

PREOPERATIVE STATUS OF DIABETIC AND NON-DIABETIC CHRONIC DIALYZED PATIENTS – THERAPY IMPLICATIONS

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received: November 26, 2013

accepted: February 21, 2014

available online: March 15, 2014

Abstract

Background and Aims: The evaluation of preoperative status of diabetic chronic dialyzed patients consists in determining the preoperative risk factors and choosing the optimal surgery time to reduce further complications. **Material and method:** we conducted a retrospective study that included 156 chronic dialyzed subjects (diabetic and non-diabetic patients) undergoing surgical interventions, between 2010 and 2013. The incidence of preoperative parameters considered as risk factors (e.g.: cardiovascular, cerebrovascular or pulmonary diseases, anemia, nutritional and inflammatory status) was compared between the 2 groups of patients. **Results:** the diabetic group compared to the non-diabetic one presented a statistically significant higher value of the following variables: obesity (29.8% vs. 8%, $p < 0.05$), ischemic cardiovascular disease (100% vs. 85.8%, $p < 0.05$), congestive heart failure (100% vs. 79.7%, $p < 0.05$), peripheral vascular disease (42.1% vs. 7%, $p < 0.05$), stroke sequelae (12.28% vs. 3.03%) and elevated C-reactive protein levels (4.01 ± 5.4 vs. 6.34 ± 10.28 , $p < 0.05$). There were no statistically significant differences between the 2 groups regarding: age, smoking status, hypertension, mean hemoglobin, serum albumin, and chronic lung diseases prevalence ($p > 0.05$). **Conclusions:** considering the high prevalence of cardiovascular diseases in diabetic patients, the preoperative evaluation of dialyzed diabetic individuals should be performed thoroughly, emphasizing the diagnosis and staging of cardiovascular diseases, chronic lung diseases and nutritional status.

key words: diabetes mellitus, chronic dialysis, preoperative risk factors.

Background and Aims

Over the years, a significant amount of studies analyzed various preoperative risk factors that could influence the evolution/long-term prognosis of surgery interventions in general population. The proper evaluation and

improvement of these factors, within the limits of the therapeutic possibilities, proved to have positive impact on surgical risks, especially in the categories of patients diagnosed with severe chronic illnesses.

According to data provided by the *National Diabetes Statistics* in 2011 [1], diabetes mellitus

(DM) was the leading cause of chronic kidney disease (CKD) in the USA; in 2008, 44% of the new CKD cases reported in the USA were due to DM, and a total of 202.290 diabetic patients, included in the dialysis or kidney transplantation program, were also reported.

Individuals with DM and renal failure in need of chronic hemodialysis represent a special category of patients, the overlapping of the two major diseases causing noticeable evolution differences. The moment of surgery is challenging because each risk factor has to be known, evaluated and treated with maximum seriousness. Furthermore, CKD patients, dialysis-dependent or not, are predisposed to increased morbidity and mortality after surgery interventions [2]. From this point of view, the evaluation of the preoperative status in these patients is focused on highlighting the presence and severity of preoperative risk factors in order to improve and monitor them, to choose the optimal surgery time for reducing as far as possible the surgical risks.

Considering these aspects, we considered important to evaluate the preoperative status of chronic dialyzed patients, diagnosed or not with diabetes mellitus.

Material and Method

We conducted a retrospective study on chronic dialyzed subjects (diabetic and non-diabetic patients) undergoing surgical interventions in "St. John" Emergency Clinical Hospital, Bucharest, over a 3-year period, from January 2010 to January 2013. The preoperative status in all patients was evaluated according to our hospital protocol (personal and medical history, physical examination, medication history, electrocardiogram (ECG), cardio-pulmonary radiography, interdisciplinary examinations – nephrology, cardiology, intensive care unit (ICU). Only 9 individuals

were excluded because of inconclusive and contradictory data (personal history, physical examination, laboratory tests were not conclusive regarding the analyzed risk factors). All patients presented preoperative controlled glycemic values.

The study included 156 patients (65.4% males, 34.6% females) that were divided in 2 groups:

1. Group DM – 57 subjects – diagnosed with diabetes mellitus based on medical documents (personal history, laboratory tests, confirmed diagnosis by diabetologists, therapies – oral diabetes medications or insulin administration);

2. Group NDM – 99 subjects – without diabetes mellitus based on personal and medical history.

Based on the medical literature data, specific preoperative parameters shown to influence the perioperative evolution regarding surgical risks and early postoperative mortality were examined: age, sex, smoking, obesity, arterial hypertension, coronary artery disease, heart failure (HF), peripheral artery disease, stroke sequelae, hemoglobin level, nutritional and inflammatory status [3-10].

