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Impact of Hypertension on the Survival of chronic hemodialysis patients in Kinshasa: A Historical Cohort Study

Impact de l'Hypertension sur la survie des patients hémodialysés chroniques à Kinshasa : Etude de cohorte historique

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Résumé

Contexte et objectif. La relation entre l'hypertension et la mortalité chez les patients hémodialysés est très controversée. L'objectif de la présente étude était d'identifier les prédicteurs indépendants de la mortalité en hémodialyse chronique et d'évaluer l'impact de l'hypertension sur la survie des patients congolais hémodialysés. ***Méthodes***. Cette étude de cohorte historique a concerné les patients hémodialysés chroniques congolais traités dans deux centres d'hémodialyse à Kinshasa entre 2010 et 2013. Les courbes de survie de Kaplan Meier basées sur la présence ou non d'hypertension ont été comparées à l'aide du test de Log-Rank. ***Résultats***. 191 patients (âge moyen de 52,3 ± 12,3 ans; hommes 68%; hypertendus 85%) ont été inclus. Parmi eux, 88 étaient décédés (46%). Les prédicteurs indépendants de la mortalité toutes causes confondues étaient les suivants : utilisation de cathéters provisoires [aHR 7,72; IC à 95%: 1,84 à 32,45; p = 0,024], statut socioéconomique faible (SSE) [aHR 2,57; IC à 95% 1,06-6,27; p = 0,038], l'absence d'hypertension artérielle [aHR 2,38; IC 95% 1,35-3,04; p = 0,003], présence de complications per dialytiques [aHR 2,28; IC à 95% 1,12-4,66; p = 0,024] et la non utilisation de l' EPO [aHR 2,23; IC 95% 1,32-3,74; p = 0,08]. Comparés aux patients normotendus, les hypertendus avaient significativement une meilleure survie médiane (4 versus 16 mois ; Log Rank p ≤ 0,001). ***Conclusion***. Malgré une mortalité très élevée dans la population d'étude, les patients hypertendus congolais en hémodialyse chronique avaient une meilleure survie par rapport aux patients normotendus. Ce paradoxe déjà signalé dans d'autres études peut s'expliquer par l'épidémiologie inverse.

Mots clés : mortalité, hémodialyse, hypertension, épidémiologie inverse, RD Congo

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Summary

Context and objective. The relationship between hypertension and mortality among hemodialysis patients remains controversial. This study aimed to identify independent predictors of mortality and assess the impact of hypertension on the survival among Congolese chronic hemodialysis patients. ***Methods***. This historical cohort study concerned Congolese chronic hemodialysis patients followed in two hemodialysis centers in Kinshasa between 2010 and 2013. The end point was survival (time-to-death). Patient and dialysis-related parameters were introduced in the Cox regression to identify independent predictors of mortality. We use Kaplan Meier method to describe survival. Survival curves based on the presence or not of Hypertension were assessed using the Log-Rank test. ***Results***. 191 patients (mean age 52.3±12.3 years; men -68%; hypertensive 85 %), were included. Among them, 88 patients died (46 %) Independent predictors of all-cause mortality were: temporary catheter use [aHR 7.72; 95% CI 1.84-32.45; p=0.024], low Socioeconomic Status (SES) [aHR 2.57; 95% CI 1.06-6.27; p=0.038], being non-hypertensive [aHR 2.38; 95% CI 1.35-3.04; p=0.003], presence of perdialytic complications [aHR 2.28; 95% CI 1.12-4.66; p=0.024] and non EPO use [aHR 2.23; 95% CI 1.32-3.74; p=0.038]. Compared to non-hypertensive, hypertensive patients had significantly better median survival (4 vs 16 months; Log rank p ≤0.001). ***Conclusion***. Despite the very high mortality in the study population, Congolese chronic hemodialysis hypertensive patients had better survival compared to non-hypertensive patients. This paradox already reported in other studies can be explained by reverse epidemiology.

