

Hemofiltration in the prevention of radiocontrast agent induced nephropathy

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Aim. The aim of the study was to investigate the role of hemofiltration in preventing contrast nephropathy in patients with renal failure.

Methods. We randomized 114 renal failure patients undergoing percutaneous coronary interventions (PCI) to either peri-procedural hemofiltration or saline hydration.

Results. Contrast nephropathy occurred in 5% of hemofiltration-treated patients and in 50% in controls ($P < 0.01$). In-hospital event rate as well as in-hospital and 1-year mortality rates were lower in patients treated with hemofiltration.

Conclusion. In patients with renal failure undergoing PCI, peri-procedural hemofiltration is effective for the prevention of contrast nephropathy, and is associated with improved in-hospital and long-term outcome.

Key words. Hemofiltration - Angioplasty, transluminal, percutaneous coronary - Kidney diseases, chemically induced.

Radiocontrast-induced nephropathy (RCN), defined as an absolute or relative increase in serum creatinine concentration occurring 48-72 hours after contrast agent exposure, is a frequent complication of percutaneous coronary interventions (PCI). Its clinical course can range from transient elevation in serum creatinine to permanent renal failure requiring dialysis^{1,2}. In patients under-

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going PCI, the occurrence of RCN has been associated with significant in-hospital and long-term mortality, increased risk of in-hospital major adverse cardiac events as well as with prolonged hospital stay and increased costs of health care³⁻⁵. Most of RCN occurs in patients with pre-existing renal insufficiency.

Several strategies have been proposed to provide prophylaxis against RCN. Until recently, only saline hydration, low osmolality contrast media, and acetylcysteine, an antioxidant, have been shown to provide some protection and to reduce the incidence of RCN. However, their efficacy in patients with severe renal failure who undergo radiographic procedures requiring high contrast volume is still controversial, and their impact on clinical outcome is unknown.

Hemofiltration (HF) is a new strategy for the prevention of RCN. In addition to provide hemodynamic stability, HF can exert a beneficial effect through other mechanisms, such as high-volume controlled hydration without the risk of fluid overload and lung congestion. Moreover, by resembling glomerular filtration, HF removes contrast agent from the circulation. This mechanism, along with contrast dilution due to replacement fluid infusion, lowers dye concentration in

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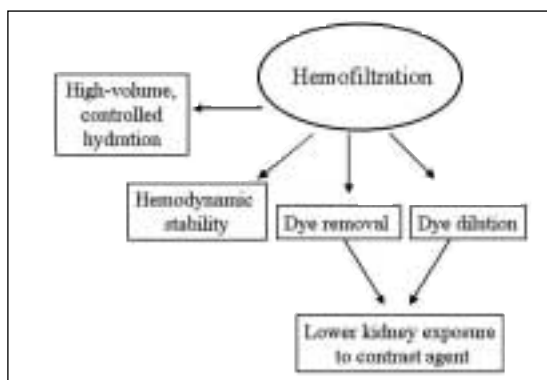


Figure 1. — Possible mechanisms of hemofiltration-associated benefit in the prevention of contrast-nephropathy.

the blood, and possibly reduces kidney exposure to its nephrotoxic effects (Figure 1). This study investigated the role of HF as a prophylactic strategy for the prevention of RCN in high-risk patients undergoing PCI.

Materials and methods

In a prospective study we randomized 114 consecutive patients with chronic renal failure (creatinine >2 mg/dl) undergoing PCI to either HF (n=58; mean creatinine =3.0±1 mg/dl) or isotonic saline hydration at a rate of 1 ml/kg/hour (n=56; mean creatinine=3.1±1 mg/dl). HF (fluid replacement rate: 1 000 ml/h without weight loss) and saline hydration were started 4-8 hours before coronary intervention, and continued 18-24 hours after.

Results

We found that 5% of subjects who received HF experienced a 25% increase in serum creatinine concentration after PCI, compared with 50% of control patients, who received isotonic-saline hydration (P<0.01). Temporary renal replacement therapy was required in 25% of the control group patients, and in 3% of HF group patients. In-hospital major adverse event rate was 9% in the HF group, and 52% in the control group (P<0.001). Moreover, the in-hospital and one-year mortality rates were significantly lower among patients who received HF (Figure 2). Indeed, in-hospital mortality was 2% in the

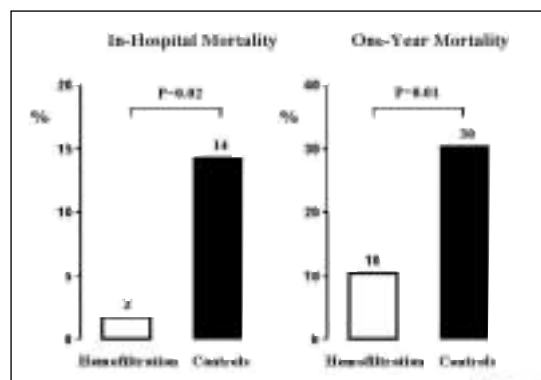


Figure 2. — In-hospital and 1-year mortality rates in patients undergoing prophylactic treatment with hemofiltration as compared with saline hydration (controls).