According to the hemoglobin (Hb) values, we estimated anemia levels as: mild (10 – 14g/dL), moderate (8 – 10g/dL), severe (6 – 8g/dL), extremely severe (< 6g/dL). Malnutrition was considered when serum albumin values were below 4g/dL. The inflammation status was determined by assessing C-reactive protein (CRP) levels (normal values: 0.1 – 1mg/dL).

Statistical analysis. All our findings were statistically analyzed performing *parametric* and *nonparametric methods*, and *chi-square tests* for comparing various percentages results. A $p < 0.05$ was considered statistical significant and all values of $p < 0.01$ were rounded to 0.01 , given the number of analyzed patients. When applying *chi-square test*, we used, in the case of ordinary

observations, the econometric software *Eviews Enterprise Edition version 8.0*, and in the case of nominal observations, the *Statistica Software version 12.0*.

Results

Depending on their age, patients were included in the 21 – 40 years old group (5.8% cases), 41 – 60 years (32.7%), 61 – 80 years (51.9%) and over 80 years (9.6%), respectively. According to the presence and degree of congestive heart failure (CHF), 20 patients (13%) presented no signs of CHF and 136 patients (87%) were diagnosed with CHF, of whom 80% with NYHA class I + II and 7% with NYHA class III + IV. Elevated blood pressure (BP) was documented in 140 patients, of whom 62.8% with essential hypertension (98 individuals) and 29.6% with secondary hypertension (42 patients). Stroke history was encountered in 15 patients (9.6%) and peripheral artery disease was recorded in 31 cases (19.9%). Smoking was documented in 115 patients (73.7%). Regarding the nutritional status, 25

patients (16%) were considered obese (body mass index = BMI >30) and 40% presented malnutrition condition (serum albumin < 4g/dL). In 91% of all patients, heart disease (including arrhythmias, atherosclerotic valvular diseases and ischemic heart disease) was diagnosed. The presence of chronic lung diseases (asthma, bronchiectasis, tuberculosis sequelae, chronic obstructive pulmonary disease, chronic respiratory failure) was recorded in 42 cases (27%). Regarding the presence of anemia, 72.8% patients presented moderate and mild anemia, 18.6% severe and profound anemia and 3.2% had normal preoperative value of Hb. Assessing the inflammatory status, our findings showed that 62% patients had a CRP value > 5mg/dL, 2.6% with CRP > 12mg/dL while 35.9% had normal CRP levels.

All parameters were evaluated comparatively and statistically analyzed within the 2 groups (DM and NDM), and the main characteristics are further on detailed in [Tables 1](#) and [2](#).

Table 1. Characteristics of diabetic dialyzed patients (DM).

Characteristics	Males	Females	Total
1. Gender	66.67%	33.33%	100%
2. Age (years; mean ± SD)	66.4±10.58	61.8±12.8 ^{NS}	64.9±11.46
3. Smoking	81.58%	78.95% ^{NS}	80.7%
4. Obesity	31.58%	26.32% ^{NS}	29.8%
5. IHD + LVH	73.68%	63.16% ^{NS}	70.18%
6. IHD + LVH + VHD + arrhythmia	26.32%	36.84% ^{NS}	29.82%
7. Ischemic heart disease	100%	100% ^{NS}	100%
8. CHF	100%	100% ^{NS}	100%
9. CHF – NYHA class I + II	89.47%	73.68% ^{NS}	84.21%
10. CHF – NYHA class III + IV	10.53%	26.32% ^{NS}	15.79%
11. Hypertension	97.37%	89.47% ^{NS}	94.7%
12. Pulmonary diseases	26.32%	15.79% ^{NS}	22.8%
13. Peripheral vascular diseases	50%	26.32% ^{NS}	42.1%
14. Cerebrovascular comorbidities	15.79%	5.26% ^{NS}	12.28%
15. Preoperative Hb (g/dL; mean ± SD)	10.26±1.89	9.9±2.09 ^{NS}	10.14±1.95
16. Preoperative serum albumin (g/dL; mean ± SD)	3.57±0.65	3.59±1.05 ^{NS}	3.58±0.8
17. Preoperative CRP (mg/dL; mean ± SD)	4.22±5.5	3.6±5.32 ^{NS}	4.01±5.4

IHD = ischemic heart disease; LVH = left ventricular hypertrophy; VHD = valvular heart diseases; CHF = congestive heart failure; Hb = hemoglobin; CRP = C-reactive protein; NS = no statistic significance; SD = standard deviation

Table 2. Characteristics of non-diabetic dialyzed patients (NDM).

