Acute Renal Failure with Cardiac Operations

MM
MW
California State University Long Beach
HSC 503
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Research Problem

- Acute Renal Failure (ARF) complicates cardiac operations in up to 31% of patients

- Mortality rate
  - Severe ARF: 90%
  - Mild to moderate ARF: 10-20%
  - No ARF: 1-2%
Research Problem

Which factors are associated with increased risk of ARF after a cardiac operation?

- Age
- Pre-surgery Creatinine level
- Pre-surgery Blood Urea Nitrogen (BUN) level
- Hours in surgery
Definitions

- **Creatinine**
  - Blood test that evaluates kidney function
  - Identifies abnormal kidney function
    - Severe ARF: Creatinine levels > 5 mg/dl
    - Mild to moderate ARF: Creatinine levels 1.5 - 2.5 mg/dl

- **BUN**
  - Blood test that evaluates kidney function
  - Normal range: 7 - 20 mg/dl
Data Collection Methodology

- Retrospective study
  - Rush-Presbyterian-St. Luke’s Medical Center
  - Hospital records
  - 1985

- 572 adult patients with a cardiac operation
  - Coronary bypass
  - Valve replacement
Data Collection Methodology

- Study group
  - 42 patients who developed postoperative ARF

- Control group
  - 42 patients who did NOT develop postoperative ARF

- Total number of observations
  - n = 84
Data Collection Methodology Variables

Clinical
- Age
- Hospital days
- Intensive care unit days
- Type of operation
- Sex
- Race
- Preoperative risk factors
- Total number of risk factors
- Total cardiac risk factors
- Pre and post surgery lab values

Intraoperative
- Total time of operation
- Total time on bypass pump
- Urine output during operation
- Mean blood pressure
Data Collection Methodology Variables

Postoperative

- Use and dose of vasopressors
- Hypotensive episodes
- Complications
- Total number of complications
- Duration of intubation

Statistical Methodology

- **Statistics Software**
  - SPSS 15.0 for Windows

- **Independent Samples T-Test**
  - Age
  - Pre-surgery Creatinine level
  - Pre-surgery BUN level
  - Hours in surgery

- **95% Confidence Interval**
Statistical Methodology

- Comparison of two groups
  - Case (x)
    - Patients with ARF after a cardiac operation
  - Control (y)
    - Patients with no ARF after a cardiac operation
Statistical Methodology

Age

- $H_0: \mu_x = \mu_y$
  - There is no age difference between case and control group

- $H_1: \mu_x \neq \mu_y$
  - There exists an age difference between case and control group
Statistical Methodology

Age

Group Statistics

<table>
<thead>
<tr>
<th>case/control</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>42</td>
<td>68.76</td>
<td>7.877</td>
<td>1.215</td>
</tr>
<tr>
<td>case</td>
<td>42</td>
<td>62.67</td>
<td>12.489</td>
<td>1.927</td>
</tr>
<tr>
<td>control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Independent Samples Test

Levene's Test for Equality of Variances

<table>
<thead>
<tr>
<th>age</th>
<th>F</th>
<th>Sig.</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
<th>Std. Error Difference</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal variances assumed</td>
<td>5.910</td>
<td>.017</td>
<td>82</td>
<td>.009</td>
<td>6.095</td>
<td>2.278</td>
<td>1.563 - 10.628</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>2.675</td>
<td>69.159</td>
<td>.009</td>
<td>6.095</td>
<td>2.278</td>
<td>1.550</td>
<td>10.640</td>
</tr>
</tbody>
</table>
Statistical Analyses Results

Age

- We reject the null hypothesis
  - Based on the sample means, there is an age difference in patients with acute renal failure and those without acute renal failure

- 95% confidence interval
  - [1.563, 10.628]

- Significance level
  - 0.017
Pre-Surgery Creatinine Levels

- **H0**: $\mu_x = \mu_y$
  - There is no difference in pre-surgery creatinine levels between case and control group

