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ORIGINAL ARTICLE

Impact of left ventricular end diastolic pressure guided hydration on prevention of contrast induced nephropathy post cardiac catheterization

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KEYWORDS

Contrast induced nephropathy;
Left ventricular end diastolic pressure;
Pressure guided hydration

Abstract *Background:* Contrast induced nephropathy (CIN) is an important complication of cardiac catheterization. Adequate hydration is the simplest and most effective way of protecting renal function. This study was designed to determine whether left ventricular end diastolic pressure (LVEDP). Guided hydration would be superior to routine hydration in patients at risk for CIN undergoing cardiac catheterization.

Methods: Prospective randomized trial including 200 patients at Alexandria main university hospital.

Laboratory investigation: Serum urea, creatinine, eGFR by the MDRD equation, Echocardiographic measurement of the left ventricular filling pressure (LVFP) using the ratio (E/septal è). LVEDP measured systematically (in mmHg) using a pigtail catheter. Patients were randomized in a 1:1 fashion to either LVEDP-guided hydration (group 1) or standard hydration (group 2). The primary endpoint was 25% or 0.5 mg/dl or more increase in SCr (two values measured on days 1 and 4), the secondary endpoints were major adverse events (death, myocardial infarction and dialysis) occurring within 30 days.

Results: We found statistically significant difference between the two types of hydration regarding the occurrence of the primary endpoint ($p = 0.046$). We found no statistically significant difference between the two groups regarding the secondary endpoints. Statistically significant correlation was found between LVEDP prior to contrast administration and that at the end of the procedure ($p < 0.001$). Statistically significant positive correlation was found between the LVFP and the LVEDP both prior to contrast administration and at the end of the procedure ($p < 0.001$).

Conclusions: LVEDP-guided hydration is superior to standard hydration in prevention of CIN. Hydration can be done based on LVFP in patients with pre-procedure normal LVF and in patients with pre-procedure elevated LVFP but not in those patients with inconclusive LVFP in which hydration should be guided by the invasively measured LVEDP.

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1. Introduction

Ischemic heart disease is the most common cardiac disease and is most commonly caused by obstruction of the coronary arteries by atheromatous plaque.[1] Coronary angiography (CAG) remains the standard for identifying the presence or absence of arterial narrowings related to coronary artery disease and provides the most reliable anatomic information.[2]

Contrast induced nephropathy (CIN) is an important complication of coronary interventions and is most commonly defined as acute renal failure occurring within 48 h of exposure to intravascular radiographic contrast material that is not attributable to other causes, CIN has many risk factors which are preexisting impairment of renal function, diabetes mellitus (DM), nephrotoxic drugs, reduction of intravascular volume, advanced age, multiple myeloma and sepsis.[3]

Adequate hydration is the simplest and most effective way of protecting renal function. Multiple trials studied the impact of hydration on prevention of CIN.[4]

2. Aim of the work

The study was designed to determine whether left ventricular end diastolic pressure (LVEDP) guided hydration would be superior to routine hydration in patients at risk for CIN undergoing cardiac catheterization.

3. Patients

200 Patients at Alexandria main university hospital undergoing conventional CAG or percutaneous coronary revascularization were included in this prospective study.

3.1. Inclusion criteria (high risk patients)

- Estimated GFR < 90 mL/min/1.73 m^2 by MDRD equation.
  And at least one of the following:
- DM.
- Age > 75 years.
- Hypertension (HTN) ($>140/90$ or on antihypertensive treatment).
- History of heart failure.

3.2. Exclusion criteria

- Pulmonary edema or acute decompensated heart failure.
- Contrast exposure within 48 h.
- Severe valvular heart disease or mechanical aortic valve.
- Heart or kidney transplant status.
- $>15\%$ Change in serum creatinine (SCr) in previous 2 days.
- Patients on regular hemodialysis.

4. Methods

An informed consent was obtained from every patient before the following:

1. Thorough history talking with special emphasis on: risk factors and drug history.
2. Complete clinical examination.
3. Laboratory investigation.
   - Serum urea, creatinine.
   - GFR estimated by the MDRD equation.
     $\text{GFR} = 186 \times \text{Serum Creatinine}^{-1.154} \times \text{Age}^{-0.203} \times 1.212$ (if Black) $\times 0.742$ (if Female).[5]
4. Standard 12 lead ECG and CAG.
5. Transthoracic echocardiography including assessment of the left ventricular ejection fraction and additional measurement of the left ventricular filling pressure (LVFP) using the ratio (E/septal è) by recording the mitral valve annular velocities using pulsed wave Doppler and tissue Doppler imaging in the LVEDP-guided hydration group.
6. LVEDP measured systematically (in mmHg) using a pigtail catheter (initially prior to contrast administration then another measurement at the end of the procedure) in the LVEDP-guided hydration group.
7. A non-ionic, low-osmolar contrast medium used for all procedures.
8. Hydration was done using intravenous 0.9% saline.

Patients were randomized in a 1:1 fashion to either LVEDP-guided hydration or standard hydration as follows:

	LVEDP (in mmHg)-guided hydration		Standard hydration
Pre-procedure	3 mL/kg × 1 h		3 mL/kg × 1 h
During procedure	LVEDP	Rate	1.5 mL/kg/h
	< 13	5 mL/kg/h	
	13–18	3 mL/kg/h	
	> 18	1.5 mL/kg/h	
Post-procedure	Continued × 4 h		Continued × 4 h

The primary endpoint was 25% or 0.5 mg/dl or more increase in SCr (two values measured on days 1 and 4), the secondary endpoints were major adverse events (death, myocardial infarction and dialysis) occurring within 30 days.

5. Results

5.1. Patient demographics

The 100 consecutive patients in the standard hydration group were 52 males (52%) and 48 females (48%). The age ranged from 36 to 77 years with a mean age of 57.88 ± 9.13 years while the other 100 patients in the LVEDP-guided hydration were 60 males (60%) and 40 females (40%). The age ranged from 40 to 77 years with a mean age of 57.54 ± 8.34 years.

- **Risk factors:**

DM: Among the standard hydration group we had 54 patients with DM (54%) and in the LVEDP-guided hydration group we had 42 patients with DM (42%).