

The Association between right ventricular dysfunction and pulmonary hypertension in hemodialysis patients with end stage renal failure in Karbala city.

Dr.mohammed sharem mahbool Al Taii; MBCHB DM internal medicine

Dr. Muntadhar Yahya Idrees Al-Muhanna; MBCHB.MSC-PhD-CV Physiology

Ali Mansoor Al Ameri; MBChB, MSc, PhD Clinical Immunology. College of Medicine University of Kerbala, Iraq; ali.mansoor@uokerbala.edu.iq.

Abstract.

Background and objective: Pulmonary hypertension together with right ventricular dysfunction are considered as risk factors that increase mortality and morbidity in patients with renal impairment, fluid over load and high systolic blood pressure. The current study tries to investigate any association between hemodialysis, right ventricular dysfunction and pulmonary hypertension.

Patients and method.

This is a cross-sectional study performed to predict the association of end-stage renal disease and dialysis with right ventricular dysfunction and pulmonary hypertension. Thirty patients (age range 35-68 years) in hemodialysis unit in Imam- Al-Hussein Medical City in Karbala, Iraq were assessed for pulmonary hypertension and right ventricular dysfunction. Whereas, twenty control persons (age range 34-65 years) who had no renal failure and no dialysis were assessed for the same purpose. Heart failure, obstructive air way disease and cardiac disease were excluded from the study. Echocardiography study was performed after taking informed consent from all participants. Blood pressure and cardiac (and pulmonary) indices were measured and finding were statistically analyzed to detect any association. All the above findings were compared in the two study groups.

Result: The average systolic diastolic blood pressure was significantly higher in hemodialysis than in control group. Regarding echocardiography, the following indices were found in the dialysis group: LVH, increase long RT ventricular dimension, increase RT ventricle fraction area change, increase tricuspid plane systolic excursion, decrease in systolic velocity at tricuspid valve, increased RT ventricular wall thickness and increase in systolic pulmonary artery pressure. In addition, the dialysis group showed increase mid zone RT Ventricular dimension , though the difference of the latter was non-significant.

Conclusion: Data of the current study revealed high incidence of pulmonary hypertension and right ventricular dysfunction among hemodialysis patients with chronic renal failure.

Keywords: ventricular dysfunction, pulmonary hypertension ,renal failure, dialysis.

الخلاصة

المقدمة والهدف من الدراسة: يعتبر ارتفاع ضغط الدم الرئوي أحد الأمراض التي تزيد الوفيات والمرضاة لدى مرضى القصور الكلوي ، والسوائل المفرطة المحملة وارتفاع ضغط الدم الانقباضي. هذه الدراسة تسعى الى تحديد العلاقة بين الديليزة واختلال وظائف البطين الايمن وارتفاع ضغط الدم الرئوي. المرضى وطرق العمل.

هذه الدراسة المقطعية تم إجراؤها للتنبؤ بترابط أمراض فشل الكلى مع اختلال وظائف البطين الأيمن وارتفاع ضغط الدم الرئوي. تم تقييم ثلاثين مريضاً (تتراوح أعمارهم بين 35-68 سنة) في وحدة غسيل الكلى في مدينة الامام الحسين الطبية في كربلاء لارتفاع ضغط الدم الرئوي واختلال وظائف البطين الأيمن. في حين تم تقييم عشرين شخصاً كمجموعة سيطرة (الفئة العمرية 34-65 عاماً) ممن لم يعانون من الفشل الكلوي للغرض نفسه. استبعدت الدراسة حالات فشل القلب ومرض انسداد المسالك التنفسية وأمراض احتشاء القلب. تم إجراء دراسة تخطيط صدى القلب بعد أخذ الموافقة من جميع المشاركين. تم قياس مؤشرات ضغط الدم والقلب (والرئة) وتم تحليل الإحصاء للكشف عن أي ارتباط بين المتغيرات. وتمت مقارنة جميع النتائج المذكورة أعلاه في مجموعتي الدراسة.

النتائج: كان متوسط ضغط الدم الانقباضي أعلى بكثير في غسيل الكلى مقارنة بمجموعة السيطرة. فيما يتعلق بتخطيط صدى القلب ، تم العثور على المؤشرات التالية في مجموعة غسيل الكلى: LVH ، زيادة البعد البطيني الايمن، زيادة تغيير منطقة البطين الايمن ، زيادة السعة الانقباضية للصمام ثلاثي الحلقات ، انخفاض في السرعة الانقباضية عند الصمام ثلاثي الشرفات ، زيادة سمك جدار البطين الايمن وزيادة ضغط الشريان الانقباضي. بالإضافة إلى ذلك ، أظهرت مجموعة غسيل الكلى زيادة منطقة منتصف البعد الايمن ، على الرغم من أن الفرق في الأخير لم يكن معنوياً.