Characteristics	Males	Females	Total
1. Gender	64.65%	35.35%	100% [†]
2. Age (years; mean ± SD)	60.78±13.6	64.8±12 ^{NS}	62.2±13.1 ^{NS}
3. Smoking	71.8%	65.7% ^{NS}	69.7% ^{NS}
4. Obesity	6.25%	11.43% ^{NS}	8% [‡]
5. IHD + LVH	57.81%	68.57% ^{NS}	61.61 ^{NS}
6. IHD + LVH + VHD + arrhythmia	28.13%	17.14% ^{NS}	24.24% ^{NS}
7. Ischemic heart disease	92.19%	74.29% [‡]	85.85% [‡]
8. CHF	81.2%	77.14% ^{NS}	79.7% [‡]
9. CHF – NYHA class I + II	71.88%	57.14% ^{NS}	66.67% ^{NS}
10. CHF – NYHA class III + IV	9.38%	20% ^{NS}	13.13% ^{NS}
11. Hypertension	87.50%	85.71% ^{NS}	86.8% ^{NS}
12. Pulmonary diseases	26.56%	34.29% ^{NS}	29.9% ^{NS}
13. Peripheral vascular diseases	9.38%	2.86% ^{NS}	7% [‡]
14. Cerebrovascular comorbidities	4.69%	0.00% ^{NS}	3.03% [†]
15. Preoperative Hb (g/dL; mean ± SD)	10.19±2.5	9.6±2.4 ^{NS}	10.01±2.5 ^{NS}
16. Preoperative serum albumin (g/dL; mean ± SD)	3.48±0.87	3.47±0.97 ^{NS}	3.47±0.9 ^{NS}
17. Preoperative CRP (mg/dL; mean ± SD)	5.57±10.28	7.74±10.28 ^{NS}	6.34±10.28 [†]

*IHD = ischemic heart disease; LVH = left ventricular hypertrophy; VHD = valvular heart diseases; CCF = congestive cardiac failure; Hb = hemoglobin; CRP = C-reactive protein; NS = no statistic significance; SD = standard deviation
[†] $p < 0.05$; [‡] $p < 0.01$ (Total DM vs. Total NDM; males vs. females)

No significant statistically differences were found within DM and NDM groups regarding: age ($p = 0.092$), preoperative Hb mean value ($p = 0.358$), preoperative serum albumin mean level ($p = 0.199$), tobacco addiction ($p = 0.561$), hypertension ($p = 0.718$), chronic pulmonary disease ($p = 0.501$).

Our results confirmed significant statistically differences between the 2 groups (DM vs. NDM) for the following parameters: CRP mean value that was significantly lower in DM group ($p = 0.033$); obesity was more frequent in DM patients ($p = 0.002$); the prevalence of the ischemic heart disease/atherosclerosis was significantly higher in DM group ($p = 0.046$);

the percentage of 100% diabetic patients with preoperatively diagnosis of CHF profoundly exceeded that in the NDM group ($p = 0.003$); the prevalence of peripheral artery disease was higher in DM patients ($p = 0.01$) while stroke history was more frequent in diabetic individuals ($p = 0.03$).

No significant differences in the prevalence of risk factors were recorded between the two genders in the DM group, while in the NDM group a significant statistical difference was found for the prevalence of ischemic heart disease/atherosclerosis ($p = 0.01$), as shown in [Figure 1](#).

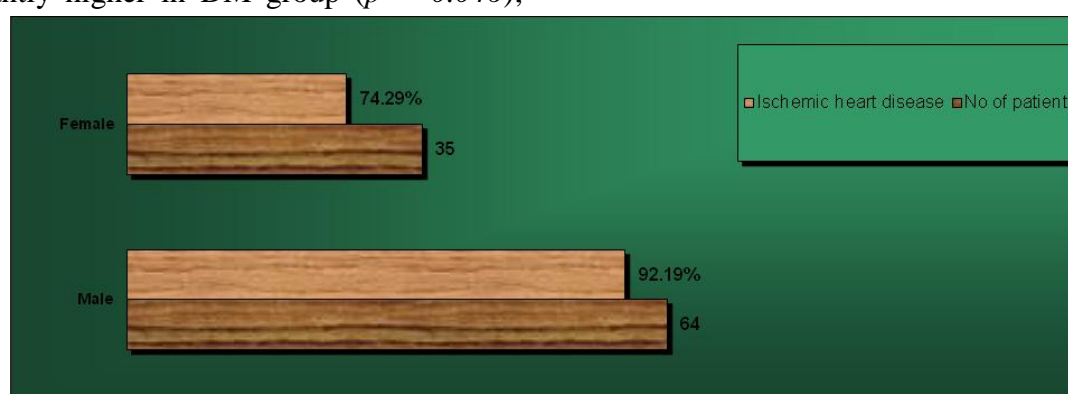


Figure 1. The prevalence of ischemic heart disease in the NDM group.

