Appropriateness of Iohexol and Iodixanol Use for Prevention of Contrast Induced Nephropathy in Patients Undergoing Cardiac Catheterization

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Disclosures
Authors of this presentation have the following to disclose concerning possible financial or personal relationships with commercial entities that may have a direct or indirect interest in the subject matter of this presentation:

Elizabeth Rathgeber: Nothing to disclose

Norman Regional Health System (NRHS)

- Norman Regional primary & HealthPlex campuses
- Licensed for 513 beds
- Acute care community hospital with a full range of services

Objectives
1. Identify a common cause of acute kidney injury that contributes to significant patient morbidity and mortality
2. Identify four patient-specific criteria for appropriate use of iodixanol, based on current literature

Patients at Risk of CIN
- Pre-existing renal dysfunction
  - $\text{SCr} > 1.5 \text{ mg/dL or CrCl} < 60 \text{ mL/min}$
- Use of high osmolality contrast media
- Diabetes
- Cardiovascular disease
- Concomitant use of nephrotoxic drugs or renal perfusion reducing agents
  - ACE-Is, aminoglycosides, NSAIDs, diuretics, etc.
- Dehydration
- Age $> 80$ years

Introduction
- Contrast induced nephropathy (CIN)
  - Third most common cause of new acute kidney injury (AKI)
    - After nephrotoxic medications and decreased renal perfusion
  - Increased risk for cardiovascular events
  - Definition:
    - Serum creatinine rise more than 0.5 mg/dL or more than 25% from baseline
    - Occurs 48 – 72 hours after radiological procedure
### Strategies to Prevent CIN

- Avoid or minimize use of contrast media, or select low osmolality contrast media
- Intravenous hydration with saline before, during, and 12 hours after contrast media administration
- Intravenous sodium bicarbonate before, during, and 6 hours after contrast media administration
- Oral or intravenous acetylcysteine before and after contrast media administration

### Omnipaque® (iohexol)

- Preferred contrast agent for majority of patients
- High-osmolar contrast media
  - More likely to result in CIN

### Visipaque® (iodixanol)

- Iso-osmolar contrast media
- Preferred contrast agent for AKI or CKD
  - Less nephrotoxic than high osmolality contrast media

### Background

- No formal patient-specific protocol previously existed in the catheterization lab for appropriate selection of iodinated contrast media based on renal function or type of procedure
- Only 150 mL bottles of Visipaque® were stocked in the automated dispensing cabinets
- 50 mL, 100 mL, 150 mL, and 200 mL bottles of Omnipaque® were stocked in the automated dispensing cabinets

### Purpose

- Evaluate appropriate use of Visipaque® and Omnipaque® in patients undergoing cardiac catheterization
- Implement a formal protocol allowing radiology technicians to select appropriate contrast agent by assessing patient-specific criteria
- Select appropriate bottle sizes to stock in automated dispensing cabinets, minimizing future waste

### Endpoint Goals

- Reduction of inappropriate Visipaque® utilization
- Reduction in contrast agent wastage
- Cost savings associated with reduced waste or improvements in appropriate utilization

<table>
<thead>
<tr>
<th>Visipaque® 320 mg/mL</th>
<th>Omnipaque® 320 mg/mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 mL</td>
<td>$0.35/mL</td>
</tr>
<tr>
<td>100 mL</td>
<td>$0.35/mL</td>
</tr>
<tr>
<td>150 mL</td>
<td>$0.32/mL</td>
</tr>
</tbody>
</table>
Criteria for Appropriate Visipaque® Use at NRHS

- SCr > 1.5 mg/dL
- eGFR < 45 mL/min
- Contrast injected into peripheral artery or vein
- Age > 80 years
- Documented iodinated contrast allergy

Methods – Phase One

- June 1, 2014 – June 14, 2014
- Assess appropriate iodinated contrast media utilization before implementation of patient-specific protocol
- Volume of contrast media used during procedures compared to bottle sizes obtained from automated dispensing cabinets
- Determine daily cost of contrast media with current process and estimated savings with appropriate contrast media utilization
- Implement a protocol for appropriate contrast media selection

Results – Phase One

- Before protocol implementation
- 105 patient charts reviewed
  - Included – 102 patient charts

<table>
<thead>
<tr>
<th>Contrast Use</th>
<th>Procedures (n=102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visipaque®</td>
<td></td>
</tr>
<tr>
<td>Appropriate</td>
<td>34 (57.6%)</td>
</tr>
<tr>
<td>Inappropriate</td>
<td>25 (42.3%)</td>
</tr>
<tr>
<td>Omnipaque®</td>
<td></td>
</tr>
<tr>
<td>Appropriate</td>
<td>35 (81.4%)</td>
</tr>
<tr>
<td>Inappropriate</td>
<td>8 (18.6%)</td>
</tr>
</tbody>
</table>