الاستنتاج: كشفت بيانات الدراسة الحالية ارتفاع حالات ارتفاع ضغط الدم الرئوي وضعف البطين الأيمن بين مرضى غسيل الكلى الذين يعانون من الفشل الكلوي المزمن.

Introduction

Pulmonary hypertension is defined as an increase pressure in the artery of lungs more than 25mmHg at rest and more than 20 mmHg at stress(1).

Regarding the types of pulmonary hypertension, pulmonary hypertension due to chronic renal failure is considered within type five(2). Increase vascular resistance due to an increase in thickness of media intimal and fibrosis with thickening of pulmonary vessels all these processes happen as chronic processes and finally lead to right ventricular dysfunctions (3). Pulmonary hypertension occurs due to imbalance between vasoconstriction and vasodilator process and in renal failure many mechanism eventually contribute to pulmonary hypertension(4). Renal osteodystrophy, pulmonary embolism, arteriovenous fistula with high flow ,low hemoglobin, volume overload where the most important causes for pulmonary hypertension in chronic renal failure in hemodialysis patients(5).

Right ventricular dysfunction is considered one of the most important causes of death in uremic patients and a risk factor for mortality in hemodialysis patients. Low dose hemodialysis ,low ultra filtration lead to right ventricular hypertrophy and dysfunctions and finally pulmonary hypertension with increase morbidity and

mortality in uremic patients(4,5). Patients with pulmonary hypertension complain from progressive dyspnea and this is one of the causes of dyspnea due to chronic renal failure(6). Other signs of pulmonary hypertension include loud second heart sound, systolic murmur due to tricuspid regurgitation, increase jugular vascular pressure ,hepatomegaly and lower limbs odema(7). The aim of the current study is to predict the association between dialysis with right ventricular dysfunction and pulmonary hypertension.

Patients and method

Thirty patients, in hemodialysis unit in Karbala city , Imam-Al Hussein medical city, were assessed by echocardiography study for right ventricular dysfunction by (VIVID) echo which was done after hemodialysis. All patients in end stage renal failure and on regular hemodialysis (mean three time per weak ,three to four hours/time, blood flow rate and ultrafiltration on optimal range) and these patients had regular investigations included blood urea creatinine hemoglobin level electrolyte serum ca ,phosphate and vitamin D level. On the other hand, twenty patients were recruited as control group had no renal failure and no dialysis. They were also assessed by echocardiography for right ventricular dysfunctions from out patients clinic in imam- Al-Hussein medical city.

Exclusion criteria

- 1.Heart failure
- 2.Valvular heart disease.
- 3.Sever chronic obstructive airways disease.
- 4.Pulmonary embolism.
- 5.Primary pulmonary hypertension.
- 6.Ischemic heart diseases.

Statistical analysis.

Level of significant was set at <0.05 to be significant difference, result and finding presented using Microsoft word for window 2016,descriptive statistic presented as frequency, proportion(%) mean and stander deviation according to variable types. The significance of different quantitative variables was tested using student-t-test; while the significance of difference of the qualitative variables was tested using chi-square (X^2) test.(8 and 9).

Limitation of the study.

- 1.Small samples.
- 2.Volume overload even with regular hemodialysis.

Results

The average systolic blood pressure in hemodialysis patients 150 ± 30 mmHg and diastolic blood pressure 90 ± 20 mmHg while in control group, systolic blood pressure average 130 ± 30 mmHg and diastolic blood pressure average 80 ± 10 mmHg revealing significant difference, p value < 0.05 , as shown in table(1).

Table (1): A comparison of gender and blood pressure measurements between dialysis patients (n=30) and control group(n=20)

Variable	HD(n=30)	Control(n=20)	P value
Male	10	9	> 0.05
Female	20	11	< 0.05
Systolic BP (mmHg)	150 ± 30	130 ± 30	< 0.05
Diastolic BP (mmHg)	90 ± 20	80 ± 10	< 0.05

Left ventricular hypertrophy.

Twenty patients in hemodialysis has been a left ventricular hypertrophy in range 1.7 ± 0.3 cm and 10 had no left ventricular hypertrophy in range 0.9 ± 0.2 cm p value < 0.05 , in control patients 6 had LVH in range 1.6 ± 0.4 cm and 14 had no LVH in range 0.8 ± 0.2 cm p value < 0.05 significant difference. The ejection fraction for hemodialysis patients average 60 ± 4 and in control patients average 65 ± 5 p value < 0.05 .

Right ventricular dimension .