Keywords: mortality, hemodialysis, hypertension, reverse epidemiology, DR Congo

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Introduction

Hypertension known associated with an increased risk of cardiovascular events and death in the general population, is a common complication among patients on hemodialysis (HD) (1). Although the high rate of cardiovascular events and mortality among patients on dialysis is widely recognized, the potential relationship between hypertension and mortality in this specific group is still debated (2).While some large longitudinal cohort studies have shown a positive relationship between hypertension and mortality, several reports indicated that, in contrast to the general population, low blood pressure and not hypertension appears to be more strongly related to poor outcome in dialysis (2-4). These paradoxical observations have been termed as "reverse epidemiology" of traditional risk factors (2-4). The exact mechanisms underlying this counterintuitive phenomenon remain still not clearly elucidated. However, potential factors evoked to explain this phenomenon include differences in the neurohormonal status in obese and hypertensive individuals, an interaction between endotoxin and lipoproteins, reverse causation, survival bias and the presence of competitive risk factors such as malnutrition as well as the modifying effect of chronic inflammation on traditional risk factors for atherosclerotic cardiovascular disease (3). With reference to geographical and racial differences in the distribution and burden of cardiovascular risk factors (5), it seems rationale for each setting offering maintenance HD to evaluate the relationship between hypertension and mortality to inform policy makers and care providers.

Sub-Saharan African (SSA) countries including the Democratic Republic of the Congo (DRC) experienced an ongoing negative impact on health status of non-communicable diseases such as hypertension and chronic kidney disease (CKD) (6). Indeed, M'buyamba-Kabangu *et al.* reported in a hospital-based cohort study that mortality increased with higher systolic blood pressure (SBP) and having renal dysfunction emerged as one of major predictors of death (6). Hypertension is common among Congolese dialysis patients with almost 90% of them having high BP at the initiation of dialysis (7). However, the relationship between hypertension and mortality in HD patients has not yet been assessed. Therefore, the present study aimed to identify independent predictors and assess the impact of hypertension on mortality among Congolese chronic hemodialysis patients.

Methods

Design, period and setting

We performed a historical cohort study enrolling all patients aged ≥18 years old who received maintenance HD therapy for at least 3 months between 2010 and 2013 in two hemodialysis centers of Kinshasa (Ngaliema Medical center and General hospital of Kinshasa).

Outcome, parameters of interests

The endpoint was survival (time-to-death). Patients survived at the end of the study (December 31st, 2013), loss of the follow up or shifted to peritoneal dialysis or transplanted were censored. Baseline data (at the start of HD) included demographic parameters (age, gender), clinical characteristics (history of hypertension and/or diabetes, residual diuresis , primary cause of end stage renal disease (ESRD), lifestyle habits (tobacco, alcohol), comorbidities, use of antihypertensive medications, height, weight, Blood Pressure (BP), biochemical parameters (hemoglobin, serum albumin, serum calcium, serum phosphorus, total cholesterol, serum C-reactive protein (CRP),dialysis parameters (vascular access, KT/V) and perdialytics complications (Intradialytic hypotension or hypertension).

Operational definitions

Hypertension was recorded if the patient was taking any antihypertensive drug or had two separate BP measurements ≥ 140/90 mmHg (8). Intradialytic hypotension was defined as a sudden drop of SBP below 90 mmHg or of at

least 20 mmHg with accompanying clinical symptoms (9). Intradialytic hypertension was defined as BP increase during or immediately after HD, resulting in post-HD BP > 130/80 mmHg (9). Patients were considered to have frequent dialysis hypotension or hypertension in ≥ 20% of dialysis sessions. The diabetes diagnosis at the initiation of dialysis was based on diagnostic criteria from the American Diabetes Association as a presence of a fasting plasma glucose level of > 126 mg/dl or usage of antidiabetic drugs (10). Overweight and obesity were defined as a BMI ≥ 25 kg/ m^2 and ≥ 30 kg/m^2, respectively (11). Inflammation was defined as a CRP level > 3 mg/l (12). KT/V was measured by an Online Clearance Monitor (OCM) (Fresenius Healthcare Ltd). Electrocardiographic left ventricular hypertrophy (LVH) was defined as the Sokolow-Lyon voltage index (SV1 + RV5 or V6 wave) >35 mm (13) and congestive heart failure (CHF) by the presence of classical clinical signs (14).

Statistical analysis

Patients were divided into 2 groups according to survival status: deceased and survivors. All data were expressed as mean ± SD, median (interquartile range) or number (percentage), as appropriate. Statistical analyses were performed using SPSS version 21 for Windows (SPSS Inc, Chicago, IL) and Stata version 13. The Kaplan-Meier curves were built for survival analyses. Survival curves based on the presence or not of Hypertension were assessed using the Log-Rank test and the Chi-square test as appropriate. Survival was defined as the time period between the beginning of HD and the death or the end of the study. Risk factors for mortality were assessed using multiple Cox regression analysis. The significance level of P value was set at 0.05 or less on two-sided tests.