HF group and 14% in the saline group (P=0.015), while the cumulative 1-year mortality was 10% and 30%, respectively (P=0.01).

Discussion and conclusions

The results of this study demonstrate that prophylactic HF is an effective and safe strategy for the prevention of RCN in patients with chronic renal failure who are undergoing PCI. Furthermore, in-hospital and 1-year clinical outcomes were also significantly improved in comparison to the control group. It must be considered that our study patients were at very high risk for RCN and poor clinical outcome¹⁻¹⁰. Indeed, all had severe renal insufficiency (creatinine ranging from 2.1 to 6.3 mg/dl), high volume contrast exposure, and, in most, one or more additional RCN risk factors were present. Despite this high-risk profile, only 5% of the HF-treated patients developed RCN, while it occurred in 50% of control patients. In HF-treated patients, all the primary end-points (morbidity and in-hospital and long-term mortality) were markedly lower than in controls, and were not different from those reported for patients without chronic renal failure or with chronic renal failure not complicated by RCN⁵⁻⁷.

The precise mechanism of the clinical benefit observed with HF remains unclear. We do not know whether its hypothetical capability of removing radiocontrast from the circulation plays a major role. Beneficial effects may derive from other factors, such as

hemodynamic stability, high-volume controlled hydration, and the general intensity of the care rendered in an Intensive Care Unit. On the other hand, RCN occurring after PCI cannot be ascribed to contrast agent toxicity only. We cannot exclude that other factors, namely hemodynamic instability, concomitant pharmacological therapy, and atheroembolism may have contributed to renal impairment and influenced the clinical outcome of our patients. Thus, the combination of several positive properties of HF, offering a broad-spectrum renal protective effect, may be a more convincing explanation of our results than that of the action of a single mechanism, such as removal of contrast agent. Indeed, when hemodialysis, the most efficient form of contrast agent removal, was utilized, no benefit in preventing RCN and associated morbidity was demonstrated⁷.

It must be emphasized that our positive results were obtained in a very high-risk group of patients undergoing multiple interventions and requiring larger contrast volume compared to that used during simple diagnostic radiographic procedures. The results of this study are not directly applicable to all patients who are at risk and are exposed to radiocontrast media for simpler procedures, and further studies are warranted to identify those renal failure patients who are at particularly high-risk and may derive the greatest benefit from this preventive strategy. In our study, patients with the higher baseline creatinine values (≥ 4 mg/dl) had the greatest positive effect, in terms of long-term survival, from hemofiltration. Hence, a more selective criteria than that used in our study (creatinine > 2 mg/dl) may identify those patients who could obtain the maximal benefit from hemofiltration, and should result in a more cost-effective application of this treatment.

Riassunto

Emofiltrazione per la prevenzione della nefropatia indotta da agenti radiopachi

Obiettivo. L'obiettivo del presente studio è rappresentato da una indagine sul ruolo dell'emofiltrazione nella prevenzione della nefropatia da mezzo di contrasto nei pazienti affetti da insufficienza renale.

Metodi. Centoquattordici pazienti sottoposti a inter-

venti di chirurgia coronarica per via percutanea sono stati assegnati, con criterio casuale, all'emofiltrazione peri-procedurale oppure all'idratazione salina.

Risultati. È stata riscontrata una nefropatia da mezzo di contrasto nel 5% dei pazienti sottoposti a emofiltrazione e nel 50% dei controlli ($p < 0,01$). Il tasso di incidenza intraospedaliera, nonché il tasso di mortalità intraospedaliera e il tasso di mortalità a un anno sono risultati essere inferiori nei pazienti sottoposti a emofiltrazione.

Conclusioni. Nei pazienti affetti da insufficienza renale e sottoposti a interventi di chirurgia coronarica per via percutanea, l'emofiltrazione peri-procedurale risulta essere efficace ai fini della prevenzione della nefropatia da mezzo di contrasto; inoltre essa si associa a un miglioramento della prognosi intraospedaliera e a lungo termine.

Parole chiave: Emofiltrazione - Angioplastica coronarica - Nefropatia, eziologia - Mezzi di contrasto.

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