In echocardiography study are been asses mid zone and long zone right ventricular dimension ,for mid zone RT ventricular dimension in hemodialysis patients 17(56%) of them > 3.5 cm versus 13(43%) had < 3.5 cm in range 3 ± 0.9 and in control patients mid zone > 3.5 in range 2.8 ± 0.4 cm p value > 0.05 no significant difference ,for longitudinal zone in HD patients 18 of them > 8.6 cm and 12 < 8.6 cm in range 9 ± 0.6 cm where in control patients all of them 7 ± 0.8 cm p value < 0.05 with significant difference..

In addition, eighty(60%) of hemodialysis patients had RVFAC $< 35\%$ and 12(40%) of them $> 35\%$ normal Right ventricular fraction area change (RVFAC) $36 \pm 10\%$

$$\text{RVFAC} = \frac{\text{EDA} - \text{ESA}}{\text{EDA}} \times 100$$

EDA=End diastolic area ,ESA=End systolic area .

For control patients, all had RVFAC of > 35 in range $45 \pm 5\%$ p value < 0.05 .

Seventeen(56%) of case who on hemodialysis had tricuspid plane systolic excursion (TAPSE) < 1.6 cm versus 13 > 1.6 cm(43%) as normal range 1.6 ± 0.4 cm where all

control patients had normal TAPSE in range 2.5 ± 0.3 cm p value <0.05 . So there was significant right ventricular dysfunction in hemodialysis patient compare with control patients not renal failure and no hemodialysis., as shown in table(2).

Furthermore, seventeen out of 30 patients (57%) had systolic velocity at tricuspid valve (TDI) <10 cm/sec versus 13 patients (43%) had TDI >10 cm/sec in hemodialysis patients in range 11.9 ± 3 cm/sec compare with control patients with TDI >10 cm/sec in range 15 ± 3 cm/sec p value <0.05 so there was significant RT ventricular dysfunction in hemodialysis patients, as shown in table(2).

Additionally, sixteen out of 30(53%) hemodialysis patients had RT ventricular wall thickness >0.7 cm and 14 had wall thickness <0.7 cm in range 0.6 ± 0.3 cm where all control patients had normal wall thickness in range 0.6 ± 0.1 cm pvalue >0.05 .

Seventeen of hemodialysis patients had systolic pulmonary artery pressure (SPAP) >35 mmHg(57%) and 13 had SPAP <35 mmHg (43%) in range 35 ± 10 mmHg versus control patients whose had SPAP <35 mmHg in range 22 ± 5 mmHg p value <0.05 with significant increase of SPAP in hemodialysis patients compared with control patients, as shown in table(2).

Table (2): A comparison of some cardiac indices of echocardiography between dialysis patients (n=30) and control group(n=20)

Variable	HD(no=30)	Control(no=20)	P value
RVRAC	$36 \pm 10\%$	$45 \pm 5\%$	<0.05
TAPSE	1.6 ± 0.4 cm	2.5 ± 0.3 cm	<0.05
TDI	12 ± 4 m/s	17 ± 4.5 m/s	<0.05
Rt ventricular wall thickness	0.6 ± 0.3 cm	0.6 ± 0.1 cm	>0.05
SPAP	35 ± 10 mmHg	22 ± 5 mmHg	<0.05

Key:RVFAC: Right ventricular fraction area change, TAPSE: tricuspid plane systolic excursion, TDI: systolic velocity at tricuspid valve, SPAP: systolic pulmonary artery pressure.

Discussion.

There was significant increase in systolic and diastolic blood pressure in hemodialysis patients. This is consistent with the finding obtained by Mohammed Momtaz(10).

Left ventricular hypertrophy had significant difference within the hemodialysis patients 20 had LVH 66% (1.7 ± 0.3) and 10 no 33% (0.9 ± 0.2) and also significant when compare with control group 6 had LVH 30% (1.6 ± 0.4) and 14 no 70% (0.8 ± 0.2) significant p value <0.05 . (10) and (13).

About right ventricular dimension found no significant increase in mid zone 17(56%) had mid zone increase and 13(43%) no (3 ± 0.9) and control patients (2.8 ± 0.4) pvalue >0.05 in long zone significant difference between HD and control 18(60%) had

increase in long zone dimension and 12(40%) no in range 8 ± 0.9 cm compare control 7 ± 0.8 cm p value < 0.05 goes with result by Mohammed Momtaz (10) and L-j.ZHAO(11).

About right ventricular fraction area change(RV FAC) study there is significant difference between hemodialysis patients and control , in hemodialysis patients 18(60%) $< 35\%$ and 12(40%) $> 35\%$ in range $36 \pm 15\%$ in compare control patients $> 35\%$ in range $45 \pm 5\%$ p value < 0.05 same result by Mohemmed Momtaz(10) and Anavekar NS(13).