Ethics approval

The study protocol was approved by the Ethics Committee of Public Health's School at the University of Kinshasa (acceptance number ESP/CE/019/2016).

Results

Table 1 show baseline characteristics of chronic hemodialysis patients as a whole and according to survival status. One hundred ninety one patients (Mean age 52.3±12.3 years, 68% men) were included in the present study at baseline.

Data are expressed as mean ± standard, absolute (n) and relative frequency (in percent) Abbreviations: HD: hemodialysis, RUV: residual urine volume, BMI: body mass index, HIVAN: Human Immunodeficiency Virus-associated nephropathy, ACE: angiotensin converting enzyme, ARB: angiotensin receptor blocker, CAA: central acting agents, SBP: systolic blood pressure, DBP: diastolic blood pressure, MAP: mean arterial pressure, PP: pulse pressure, ECG-LVH, electrocardiographic-left ventricular hypertrophy, CHF: congestive heart failure, AIDS: acquired immunodeficiency syndrome, CRP: C-reactive protein, Hb: hemoglobin, Ht: hematocrit.

Compared to survivors, deceased group had a significantly higher proportion of patients with comorbidities (57.6% vs 44.3%, p=0.046), congestive heart failure (CHF) (41.2 % vs 31.1%, p=0.09), a non-hypertensive status (21.1% vs 9.4%, p=0.019). They had in average significantly elevated Charlson Index (4.6±1.3 vs 3.4±2.0, p=0.004), and significantly lower levels of hemoglobin (7.4±1.8 vs 8.7±1.9, p<0.000) and serum albumin (35.2±8.6 vs 39.6±7.3, p=0.002). Deceased group had also a significantly higher proportion of patients with reduced residual dieresis volume (51.8% vs6.6%, p<0.001), inflammation (100% vs 72.9%, p=0.015), malnutrition (64.4% vs 32.4%, p<0.001). With reference to HD parameters (Table 2), deceased patients had a significantly higher proportion of intradialytic hypotension (44.7% vs 26.4%, p=0.006), intradialytic hypertension (75.3% vs 46.2%, p<0.001), and catheter vascular access (97.6% vs 78.3%, p<0.001) than survivors.

When patients were stratified by hypertension status (Table 3), hypertensive ones had a significantly higher proportion of LVH (45.7% vs 34.6%, p=0.022) and a lower proportion of subjects with history of cancer (3.7% vs 21.4%, p=0.003). They also had in average a significantly longer HD duration (9.2±2.7 vs 4.8±1.1, p=0,013) and lower level of hemoglobin (7.1±1.5 vs 8.3 ±2.0, p=0.001).

During the follow-up period (1692.3 patients-months), 88 patients (46%) died representing a mortality rate of 5.02 deaths per 100-months; five patients were lost to follow-up (2.6%). Kaplan Meir survival curve of the study population is illustrated in figure 1.

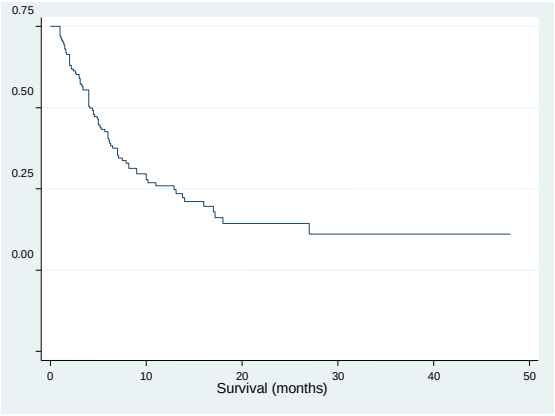

Figure 1. Survival Curve of chronic hemodialysis Patients study population

The median survival time of the entire group was 12.9 months. The cumulative survival rate of HD patients in this cohort study was 91.1% at 2 months, 69.1% at 6 months, 57.6% at one year, 53.4% at two years and 52.8% at four years. At the end of follow-up, 18 (64.3%) of the non-hypertensive patients had died representing a mortality of 10.02 deaths per 100-months. The Kaplan Meir survival curves for hypertensive and non-hypertensive status are shown in Fig 2. Compared to non-hypertensive, hypertensive had significantly better median survival (4.4 versus 16, Log rank $p \leq 0.001$).

