel DE, Desmeules M, et al. Hemodialysis versus peritoneal
22
23 dialysis: a comparison of adjusted mortality rates. *Am J Kidney Dis* 1997;
24
25
26
27 30:334-42.
28
29
30 28. Jaar BG, Coresh J, Plantinga LC, et al. Comparing the risk for death with
31
32 peritoneal dialysis and hemodialysis in a national cohort of patients with
33
34 chronic kidney disease. *Ann Intern Med* 2005; **143**:174-83.
35
36
37 29. Weinhandl ED, Foley RN, Gilbertson DT, et al. Propensity-matched mortality
38
39 comparison of incident hemodialysis and peritoneal dialysis patients. *J Am Soc*
40
41
42
43
44
45
46 30. Bargman JM, Girsberger M. Visions in a Crystal Ball: The Future of Peritoneal
47
48 Dialysis. *Blood Purif* 2018; **45**:218-23.
49
50
51 31. Bargman JM. New technologies in peritoneal dialysis. *Clin J Am Soc Nephrol*
52
53
54 2007; **2**:576-80.
55
56 32. Zang XJ, Yang B, Du X, et al. Urgent-start peritoneal dialysis and patient
57
58
59
60

- 1
2
3
4 outcomes: a systematic review and meta-analysis. *Eur Rev Med Pharmacol*
5
6
7 *Sci* 2019; **23**:2158-66.
8
- 9 33. Wojtaszek E, Grzejszczak A, Grygiel K, et al. Urgent-Start Peritoneal Dialysis as
10
11 a Bridge to Definitive Chronic Renal Replacement Therapy: Short- and
12
13 Long-Term Outcomes. *Front Physiol* 2018; **9**:1830.
14
15
- 16 34. Ponce D, Brabo AM, Balbi AL. Urgent start peritoneal dialysis. *Curr Opin*
17
18 *Nephrol Hypertens* 2018; **27**:478-86.
19
20
- 21 35. Blake PG, Jain AK. Urgent Start Peritoneal Dialysis: Defining What It Is and
22
23 Why It Matters. *Clin J Am Soc Nephrol* 2018; **13**:1278-79.
24
25
- 26 36. Jin H, Ni Z, Mou S, et al. Feasibility of Urgent-Start Peritoneal Dialysis in Older
27
28 Patients with End-Stage Renal Disease: A Single-Center Experience. *Perit*
29
30 *Dial Int* 2018; **38**:125-30.
31
32
- 33 37. Jin H, Fang W, Zhu M, et al. Urgent-Start Peritoneal Dialysis and Hemodialysis in
34
35 ESRD Patients: Complications and Outcomes. *PLoS One* 2016; **11**:e0166181.
36
37
- 38 38. Patel PR, Kallen AJ, Arduino MJ. Epidemiology, surveillance, and prevention of
39
40 bloodstream infections in hemodialysis patients. *Am J Kidney Dis* 2010;
41
42
43
44
45 **56**:566-77.
46
47
- 48 39. Lukowsky LR, Mehrotra R, Kheifets L, et al. Comparing mortality of peritoneal
49
50 and hemodialysis patients in the first 2 years of dialysis therapy: a marginal
51
52 structural model analysis. *Clin J Am Soc Nephrol* 2013; **8**:619-28.
53
54
- 55 40. Lee CC, Sun CY, Wu MS. Long-term modality-related mortality analysis in
56
57
58
59
60