About tricuspid plane systolic excursion(TAPSE) study found significant difference 17(56%) of patients < 1.6 cm and 13(43%) > 1.6 cm in range 1.6 ± 0.4 cm in compare control patients in range 2.5 ± 0.3 cm p value < 0.05 result goes with that of Mohemmed Momtaz (10), Lopezcandales A(14) and Digoche D(17).

About systolic velocity at tricuspid valve (TDI) found significant difference 16(56%) patients < 10 cm/s and 14(43%) > 10 cm/s in range 12 ± 4 cm/s compare control in range 17.6 ± 4.5 cm/s p value < 0.05 result consistent with that of Paneni F(15) and Said K(16).

About Right ventricular wall thickness study found no significant difference 16(56%) of case > 0.7 cm and 14(43%) < 0.7 cm in range 0.6 ± 0.3 cm compare control patients in range 0.6 ± 0.1 cm pvalue > 0.05 , this finding goes with that of Esquitin(12) and Anavekar NS(13).

About systolic pulmonary artery pressure (SPAP) study found significant difference 17(56%) of case > 35 mmHg and 13(43%) < 35 mmHg in range 35 ± 10 compare control patents in range 22 ± 5 mmHg p value < 0.05 , (11,12, 13, 17 and (18).

Conclusion

Pulmonary hypertension was found to be elevated in the presence of hemodialysis as a multifactorial process either due to metabolic or hormonal cause. The current study revealed und increase incidence of right ventricular dysfunction and pulmonary hypertension among end-stage renal failure patients.

References

- 1.Dagli CE.prevalanceandfactors affecting pulmonary hypertension in hd pat .Respiration.2009;78(4):411-415.
- 2.Amin M.pulmonary hypertension in patients with ghronic renal failure .chest.2003;124(6):2093.
- 3.Nakhoul F. The pathogenesis of pulmonary hypertension in hemodialysis patients via arteriovenous access..Nephrology dialysis transplantation.2005;20(8):1686-1692.
- 4.Yigla M. Pulmonary hypertension in patients with end stage renal disease.chest J.2003;123(5):1577-1582.

5. Di Lullo L, Floccari F, Polito P. Right ventricular diastolic function in dialysis patients could be affected by vascular access. *Nephron Clin Pract* 2011;118:c257-c261.
6. Abdelwhab S, Elshinnawy S. Pulmonary hypertension in chronic renal failure. *Am J Nephrol* 2008;28:990-997.
7. Sise ME, Courtwright AM, Channick RN. Pulmonary hypertension with chronic and end stage kidney disease. *Kidney Int* 2013;3:63-70.
8. Daniel W and Chad L. Cross : Biostatistics: Basic Concepts and Methodology for the Health Sciences, 10ed, ISV , 1 January 2014.
9. Wang J and Shete S.: Estimation of odds ratios of genetic variants for the secondary phenotypes associated with primary diseases. *Genet Epidemiol*. 2011 Apr;35(3):190-200.
10. Mohamed Mommtaz, Right ventricular dysfunction with end-stage renal disease on regular hemodialysis. 2013;25:127-132.
11. L.-j. ZHAO, S.-M. Huang, J. LIANG, H. TANG. Pulmonary hypertension and right ventricular dysfunction in hemodialysis patients. 2014;18:3267-3273.
12. Esquitin R, Razzouk L, Left ventricular hypertrophy by echocardiography I the African American study of kidney disease cohort study. *J Am Soc Hypertens* 2012;6:193-200.
13. Anavekar NS, Geerson D. Two dimension assessment of right ventricular function : an echocardiography-MRI correlative study. *Echocardiography* 2007;24:452-456.
14. Lopez candelas A, Dohi K, Defining normal variable of right ventricle size and function in pulmonary hypertension : an echo study. *Postgrad Med J* 2008;84:40-45.
15. Paneni F, Gregori M. Right ventricular dysfunction in patients with end stage renal disease. *Am J Nephrol* 2010;32:432-438.
16. Said K, Hassan M. ventricular function in patient with end stage renal disease starting dialysis therapy: tissue Doppler image study. *Echocardiography* 2012;29:1054-1059.
17. Digoche D, Peter I, Mustafa O A sani. Elevated mean pulmonary artery pressure and right ventricular dysfunction with chronic kidney disease. *DOL:10.4103/Jecho*. -56-17-2018.
18. Sichuan Daxuexnebaoyi Xue Ban. Effect of maintenance hemodialysis on right ventricular dysfunction in patients with end stage renal disease. 2014, Sep;45(5):8(4-8).