Discussions

According to several experimental and clinical trials, cardiovascular, respiratory, cerebrovascular diseases, and obesity represent major surgery risk factors that influence the long-term prognosis, and also perioperative morbidity and mortality [3-10]. It was established that perioperative mortality could be up to 0.7 – 0.8% [9]. The proportion of cases where a definite cause-effect link was determined can be divided into approximately equal parts among the three main types of preoperative diseases which could cause an adverse prognosis of the surgical patient: heart diseases (over 1/3 of the cases), chronic lung diseases (about 1/3 of the cases), other diseases – malnutrition, anemia, obesity, cerebrovascular diseases (below 1/3 of the cases) [9].

The important independent predictors of major cardiac complications (history of coronary artery disease, heart failure, cerebrovascular disease, diabetes mellitus requiring insulin, serum creatinine > 2mg/dL), that could increase the risk of mortality in patients in need for surgery interventions [4], were also highly prevalent in our study groups.

Our study also noted that chronic dialyzed diabetic patients presented an increased global prevalence of diseases having a major impact on the surgery prognosis. The manifest ischemic heart disease/atherosclerosis was present in all of the analyzed patients. In addition, varying degrees of CHF, arterial hypertension (over 94%) and neurological sequelae (12%) were observed. The peripheral arterial disease had also a significantly higher prevalence in patients with DM (over 42%) than in non-DM individuals (7%).

Chronic complications due to microangiopathy (retinopathy, nephropathy, and neuropathy) and macroangiopathy

(atherosclerosis) in the DM patient directly increase the need for surgery and consequently the development of surgical complications due to infections and vascular disease [11].

The chronic pulmonary diseases, inflammatory status, malnutrition and anemia were present almost equally in both groups and amplified the POM score (*Perioperative Mortality Risk*) [6]. Furthermore, according to Arozullah et al. [10], the score index of respiratory failure indicates an increased surgical risk of respiratory failure, from 0.5% for class 1 to 26.6% for class 5 [10].

The revised Goldman Cardiac Risk Index [10] regarding the rate of sudden death, myocardial infarction, cardiac arrest, predicts a mean mortality of 0.4% in the absence of risk factors; 1% in the presence of a single risk factor; 2.4% in the presence of two risk factors; 5.4% for more than three risk factors. Therefore, in 2007, the “*ACC/AHA Cardiac Evaluation and Care Algorithm*” classified the presence of 3 or more factors as being a high surgical risk situation [8].

For this reason, chronic dialyzed DM patients are susceptible of surgical risk aggravation due to the coexistence of cardiovascular diseases, obesity, inflammatory status [3-10], aspects also observed by our study which showed increased prevalence of these factors in the diabetic group.

According to the *Goldman score* [10], the majority of chronic dialyzed DM patients, preoperatively diagnosed with coronary heart disease or atherosclerotic heart disease, presented a minimum risk of surgical mortality over 1%. Additionally, the association of a creatinine value over 2mg/dL and different contributing factors (e.g.: arterial hypertension, chronic lung diseases, peripheral arterial disease, anemia, malnutrition) places chronic dialyzed

diabetic patients in the high surgical risk category, over 5%.

Conclusions

The preoperative evaluation of patients with DM and chronic renal failure has to be performed carefully. We recommend for this category of patients to postpone surgery until a clear adequate control of these risk parameters: a balanced fluid and electrolyte status, notable improvement of cardiovascular disturbances, remission of acute lung diseases, improvement of respiratory function, blood pressure, anemia and nutritional status.

Therefore, we consider useful to divide the studied risk factors in three groups, for a better preoperative evaluation and decreased postoperative mortality: **1.** factors potentially reversible – anemia, inflammatory status; **2.**

factors potentially improvable – ischemic heart disease, arterial hypertension, level of congestive heart failure, chronic pulmonary diseases; **3.** factors non-susceptible to influence – age, gender, stroke sequelae, obesity, peripheral arterial disease.

Based on these considerations, the evaluation of surgical status in chronic dialyzed DM patients should be done with the utmost seriousness and as early as possible in the preoperative period, emphasizing the factors known to have maximum prevalence in these patients and a major influence on the surgical prognosis. In addition, our study highlights *the importance to determine the right surgical time in chronic dialyzed diabetic patients – not too soon (after the correction of risk factors) and not too late to endanger patients' life.*

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