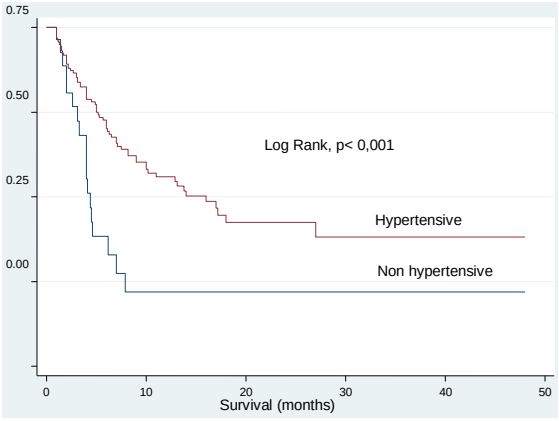

Figure 2. Survival Curves of chronic hemodialysis patients according to hypertension status

In multivariate Cox regression analysis (Table 4), being non-hypertensive (aHR 2.38; 95% CI 1.35-4.20; p=0.003), low socioeconomic status (aHR 2,57; 95%CI 1.06-6.27; p=0.038), catheter vascular access (aHR7.72; 95% CI 1.84-32.45; p=0.005), perdialytic complications (aHR 2.28; 95% CI 1.12-4.66; p = 0.024) and lack of erythropoietin use (aHR 2.23; 95% CI 1.32-3.74; p=0.003) emerged as independent predictors of all-cause mortality. The likelihood of dying was two-fold higher in non-hypertensive HD patients compared to hypertensive ones.

Discussion

The results of this study indicate that mortality was significantly higher in the non-hypertensive group than in the hypertensive group among dialysis patient. The main independent predictors of mortality in the study population were low socioeconomic status (SES), non-hypertensive status, lack of erythropoietin (EPO) treatment, catheter use as access vascular, and perdialytic complications.

In this cohort of 191 patients, the overall mortality was 46% and the mortality rate was 5.02 patients per 100 patients-months. These results, similar to death rate reported in previous studies in SSA (15-17), were significantly higher than those reported in developed countries (18-21). This very high HD mortality in our cohort is, in general, related to late referral and precarious management of patients in end stage renal disease (ESRD). Patient's differences in

baseline, clinical characteristics, dialysis treatment and financial constraints may explain the discrepancy in mortality on dialysis.

Patients' survival decreased over time despite being switched to chronic HD. The median survival was 12.9 months. The probability of survival of patients admitted to HD at initiation of treatment was 91.1%, 69.1%, 57.6%, 53.4% and 52.8% at two months, six months, one year, two years and four years, respectively.

Beyond the impact of dialysis performance on mortality, this observation raises the question of the effectiveness of conventional dialysis techniques usually recommended by guidelines (22). Indeed, HD remains the most widely used renal replacement therapy (RRT) modality used in the treatment of ESRD in the world (22). In spite of technological advances in HD, the mortality of patients under conventional HD remains alarmingly high. This high mortality implies that HD techniques in their current format are sub-optimal and do not significantly improve patients clinical outcome; hence, the necessity to identify other more efficient unconventional techniques. In this respect, the HD with short diurnal and long nocturnal sessions is becoming popular, with the assumption that it will better approach renal physiology and improve the outcome of patients on HD (23).

This study showed that patients with Hypertension status had better survival in HD. This finding is coherent with other studies stating that, in contrast to the general population where hypertension is associated with high mortality, elevation of blood pressure does not appear to confer the same risk (3-4). This paradoxical relationship is referred to as reverse epidemiology. Many factors that may explain the reverse epidemiology of hypertension in the hemodialysis population have been identified. This reverse association could be due to BP measurements setting and technique used for the diagnosis of hypertension, severity of comorbid conditions (congestive heart failure, autonomic neuropathy, malignancies, hypoalbuminemia associated with malnutrition-inflammation complex syndrome…) with opposing effect on blood pressure (BP), time discrepancies among competitive risk factors (reverse epidemiology of hypertension disappeared with prolonged follow up) and methods of data analysis, with peridialytic BP (predialytic or postdialytic BP), intradialytic or interdialytic BP (home BP, ambulatory BP monitoring) (24-36). Clinical characteristics of non-hypertensive patients in our cohort may, in part, explain this paradoxical relationship. In our study, non-hypertensive patients had a lower HD duration compared to hypertensive ones; in addition, malignancy status was significantly associated with non-hypertensive status. Hypertensive status was assessed using conventional BP measurements (predialytic BP). Non-hypertensive patients and those who deceased had in average a higher creatinine serum. This finding may suggest the severity of uremic syndrome at start of HD and possible role of autonomic neuropathy.

