Utility of Cocaine Drug Screens to Predict Safe Delivery of General Anesthesia for Elective Surgical Patients

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Cocaine use in the United States is prevalent. It has been associated with acute onset of hemodynamic changes and disease states that can include hypertension, myocardial infarction, cardiac arrest, ischemic or hemorrhagic stroke, and dysrhythmias. Because of these potential complications, elective surgical procedures frequently are postponed for patients who test positive for cocaine unless a life-threatening crisis requires immediate intervention. However, there are few studies examining the occurrence of hemodynamic instability among cocaine-positive individuals undergoing elective surgical procedures.

Substance abuse is a widespread problem affecting all races and age groups. A recent survey reported that 33.7 million Americans aged 12 years and older had tried cocaine at least once in their life. On average, 0.7% of adults use cocaine regularly in the United States. In fact, the rate of substance abuse has increased from 6.7% to nearly 8% of all individuals aged 12 years or older in Davidson County, Tennessee, where this study took place. Factors such as availability, the ease of administration, and an erroneous perception that cocaine use is safe has led to a dramatic increase in cocaine use.

Despite the prevalence of cocaine users in the US population, there is a lack of standardization of care regarding cocaine-positive individuals when they present for surgical intervention. The purpose of this study was to examine the risk for a hemodynamic event among elective surgical patients who test positive for cocaine.

Methods
After institutional review board approval, a retrospective cohort study was conducted to determine the differences and predictors of intraoperative hemodynamic instability among patients undergoing elective surgery who tested cocaine positive on a urine drug screen at hospital admission. The cohort was assembled from an administrative database and consisted of the first 300 (150 cocaine-positive and 150 cocaine-negative) consecutive cases admitted between January 2006 and March 2010 that met the inclusion criteria.

Baseline systolic pressure (P = .001; mean difference, 6.5 mm Hg; 95% confidence interval [CI], 2.7-10.2), mean arterial pressure (P = .04; mean difference, 2.9 mm Hg; 95% CI, 1.0-5.7), and heart rate (P = .02; mean difference, 3.3/min; 95% CI, 0.46-6.2) were significantly higher, but not clinically important in the cocaine-positive cohort.

Our study demonstrates that use of drug screen results alone is insufficient to predict the safe administration of general anesthesia in patients undergoing elective surgeries.

Keywords: Cocaine, drug screen, hemodynamic instability, urine drug screen.
required for the procedure. Reversal of neuromuscular block was performed with neostigmine, 40 to 70 μg/kg−1, and glycopyrrrolate, 3 to 6 μg/kg −1. Cases were excluded if they were not alert at baseline, or if they required more than 1 surgical procedure.

Hemodynamic instability was defined as any of the following: 20% or greater increase in heart rate from baseline; 20% or greater decrease in arterial blood pressure (BP) from baseline; severe elevation in arterial BP requiring intraoperative use of any IV antihypertensive agent; severe BP lowering requiring use of IV vaspressor agents started intraoperatively; and change in cardiac rhythm from baseline normal sinus rhythm on ECG.

The following data were analyzed in the study: age; sex; baseline preoperative systolic, diastolic, and mean arterial BPs; heart rate; ECG rhythm; number of hemodynamic events per subject (BP events, heart rate events, and combined BP and heart rate events); surgical procedure performed; and length of time for each surgical case. Data were entered and analyzed using statistical analysis software (SPSS, IBM SPSS, Armonk, NY) to describe subject characteristics and to determine differences in the occurrence of adverse hemodynamic events as well as predictors for these events.

Results

Two groups of subjects were assembled and dichotomized by cocaine testing status: 150 cocaine-positive and 150 cocaine-negative subjects. Table 1 presents group characteristics for the sample. For the entire sample, 52% (n = 155) were female. Whereas age was similar between the cocaine-positive and negative groups, cocaine-positive subjects were significantly more likely to be male ($\chi^2 = 5.9; P = .02$).