Methods – Phase Two

- October 1, 2014 – October 14, 2014
- Assess appropriate iodinated contrast media utilization after implementation of patient-specific protocol
- Volume of contrast media used during procedures compared to bottle sizes obtained from automated dispensing cabinets
- Determine daily cost of contrast media with current process and estimated savings with appropriate contrast media utilization
- Provide catheterization lab with reference guide to encourage appropriate agent selection

Methods

- IRB-approved retrospective chart review
- Patient identification
  - Automated dispensing cabinet charges
  - Documented procedures in the General Electric Centricity Data Management System
- Inclusion criteria
  - Age ≥ 18 years
  - Received Visipaque® or Omnipaque® in the cardiac catheterization lab
- Exclusion criteria
  - Age < 18 years
  - Did not receive either contrast agent
• Projected cost reduction using appropriate bottle sizes
  – Visipaque – 25.2% daily cost reduction
  – Omnipaque – 36.4% daily cost reduction

<table>
<thead>
<tr>
<th>Contrast Use</th>
<th>Cost ($) – Current Bottle Sizes</th>
<th>Cost ($) – Appropriate Bottle Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visipaque®</td>
<td>Total Cost: 3,456.00</td>
<td>2,348.50</td>
</tr>
<tr>
<td></td>
<td>Daily Cost: 314.18</td>
<td>234.85</td>
</tr>
<tr>
<td>Omnipaque®</td>
<td>Total Cost: 577.50</td>
<td>367.50</td>
</tr>
<tr>
<td></td>
<td>Daily Cost: 41.25</td>
<td>26.25</td>
</tr>
</tbody>
</table>

Results – Phase Two

• After protocol implementation
  • 74 patient charts reviewed
    – Included – 71 patient charts

<table>
<thead>
<tr>
<th>Contrast Use</th>
<th>Procedures (n=71)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visipaque®</td>
<td>Appropriate: 21 (77.8%)</td>
</tr>
<tr>
<td></td>
<td>Inappropriate: 6 (22.2%)</td>
</tr>
<tr>
<td>Omnipaque®</td>
<td>Appropriate: 39 (88.6%)</td>
</tr>
<tr>
<td></td>
<td>Inappropriate: 5 (11.3%)</td>
</tr>
</tbody>
</table>

• Projected waste reduction using appropriate bottle sizes
  – Visipaque – 73.5% waste reduction
  – Omnipaque – 70.8% waste reduction

<table>
<thead>
<tr>
<th>Contrast Use</th>
<th>Volume (mL) – Current Bottle Sizes</th>
<th>Volume (mL) – Appropriate Bottle Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visipaque®</td>
<td>Total Waste: 2,933</td>
<td>783</td>
</tr>
<tr>
<td></td>
<td>Daily Waste: 226</td>
<td>60</td>
</tr>
<tr>
<td>Omnipaque®</td>
<td>Total Waste: 3,344</td>
<td>1,044</td>
</tr>
<tr>
<td></td>
<td>Daily Waste: 257</td>
<td>75</td>
</tr>
</tbody>
</table>
Results – Phase Two

- Projected cost reduction using appropriate bottle sizes
  - Visipaque – 40.3% daily cost reduction
  - Omnipaque – 40.5% daily cost reduction

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<th>Cost ($) – Appropriate Bottle Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visipaque®</td>
<td>Total Cost: 1,632.00</td>
<td>975.00</td>
</tr>
<tr>
<td></td>
<td>Daily Cost: 125.54</td>
<td>75.00</td>
</tr>
<tr>
<td>Omnipaque®</td>
<td>Total Cost: 458.50</td>
<td>294.00</td>
</tr>
<tr>
<td></td>
<td>Daily Cost: 35.27</td>
<td>21.00</td>
</tr>
</tbody>
</table>

Cost Savings

- Annual expenditures 12/01/13 through 11/30/14
  - Visipaque® – $68,448
  - Omnipaque® – $13,552

- Annual estimated savings of $13,617 after protocol implementation

Discussion

- Approximately 42.3% of cases utilizing Visipaque® were inappropriate
- Implementation of a formal protocol decreased inappropriate Visipaque® use to 22.2%

Discussion

- Waste reduction
  - Over 70% reduction in waste daily by selecting appropriate bottle sizes
- Cost reduction
  - Over 25% reduction in daily cost by selecting appropriate bottle sizes
  - As much as 40% reduction in daily cost

Future Directions

- Phase Three
  - March 1, 2015 – March 14, 2015
  - Assess sustainability of appropriate iodinated contrast media utilization after implementation of patient-specific protocol
  - Currently in process

Self Assessment #1

Which of the following options is NOT a common cause of acute kidney injury:

a. Utilization of nephrotoxic antibiotics
b. High osmolar contrast media
c. Use of acetylcysteine
d. Decreased renal perfusion
Self Assessment #2

Each of the following choices describes appropriate utilization of Visipaque® (iodixanol) EXCEPT:

a. Age 85 years  
b. Contrast injected into central vein  
c. Prior iodinated contrast allergy  
d. eGFR 40 mL/min

Acknowledgements

- Lisa Mayer, Pharm.D., BCPS  
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