Low SES was a factor with an adverse impact on mortality. This statement illustrates the lack of health policy and community care observed in several underdeveloped countries (37). Very few countries in Sub-Saharan Africa take care of patients with ESRD almost free of charge (37).

The lack of EPO treatment conferred in the present study a significantly higher risk of mortality. This result is in agreement with the literature that reported non-response to EPO treatment as a predictor of mortality (38).

Indeed, the use of EPO reduces the cardiovascular risk and death (38). Directly, a neuro and cardio-protective effect of EPO against ischemia-induced stroke or myocardial infarction is already mentioned in the literature (39-40). Indeed, it has been reported that the expression of EPO receptors is not limited solely to the erythrocytes medullary precursors; it has also been detected in non-erythrocyte cells such as neurons, vascular endothelial cells and cardiomyocytes, where the binding of EPO positively influences endothelial function by having an anti-oxidant, anti-inflammatory, anti-

inflammatory action (39, 40). Indirectly, the correction of severe anemia using EPO has a beneficial effect on the reduction of left ventricular mass and therefore on the reduction of the incidence of cardiovascular events (39-40). Therefore, treatment with EPO should normally contribute to the reduction in cardiovascular risk and death observed in the pre-dialysis and dialysis (39-40).

In the present study, catheter use emerged as a predictor of mortality. Banerjee *et al.* reported similar results, showing a correlation between catheter use and the high level of inflammation markers (41). Indeed, the use of the catheter is associated with a chronic inflammatory state through endothelial trauma and infection (41). This chronic inflammation, as mentioned above, is responsible for the atherosclerosis process, which, in dialysis, is responsible for a high incidence of cardio-vascular events and deaths (42). It would also be lead to resistance to EPO, already described as a predictor of mortality in dialysis (43). In addition, the use of the catheter may explain a lower delivery of the dialysis dose, exposing the patient to uremic toxins (43).

The presence of perdialytic complications (arterial hypertension, hypotension) also presents a higher risk of mortality. The relationship between blood pressure and survival in HD remains controversial (44). Several studies have suggested poor control of hypertension, while more recent studies have shown that low BP before dialysis is associated with excess mortality (44).

Strengths and limitations

Our study has some limitations that must be acknowledged. First, our results cannot be generalized to all hemodialysis patients since it is limited to two HD centers. The majority of patients with ESRD whose social level economic is rather low and does not even have the ability to attend Nephrology center. Second, the retrospective character of our study has not allowed to obtain all data related to the parameters of interest. Third, the small sample size does not give enough power to statistical tests to identify potential associations between variables of interest. Fourth, our study has only a four-year follow–up, which may be insufficient to reveal hypertension as a risk factor for cardiovascular disease. Nevertheless, this study has the advantage of being the first one in the country to determine the impact of hypertension on the survival in HD.

Conclusion

Mortality rate is higher in Congolese patients receiving hemodialysis with non-hypertensive patients having the highest risk suggesting the reverse epidemiology of BP in chronic hemodialysis.

List of abbreviations

ACE: angiotensin converting enzyme, AIDS: acquired immunodeficiency syndrome, ARB: angiotensin receptor blocker, BMI: body mass index, CAA: central acting agents, CHF: congestive heart failure, CKD: chronic kidney disease, CRP: C-reactive protein, DBP: diastolic blood pressure, ECG-LVH: electrocardiographic -left ventricular hypertrophy, Hb: hemoglobin, HD: hemodialysis, HIVAN: Human Immuno-deficiency Virus-associated nephropathy, Ht: hematocrit, MAP: mean arterial pressure, PP: pulse pressure, RRT: renal replacement therapy, RUV: residual urine volume, SBP: systolic blood pressure, SSA: sub Saharan African.

Conflict of interest statement

The authors declare that they do not have any financial interest or non-financial interest with the information contained in this paper.

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Authors'contributions

YNM, FLB, JRM designed the study, acquired, analyzed and interpreted data, drafted and revised manuscript. YEM, PAZ, AN, ESK and

NNM analyzed, interpreted data and revised the manuscript. All authors read and approved the final version.