- **H1**: $\mu_x \neq \mu_y$
  - There is a difference in pre-surgery creatinine levels between case and control group
Statistical Methodology

Pre-Surgery Creatinine Levels

<table>
<thead>
<tr>
<th>Group Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>case/control</td>
</tr>
<tr>
<td>preoperative creatinine</td>
</tr>
<tr>
<td>case</td>
</tr>
<tr>
<td>control</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Samples Test</th>
</tr>
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<tbody>
<tr>
<td>Levene's Test for Equality of Variances</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>------------------------------</td>
</tr>
<tr>
<td>preoperative creatinine</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
We reject the null hypothesis

Based on the sample means, there is a difference between pre-surgery creatinine levels in patients with acute renal failure and those without acute renal failure

95% confidence interval

[0.27539, 0.86271]

Significance level

0.001
Statistical Methodology
Pre-Surgery BUN Levels

- **H0**: $\mu_x = \mu_y$
  - There is no difference in pre-surgery BUN levels between case and control group

- **H1**: $\mu_x \neq \mu_y$
  - There is a difference in pre-surgery BUN levels between case and control group
**Pre-Surgery BUN Levels**

**Group Statistics**

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>preoperative BUN</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>case</td>
<td>42</td>
<td>24.76</td>
<td>14.781</td>
<td>2.281</td>
</tr>
<tr>
<td>control</td>
<td>42</td>
<td>20.29</td>
<td>24.523</td>
<td>3.784</td>
</tr>
</tbody>
</table>

**Independent Samples Test**

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td><strong>preoperative BUN</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>.006</td>
<td>.940</td>
<td>1.013</td>
</tr>
</tbody>
</table>
We fail to reject the null hypothesis
- Based on the sample means, there is no difference between pre-surgery BUN levels in patients with acute renal failure and those without acute renal failure

95% confidence interval
- [-4.313, 13.265]

Significance level
- 0.940
Statistical Methodology

Operative Hours

- **H0**: $\mu_x = \mu_y$
  - There is no difference in operative hours between case and control group

- **H1**: $\mu_x \neq \mu_y$
  - There is a difference in operative hours between case and control group
### Statistical Methodology

**Operative Hours**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>hours in operating room</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>case</td>
<td>42</td>
<td>5.2857</td>
<td>1.53870</td>
<td>.23743</td>
</tr>
<tr>
<td>control</td>
<td>42</td>
<td>4.3571</td>
<td>.81365</td>
<td>.12555</td>
</tr>
</tbody>
</table>

**Independent Samples Test**

<table>
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<th>95% Confidence Interval of the Difference</th>
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<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hours in operating room</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>13.881</td>
<td>.000</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>3.457</td>
<td>62.266</td>
</tr>
</tbody>
</table>
Statistical Analyses Results

Operative Hours

- We reject the null hypothesis
  - Based on the sample means, there is a difference between operative hours in patients with acute renal failure and those without acute renal failure

- 95% confidence interval
  - [0.39429, 1.46286]

- Significance level
  - 0.000
Conclusions From the Study

Based on Independent Samples T-Test Results

- Factors that increase risk of ARF after a cardiac operation
  - Age
  - Pre-surgery Creatinine level
  - Hours in surgery

- Factors that did not increase risk of ARF after a cardiac operation
  - Pre-surgery BUN level
Quality Control Issues

- Samples were not random
  - Based on two distinct groups

- Sample size was small
  - n = 84

- Data set had many comparable variables

- Discriminate analysis
  - More effective in analyzing this sample data
Final Questions

The questions are based on the information below:

- $H_0: \mu_x = \mu_y$
- $H_1: \mu_x \neq \mu_y$
- 95% confidence interval [0.39429, 1.46286]
- Significance level was 0.000

1. Based on the confidence interval, do we reject the null hypothesis or fail to reject the null hypothesis?

2. Based on the significance level, is the sample data significant? Yes or No?