Baseline systolic BP was significantly higher in the cocaine-positive group ($P = .001$; mean difference, 6.5 mm Hg; 95% confidence interval [CI], 2.7-10.2), but the difference was not clinically important compared with systolic BP in cocaine-negative subjects. Similarly, baseline mean arterial pressure (MAP) was significantly higher ($P = .04$; mean difference, 2.9 mm Hg; 95% CI, 1.0-5.7), but not clinically important in the cocaine-positive group compared with cocaine-negative subjects. Baseline heart rates were also significantly higher in the cocaine-positive group ($P = .02$; mean difference, 3.3/min; 95% CI, 0.46-6.2), but not clinically important in their difference from cocaine-negative subjects. Cocaine-negative subjects had significantly longer surgical procedure times ($P = .002$; mean difference, 0.38

Table 1. Characteristics of Subjects

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Cocaine negative (n = 150)</th>
<th>Cocaine positive (n = 150)</th>
<th>Mean difference (95% CI)</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>40.8 ± 10.3</td>
<td>39.2 ± 10.4</td>
<td>NA</td>
<td>NS</td>
</tr>
<tr>
<td>Female sex (No., %)</td>
<td>88 (58.7)</td>
<td>67 (44.7)</td>
<td>NA</td>
<td>.02&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Baseline systolic BP (mm Hg)</td>
<td>125.0 ± 16.3</td>
<td>131.5 ± 16.6</td>
<td>6.5 (2.7-10.2)</td>
<td>.001</td>
</tr>
<tr>
<td>Baseline diastolic BP (mm Hg)</td>
<td>76.7 ± 11.5</td>
<td>77.8 ± 12.5</td>
<td>NA</td>
<td>NS</td>
</tr>
<tr>
<td>Mean arterial pressure (mm Hg)</td>
<td>92.8 ± 11.9</td>
<td>95.7 ± 12.6</td>
<td>2.9 (1.0-5.7)</td>
<td>.04</td>
</tr>
<tr>
<td>Baseline heart rate (/min)</td>
<td>78.8 ± 12.8</td>
<td>82.1 ± 12.6</td>
<td>3.3 (0.46-6.2)</td>
<td>.02</td>
</tr>
<tr>
<td>Mean surgical time (h)</td>
<td>3.0 ± 1.2</td>
<td>2.6 ± 0.9</td>
<td>0.4 (0.14-0.61)</td>
<td>.002</td>
</tr>
</tbody>
</table>

<sup>a</sup> Data are mean ± SD except where otherwise indicated. $P$ value is with the Student t test. 
<sup>b</sup> $\chi^2 = 5.9$. 

Abbreviations: BP, blood pressure; CI, confidence interval; NA, not applicable; NS, not significant.

Table 2. Operative Procedures by Cocaine Status

<table>
<thead>
<tr>
<th>Type of elective surgical procedure</th>
<th>No. (%) of subjects by cocaine testing status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cocaine negative</td>
</tr>
<tr>
<td>General surgery</td>
<td>66 (44)</td>
</tr>
<tr>
<td>Gynecologic surgery</td>
<td>26 (17)</td>
</tr>
<tr>
<td>Orthopedic surgery</td>
<td>24 (16)</td>
</tr>
<tr>
<td>Ear, nose, and throat surgery</td>
<td>5 (3)</td>
</tr>
<tr>
<td>Oral and maxillofacial surgery</td>
<td>9 (6)</td>
</tr>
<tr>
<td>Plastic surgery</td>
<td>5 (3)</td>
</tr>
<tr>
<td>Vascular surgery</td>
<td>14 (9)</td>
</tr>
<tr>
<td>Genitourinary surgery</td>
<td>1 (1)</td>
</tr>
</tbody>
</table>
hour; 95% CI, 0.14-0.61), averaging about 23 minutes longer than for cocaine-negative subjects.

Table 2 lists the frequency of the different elective surgical procedures for both cocaine-positive and negative subjects. The most common operative procedure for cocaine-negative cases was hernia repair, while orthopedic hardware removal was the most common surgical procedure performed in cocaine-positive subjects.

There was no significant difference in the number of intraoperative hypotensive, heart rate, or combined hypotensive and heart rate events between subjects in the cocaine-positive and negative groups (Table 3). On binary logistic regression analysis, age, operative procedure time, and both systolic and diastolic BPs were independent predictors of any type of hemodynamic event (hypotension and/or heart rate events), collectively predicting 81.3% of hemodynamic events ($\chi^2 = 37.9; P < .001$).

Overall for the sample, 134 subjects (44.7%) required IV vasopressor medications for treatment of intraoperative hypotension, and of these, significantly more (n = 83; 61.9%) were cocaine positive ($\chi^2 = 31.1; P < .003$). There were 34 (11.3%) subjects who required IV antihypertensive medication intraoperatively for treatment of severely elevated BP, and of these, significantly more (n = 26; 76.5%) were cocaine positive ($\chi^2 = 12.9; P < .02$). Intraoperative dysrhythmias were not noted in either group. There were no patient deaths, and no patients in either group had major anesthesia complications.