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Table 1: Clinical and biological characteristics of deceased and survivors patients

Variables	N	All Group (N=191)	deceased n=85	survivor n=106	p
Demographics					
Age, (years),	191	52.3±12.3	52.7±13.1	52.0±11.7	0.732
Age≥55 years, n(%)	191	95(47.3)	44(51.8)	51(48.1)	0.361
Male, n(%)	191	129(63.3)	55(64.7)	74(69.8)	0.278
HD duration (months)	190	8.5±2.4	5.5±1.5	11.0±9.8	<0.000
BMI (Kg/m^2)	112	24.7±4.7	24.4±4.1	24.8±5.1	0.663
RUV<250 ml, n(%)	190	51(26.7)	44(51.8)	7(6.6)	<0.001
Primary renaldisease, n (%)	191				
Diabetic nephropathy		64(33.5)	28(32.9)	36(34.0)	0.503
Glomerulonephritis		54(28.2)	25(29.4)	29(27.4)	0.439
HIVAN		9(4.7)	4(4.7)	5(4.7)	0.636
Hypertensive nephropathy		48(25.1)	19(22.4)	29(27.4)	0.267
Antihypertensive drug, n(%)	191				
Diuretics		106(55.5)	33(38.8)	73(68.9)	<0.001
ACE inhibitors		104(54.4)	30(35.3)	74(69.8)	<0.001
ARB		23(12.0)	7(8.2)	16(15.1)	0.110
Calcium channel blockers		122(63.8)	52(61.2)	70(66.0)	0.293
CAA		44(23.0)	18(21.2)	26(24.5)	0.356
Beta blockers		30(15.7)	9(10.6)	21(19.8)	0.060
Hypertensive, n(%)	191	163(85.3)	67(78.8)	96(90.6)	0.019
SBP, mmHg	191	155.7±27.6	154.8±25.4	156,5±29.4	0.654
DBP, mmHg	191	86.4±18.9	87.1±17.4	85,8±20.0	0.652
MAP, mmHg	191	109.5±19.8	109.6±18.3	109,4±20.9	0.938
PP, mmHg	191	69.6±21.1	67.5±18.6	71,4±22.9	0.207
Diabetics, n(%)	191	79(41.3)	34(40.0)	45(42.5)	0.423
LVH, n(%)	191	78(40.8)	37(48.1)	41(41.0)	0.216
Comorbidities, n(%)	191	96(50.2)	49(57.6)	47(44.3)	0.0046
CHF, n(%)	191	68(35.6)	35(41.2)	33(31.1)	0.099
History of cancer, n(%)	191	12(6.3)	6(7.1)	6(5.7)	0.458
AIDS, n(%)	191	11(5.7)	4(4.7)	7(6.6)	0.407
Malnutrition, n(%)	191	60(31.4)	38(64.4)	22(32.4)	<0.001
Laboratory variables					
CRP>3, n(%)	191	51(26.7%)	16(100.0)	35(72.9)	0.015
Serum calcium (mEq/l)	154	4.3±0.7	4.3±0.7	4.4±0.6	0.020
Serum phosphate (mg/dl)	66	5.0±2.2	5.7±2.3	4.8±2.2	0.178
Cholesterol (mg/dl)	102	186.4±62.9	188.5±70.2	185.5±60.2	0.832
Serum albumin (g/l)	128	37.6±8.2	35.2±8.6	39.6±7.3	0.002
Hb (g/dl)	190	8.2±1.9	7.4±1.8	8.7±1.9	<0.000
Ht (%)	189	24.8±6.0	22.9±5.9	26.3±5.7	<0.000

Table 2: Hemodialysis characteristics of deceased and survivor patients

Variables	N	All Group (N=191)	deceased n=85	survivor n=106	p
Vascular access, n(%)	191				<0,001
Catheter		166(86,9)	83(97,6)	83(78,3)	
AVF		25(13,1)	2(2,4)	23(21,7)	
Intradialytic hypotension	191	66(36,9)	38(44,7)	28(26,4)	0,006
Intradialytic hypertension	191	113(63,1)	64(75,3)	49(46,2)	<0,001
Kt/Vurea	115	1,3±0,2	1,3±0,2	1,3±0,1	0,435
Catheter infection, n(%)	191	80(41,8)	45(52,9)	35(33,0)	0,004

Data are expressed as mean ± standard, absolute (n) and relative frequency (in percent) Abbreviations: AVF: artério-venous fistula, KT/V: clearance of urea ml/min based on the volume of distribution, HD: hemodialysis