- 1
2
3
4 incident dialysis patients. *Perit Dial Int* 2009; **29**:182-90.
5
6
7 41. Couchoud C, Bolignano D, Nistor I, et al. Dialysis modality choice in diabetic
8
9 patients with end-stage kidney disease: a systematic review of the available
10
11 evidence. *Nephrol Dial Transplant* 2015; **30**:310-20.
12
13
14 42. Heaf JG, Wehberg S. Relative survival of peritoneal dialysis and haemodialysis
15
16 patients: effect of cohort and mode of dialysis initiation. *PLoS One* 2014;
17
18 **9**:e90119.
19
20
21 43. Mircescu G, Stefan G, Garneata L, et al. Outcomes of dialytic modalities in a
22
23 large incident registry cohort from Eastern Europe: the Romanian Renal
24
25 Registry. *Int Urol Nephrol* 2014; **46**:443-51.
26
27
28
29 44. Marshall MR, Walker RC, Polkinghorne KR, et al. Survival on home dialysis in
30
31 New Zealand. *PLoS One* 2014; **9**:e96847.
32
33
34
35 45. Waldum-Grevbo B, Leivestad T, Reisaeter AV, et al. Impact of initial dialysis
36
37 modality on mortality: a propensity-matched study. *BMC Nephrol* 2015;
38
39 **16**:179.
40
41
42
43 46. van de Luitgaarden MW, Noordzij M, Stel VS, et al. Effects of comorbid and
44
45 demographic factors on dialysis modality choice and related patient survival in
46
47 Europe. *Nephrol Dial Transplant* 2011; **26**:2940-7.
48
49
50
51 47. Xue J, Li H, Zhou Q, et al. Comparison of peritoneal dialysis with hemodialysis
52
53 on survival of diabetic patients with end-stage kidney disease: a meta-analysis
54
55 of cohort studies. *Ren Fail* 2019; **41**:521-31.
56
57
58
59
60

1
2
3
4 48. Haggerty S, Roth S, Walsh D, et al. Guidelines for laparoscopic peritoneal dialysis
5
6 access surgery. *Surg Endosc* 2014; **28**:3016-45.

7
8
9 49. Hu J, Liu Z, Liu J, et al. Reducing the occurrence rate of catheter dysfunction in
10
11 peritoneal dialysis: a single-center experience about CQI. *Ren Fail* 2018;
12
13 **40**:628-33.
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
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3 **Figure legends**
4

5 **Figure 1.** Survival rates of the patients in the peritoneal dialysis and hemodialysis
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8 groups. Kaplan-Meier survival analysis.
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Table 1. Comparisons of the baseline data

Parameter	USPD (n=309)	USHD (n=233)	P
Males [n (%)]	179 (57.9)	123 (52.8)	0.248
Age (years)	73.1±5.6	72.6±7.5	0.622
Duration of dialysis (months)	22.9±5.1	24.6±5.2	<0.001
Primary disease			
Chronic glomerulonephritis [n (%)]	116 (37.4)	119 (51.1)	0.065
Diabetic nephropathy [n (%)]	105 (34.0)	170 (7.3)	0.002
Hypertensive renal lesion [n (%)]	161 (5.2)	114 (4.9)	1.000
Lupus nephritis [n (%)]	65 (2.1)	30 (1.3)	1.000
Polycystic kidney [n (%)]	176 (5.7)	28 (12.2)	0.260
Unknown causes [n (%)]	67 (21.8)	43 (18.4)	0.502
Comorbidities			
Coronary artery-related events [n (%)]	76 (24.5)	74 (31.7)	0.440
Diabetes [n (%)]	152 (49.1)	74 (31.7)	0.090
Hypertension [n (%)]	175 (56.5)	131 (56.1)	0.816
Heart failure [n (%)]	128 (41.5)	142 (61.0)	0.061
Cerebrovascular events [n (%)]	35 (11.3)	45 (19.5)	0.209

USPD: urgent-start peritoneal dialysis; USHD: urgent-start hemodialysis.

Table 2. Comparisons of the baseline biochemical indexes

Index	USPD (n=309)	USHD (n=233)	P
eGFR (ml/min.1.73m ²)	5.3 (4.6,6.4)	5.6 (3.6,7.8)	0.738
Serum potassium (mmol/L)	3.9 (3.5,4.9)	4.0 (3.6,4.5)	0.427
Calcium (mmol/L)	1.89 (1.69,2.06)	1.99 (1.78,2.08)	0.212
Phosphorus (mmol/L)	1.91 (1.71,2.23)	1.62 (1.29,2.19)	0.010
iPTH (ng/L)	355.0 (217.5,504.0)	219.0 (127.5,449.0)	0.083
Serum albumin (g/L)	33.2±5.1	31.7±5.9	0.203
B-type natriuretic peptide (pg/mL)	299.0 (134.0,900.5)	479.0 (249.0,1480.0)	0.054
Hemoglobin (g/L)	82.0 (72.5,95.0)	82.0 (66.5,98.0)	0.888

All data are presented as median (P25, P75), except albumin (mean±standard deviation).

USPD: urgent-start peritoneal dialysis; USHD: urgent-start hemodialysis; eGFR: estimated glomerular filtration rate; iPTH: intact parathyroid hormone.

