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Arteriovenous fistula and pulmonary hypertension in patients on hemodialysis

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Background: Pulmonary hypertension (PH) is a frequent complication in patients with end-stage renal disease (ESRD) undergoing hemodialysis (HD), particularly in those with arteriovenous (AV) access.

Aim: To determine the relationship between endothelin-1 (ET-1) and nitric oxide (NO) in the development and progression of PH in patients undergoing hemodialysis and AV access.

Method: The study involved 48 patients on maintenance HD at the Republican Scientific and Practical Center for Nephrology and Hemodialysis. Patients were divided into two groups: 22 with PH and 22 without PH. Assessment of PAP was done by Doppler echocardiography, whereas plasma levels of ET-1 and NO metabolites were assessed before and after HD and compared between the groups.

Results: Among the 48 patients studied, 22 (48%) were diagnosed with PH with a mean PAP of 46 $\pm$ 2 mmHg (range: 36–82 mmHg), which was significantly higher compared to patients with normal PAP (29 $\pm$ 1 mmHg, $P < 0.0001$). Cardiac output was significantly higher in HD patients with PH than in those without (6.0 $\pm$ 1.2 vs. 5.2 $\pm$ 0.9 L/min, $P < 0.034$). Both HD patient groups had higher plasma ET-1 levels than controls (1.6 $\pm$ 0.7 and 2.4 $\pm$ 0.8 fmol/ml vs. 1.0 $\pm$ 0.2 fmol/ml, $P < 0.05$), while no significant changes were detected after dialysis. NO metabolite levels (NO2 + NO3) were similar between HD patients without PH and control subjects (24.2 $\pm$ 5.2 vs. 19.7 $\pm$ 3.1 μM, $P > 0.05$) but significantly lower in HD patients with PH (14.3 $\pm$ 2.3 μM, $P < 0.05$). Accordingly, following HD, plasma levels of NO increased considerably in both groups. However, this rise was far more significant among those without PH compared with those with PH, that is, 77.1 $\pm$ 9.6 μM compared to 24.2 $\pm$ 5.2 μM and 39.9 $\pm$ 11.4 from 14.3 $\pm$ 2.3 μM ($P < 0.0001$ vs $P < 0.0074$). Successful kidney transplantation in 11 PH patients resulted in significant reductions in both PAP (from 49.8 $\pm$ 2.8 to 38.6 $\pm$ 2.2 mmHg, $P < 0.004$) and CO (from 7.6 $\pm$ 0.6 to 6.1 $\pm$ 0.3 L/min, $P < 0.03$). Analogously, temporary closure of the AV shunt in 8 PH patients resulted in temporary reduction of CO from 6.4 $\pm$ 0.6 to 5.3 $\pm$ 0.5 L/min, $P = 0.18$, and systolic PAP from 47.2 $\pm$ 3.8 to 34.6 $\pm$ 2.8 mmHg, $P < 0.028$.

Conclusion: The present investigation again illustrates a high prevalence of PH in patients with ESRD during HD with AV fistula. Results also suggest that impaired basal and HD-induced NO production could partly explain the increased pulmonary vascular resistance observed in ESRD patients. In addition, the partial reversals of PAP and CO toward normal values after either the closure of AV access or kidney transplantation underline an excessive pulmonary blood flow as one of the main contributing factors to the development of PH in ESRD.

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