Table 3: General characteristics of chronic hemodialysis patients according to hypertension status

Variables	N	All group (N=191)	NHT (N=28)	HT (N=163)	p
Age (années)	191	52,3±12,3	48,6±16,2	52,9±11,5	0,083
Male, n(%)	191	129(63,3)	21 (75,0)	108(66,3)	0,247
BMI (Kg/m2), n=112	112	24,7±4,7	22,5±4,0	24,9±4,7	0,059
RUV <250 ml, n(%)	191	51(26,7)	11(39,3)	40(24,5)	0,084
HD duration (months)	190	8,5±2,4	4,8±1,1	9,2±2,7	0,013
CHF, n(%)	191	68(35,6)	7(25,0)	61(37,4)	0,145
History of Cancer,n(%)	191	12(6,3)	6(21,4)	6(3,7)	0,003
Malnutrition, n(%)	191	60(31,4)	14(63,6)	46(43,8)	0,072
LVH, n(%)	191	78(40,8)	9(34,6)	69(45,7)	0,022
AIDS, n(%)	191	11(5,7)	3(10,7)	8(4,9)	0,207
Kt/Vurea	115	1,3±0,2	1,3±0,2	1,3±0,2	0,370
CRP>3 (mg/dl), n (%)	191	51(79,7)	4(100,0)	47(78,3)	0,393
Serum calcemia (mEq/l)	154	4,3±0,7	4,3±0,7	4,3±0,7	0,974
Serum phosphate (mg/dl)	66	5,0±2,2	5,6±1,9	4,9±2,3	0,382
Serum cholesterol(mg/dl)	102	186,4±62,9	152,5±34,5	190,1±64,3	0,636
Serum albumine (g/l)	128	37,6±8,2	36,8±5,6	37,7±8,7	0,614
Hb (g/dl)	190	8,2±1,9	7,1±1,5	8,3±2,0	0,001
Ht (%)	189	24,8±6,0	21,7±4,2	25,4±6,1	0,002
Vascular access, n(%)	191				0,134
AVF	191	25(13,1)	6(21,4)	19(11,7)	
Catheter	191	166(86,9)	22(78,6)	144(88,3)	
Intradialytic hypotension, n (%)	191	66(34,5)	14(50,0)	52(31,9)	0,052

Data are expressed as mean ± standard, absolute (n) and relative frequency (in percent) Abbreviations: HD: hemodialysis, RUV: residual urine volume, BMI: body mass index, HIVAN: Human Immunodeficiency Virus-associated nephropathy, ACE: angiotensin converting enzyme, ARB: angiotensin receptor blocker, CAA: central acting agents, SBP: systolic blood pressure, DBP: diastolic blood pressure, MAP: mean arterial pressure, PP: pulse pressure, ECG-LVH, electrocardiographic-left ventricular hypertrophy, CHF: congestive heart failure, AIDS: acquired immunodeficiency syndrome, CRP: C-reactive protein, Hb: hemoglobin, Ht: hematocrit, AVF: artério-venous fistula, KT/V: clearance of urea ml/min based on the volume of distribution

Table 4: Mortality predictors of hemodialysis patients in Kinshasa, with Cox regression

Variables	HR (IC95%)	p	Adjusted HR (IC95%)	P
Financing securised				
- No	2.31 (1,45 – 3.69)	< 0.001	1.25 (0.75 – 2.06)	0.392
- yes	1		1	
SES				
- low	6.07 (2,71 – 13.60)	< 0.001	2.57 (1.06 – 6.27)	0.038
- middle	1.67 (0,79 – 3.53)	0.179	1.37 (0.62 – 3.04)	0.440
- high	1		1	
Hypertension				
- no	2.36 (1.39 – 3.99)	0.001	2.38 (1.35 – 4.20)	0.003
- yes	1		1	
EPO treatment				
- no	3.64 (2.27 – 5.3)	< 0.001	2.23 (1.32 – 3.74)	0.003
- yes	1		1	
Vascular access				
- AVF	1		1	
- Catheter	11.91 (2.91 – 48.72)	0.001	7.72 (1.84 – 32.45)	0.005
Perdialytic complications				
- No	1		1	
- Yes	4.43 (2.28 – 8.61)	< 0.001	2.28 (1.12 – 4.66)	0.024

Abbreviations: AVF: artério-venous fistula, EPO :erytropoeitin, SES, socioeconomic status