Table 3. Complications within 30 days after catheter implantation

Complications	USPD (n=309)	USHD (n=233)	P
Dialysis-related complications [n (%)]	14 (4.5)	25 (10.7)	0.031
Infectious complications [n (%)]	4 (1.2)	9 (3.8)	0.014
Non-infectious complications [n (%)]	9 (2.9)	13 (5.5)	0.395
Complications requiring re-catheterization [n (%)]	5 (1.6)	22 (9.4)	<0.001
Bacteremia [n (%)]	4 (1.2)	13 (5.5)	0.006

USPD: urgent-start peritoneal dialysis; USHD: urgent-start hemodialysis.

Table 4. Multivariable Cox analysis of the independent factors for survival

Factor	HR	95%CI	P
Age (every 1-year increase)	1.025	1.013-1.043	<0.001
Serum potassium (every 1 mmol/L increase)	0.678	0.487-0.970	0.032
Diabetes	1.705	0.978-2.967	0.067
USHD (comparing with USPD)	2.220	1.298-3.790	0.004

HR: hazard ratio; USHD: urgent-started hemodialysis; USPD: urgent-started peritoneal dialysis.

Table 5. Multivariable Cox analysis of the independent factors for survival in elderly patients with diabetes.

Factor	HR	95%CI	P
Serum albumin (every 1 g/L increase)	0.926	0.861-1.000	0.049
Serum potassium (every 1 mmol/L increase)	0.258	0.126-0.538	<0.001
USHD (comparing with USPD)	2.813	1.092-7.330	0.033

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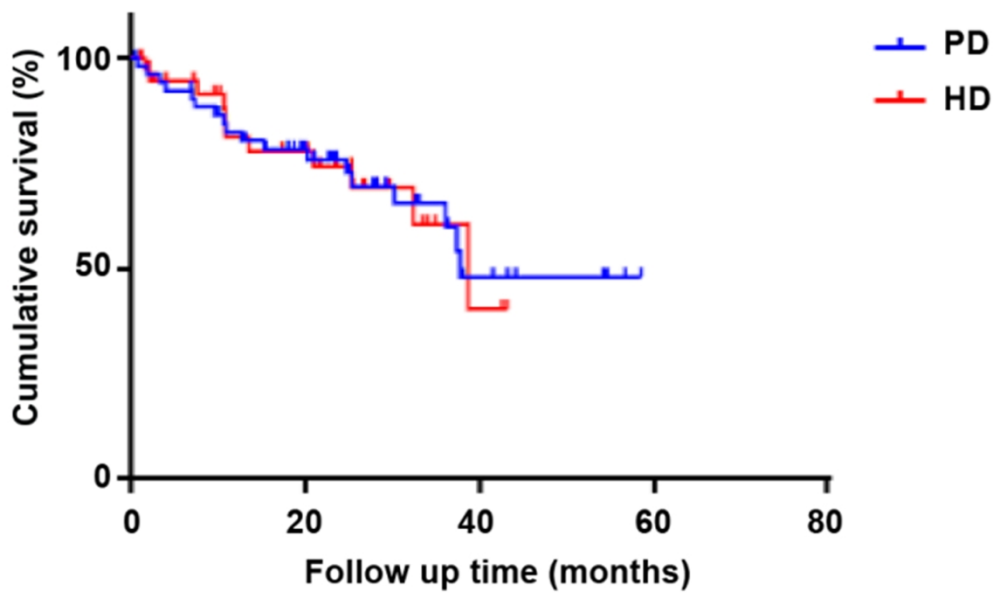


Figure 1. Survival rates of the patients in the peritoneal dialysis and hemodialysis groups. Kaplan-Meier survival analysis.

80x47mm (600 x 600 DPI)

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	1 2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6-7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	7 7 7 7 7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	8-9
Outcome data	15*	Report numbers of outcome events or summary measures over time	8-9

1	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-9
2			(b) Report category boundaries when continuous variables were categorized	
3			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
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9	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-9
10				
11	Discussion			
12				
13	Key results	18	Summarise key results with reference to study objectives	9-11
14	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
15				
16	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-11
17				
18				
19	Generalisability	21	Discuss the generalisability (external validity) of the study results	9-11
20				
21	Other information			
22	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12
23				
24				

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.