### Discussion

Our study showed that testing positive for cocaine before elective surgery is not predictive of significantly more intraoperative hemodynamic events than for cocaine-negative patients. This is an important finding, in that providers often use drug screen findings to determine eligibility for elective surgeries, and in the case of cocaine, these findings may not be reliable.

Interestingly, our study also showed that cocaine-positive patients were significantly more likely to receive vasopressor agents, despite the fact that they had fewer clinically important incidents of hypotension than did cocaine-negative patients. Our retrospective methods leave us unclear about why this was the case, although the fact that anesthesia providers knew the cocaine-positive status of these patients may have played a role in lowering the threshold to treatment of hypotension.

We also found that cocaine-positive subjects were significantly more likely to receive an IV antihypertensive agent intraoperatively. Given the vascular effects of cocaine, this finding is not unexpected. Cocaine causes increased release of catecholamines from presynaptic nerve terminals, with profound vasoconstriction and hypotension due to inhibition of catecholamine reuptake and decreased production of the vasodilator nitric oxide that results in sympathetic overdrive. This frequently results in coronary ischemia, myocardial infarction, arrhythmias, and over time, cardiomyopathy. However,
the fact cannot be ignored that, despite vasoactive drug treatment differences, there were no patients who suffered anesthesia complications and no incidents of dysrhythmias in either group.

Cocaine is rapidly redistributed and metabolized in the body.\(^7\)\(^,\)\(^6\) The metabolism of cocaine produces benzoylecgonine, the primary urinary marker for detecting cocaine use.\(^8\) Cocaine’s half-life is only 1 to 1.5 hours.\(^1\)\(^,\)\(^5\)\(^,\)\(^7\) Its metabolites are inactive and, therefore, incapable of producing hemodynamic instability. Yet, cocaine metabolites may remain in the urine for up to 14 days or longer after consumption.\(^1\)\(^,\)\(^8\)\(^,\)\(^9\) so that a patient may test positive for cocaine while not being acutely toxic.\(^1\)

Our study supports the argument that cocaine-related diseases as well as deaths are due less to overdose than they are the pathophysiology that develops from long-term use. This suggests that the risk of anesthesia-related complications or death is unlikely to change based solely on drug screen findings,\(^3\)\(^,\)\(^10\) which simply identify the presence or absence of inactive cocaine metabolites, not the degree of intoxication.\(^11\) Recent cocaine use alone may not necessarily be a contraindication to surgery if the patient is asymptomatic and has normal vital signs, ECG, and results of review of systems.\(^3\)

Despite this, there remains no consensus on whether the cocaine-positive patient should be allowed to undergo anesthesia for elective surgery. In fact, a recent survey found that 30% of providers believe that cocaine-positive patients should wait 7 days after a positive drug screen before undergoing an elective surgical procedure.\(^3\) However, our findings suggest that this will do little to predict hemodynamic stability, and given the growing use of cocaine in the United States, this practice may result in chaotic, disruptive surgical scheduling.

Our study has several limitations that must be acknowledged. First, we conducted a retrospective cohort study. Whereas these studies do allow for watching the natural occurrence of a variety of conditions over time, they largely strengthen causality, they are also limited by their retrospective nature. We were unable to follow actual changes in heart rate and BP data throughout the intraoperative period, as these variables were not part of the administrative dataset that was utilized. Following actual changes in BP may have afforded an improved understanding of our sample’s hemodynamic changes, as well as the actual need for vasoactive therapies. Similarly, we were unable to determine which preexisting conditions were present in our subjects that may have contributed to our results. Despite this, we were able to demonstrate that prediction of hemodynamic instability is more complex than the results of a drug screen, and this is valuable information that supports the need for a future prospective study.

**Conclusion**

Cocaine use is prevalent, and anesthesia providers are likely to face decisions about how to manage patients testing positive for cocaine use. Our study provides important information for anesthesia providers, by demonstrating that use of drug screen results alone is insufficient to predict the safe administration of general anesthesia in patients undergoing elective surgeries. Best practice should include a thorough assessment for major pathophysiologic changes resulting from long-standing cocaine use, which are more likely to predict anesthesia safety than a positive cocaine drug screen.

**REFERENCES**


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