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Sodium Bicarbonate Hydration for the Prevention of Contrast Induced Nephropathy following Computed Tomography Angiography of the Chest for Pulmonary Embolism

A. Study Purpose and Rationale

Contrast induced nephropathy (CIN) is currently the leading cause of acute renal failure in hospitalized patients. This complication, in its severe form, is associated with significant morbidity and mortality, ranging from longer length of stay, need for dialysis, and increased risk of death. CIN is defined as an increase in the baseline serum creatinine of 25% or an absolute increase of 0.5mg/dL. Patient with baseline renal impairment are at significantly increased risk for the development of CIN with a 25% increased incidence. In fact, the incidence of CIN in patients with mild to moderate renal insufficiency has been reported as 4 to 11 percent.

Many studies have evaluated strategies for prevention of CIN, looking at hydration with sodium bicarbonate, hydration with normal saline, furosemide, mannitol, and N-acetylcysteine but there still remains uncertainty about the best regimen. Studies comparing sodium bicarbonate with sodium chloride have found either equivalent or improved outcomes with sodium bicarbonate. A 2009 retrospective study comparing sodium bicarbonate with normal saline for prevention of CIN found that sodium bicarbonate appears to be more effective. Furthermore, a prospective randomized trial published in JAMA in 2004 found that hydration with sodium bicarbonate was a more effective prophylactic strategy than sodium chloride. Thus, the current recommendation is administration of isotonic sodium bicarbonate as a bolus of 3 ml/kg for one hour prior to procedure and continuation at a rate of 1 ml/kg/hr for 6 to 12 hours after the procedure.

Most research on contrast induced nephropathy has focused on development of CIN after coronary angiography. Coronary angiography is associated with high doses of contrast media. However, studies on the incidence of CIN after CT angiography has been scarce. CT angiography is the imaging modality of choice in diagnosing patients with clinically suspected acute pulmonary embolism. One study showed a 12% incidence of CIN after CT angiography in an emergency room population. More recently, a single center retrospective analysis performed in a tertiary referral center found a CIN incidence of 8.9%. Impaired renal function prior to the study was found to be an independent risk factor for the development of CIN. To date there have not been any studies evaluating the efficacy of hydration with sodium bicarbonate prior to CT angiography in the high risk patient population with impaired renal function.

Given the concern for development of CIN in the at risk patient population with impaired renal function, delays in obtaining CT angiography may occur while adequate hydration is administered. However, the contrast load given to patients for a CT angiography study is significantly lower than that which is given for coronary angiography. Thus, the goal of this study is to evaluate the efficacy of hydration with sodium bicarbonate in this patient population as well as attempt to determine the optimum volume of hydration to prevent contrast induced nephropathy.

B. Study Design and Statistical Analysis

This will be a retrospective case control study in which the cases will be patients developing contrast induced nephropathy after CT angiography and controls will be patients who did not develop CIN post CT angiography. Using the data warehouse search for CPT code 71275 (CT angiography of chest), the investigator will obtain medical charts of patients who had a CT angiography study performed and perform a chart review to determine volume of hydration received and development of CIN. The determination of CIN will be either with at least a 25% increase in serum creatinine within 48 hours of receiving contrast or an increase in serum creatinine greater than 0.5mg/dL. Only patients with baseline creatinine prior to procedure greater than or equal to 1.5mg/dL will be included.

The determination of sample size is based on a composite of studies which show an incidence of CIN post CT angiography of 8.9-12%. These studies did not separate out those patients at increased risk with impaired renal function. Therefore, for the purpose of sample size and power calculations, the incidence will be estimated at 10%. Assuming an effect size of 5% given a reported odds ratio of 0.52 and in order to achieve 80% power with a 5% Type I error rate, a sample size of 1044 patients (522 in each arm) was calculated for the chi-square test.

Given the nature of a busy tertiary care center such as CPMC, the duration and thus volume of hydration both prior to and after a CT angiogram is likely to vary along a spectrum. Once the chart review is completed, patients will be split into tertiles based on the distribution of volume received for 1 hour prior to procedure and up to 12 hours post procedure. A chi-square test will be performed comparing the high volume and low volume group. Furthermore, the patients would then be split into deciles and a graph of volume of hydration versus incidence of CIN would be plotted to determine the optimum or minimum hydration required for prevention of CIN in this patient population. To control for confounders, the investigator will perform propensity analysis using a multiple logistic regression and include only those subjects in whom model does not predict volume of hydration well.

C. Study Procedure

This is a retrospective chart review that will require going through the patients' medical records to extract data on volume of hydration and serum creatinine values pre CT angiography and up to 2 days post CT angiography. Additionally, demographic data such as age and sex and comorbidities will be recorded. No new procedures will be performed on the patients studied.

D. Study Drugs

N/A

E. Medical Devices

N/A

F. Study Questionnaires

N/A

G. Study Subjects

Inclusion criteria:

- patients who received CT angiography at CPMC
- patients with serum creatinine greater than or equal to 1.5
- patients with recorded serum creatinine values pre study and up to 2 days post study

Exclusion criteria :

- patients less than 18 years of age
- patients who were in the Intensive Care Unit at time of study
- patients with evidence of shock prior to CT angiography

H. Recruitment of Subjects

There will be no specific recruitment of subjects as this is a retrospective chart review.

I. Confidentiality of Study Data

All data obtained will be stored on a password protected computer in a password protected file. Patients will be assigned a study number to protect their identity. All study subject identifying data will be destroyed when the study is completed.

J. Potential Conflict of Interest

None

K. Location of the Study

The study will be conducted at New York Presbyterian – Columbia University Medical Center.

L. Potential Risks

Risks to the patient are minimal to none as this is purely a retrospective chart review with all data already existing in EMR. The only potential risk would be disclosure of personal health information although steps would be taken to prevent this such as assigning a study number to each patient.

M. Potential Benefits

This study will provide no direct benefit to study subjects. However, information obtained from this study will help in better understanding the appropriate prophylactic measures for prevention of Contrast Induced Nephropathy in high risk patients with impaired renal function undergoing CT angiography of the chest.

N. Alternative Therapies

N/A

O. Compensation to Subjects

N/A

P. Costs to Subjects

N/A

Q. Minors as Research Subjects

N/A

R. Radiation or Radioactive Substances

N/A

Resources:

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