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TECHNICAL NOTE

Henry A. Spiller,[1] *M.S., D. ABAT*

Postmortem Oxycodone and Hydrocodone Blood Concentrations

ABSTRACT: There is limited data on postmortem oxycodone concentrations, consisting of three published reports with a total of 11 cases, many of which were polypharmacy cases. This report presents the results of a review of autopsy and coroner's reports from 10 counties for the years 2000 and 2001 to locate cases with oxycodone or hydrocodone exposure as a leading cause of death. Eighty-eight cases were located. Twenty-four deaths were attributed to oxycodone alone. Mean and median postmortem oxycodone blood concentrations were 1.23 mg/L and 0.43 mg/L, respectively. The range was 0.12 to 8.0 mg/L, with 13 cases (54%) ≤0.5 mg/L. Seventeen deaths were attributed to hydrocodone alone. Mean and median postmortem hydrocodone blood concentrations were 0.53 mg/L and 0.40 mg/L, respectively. The range was 0.12 to 1.6 mg/L, with 11 cases (65%) ≤0.5 mg/L. There were seven cases where the cause of death was attributed to the effects of a combination of hydrocodone and oxycodone. Mean oxycodone and hydrocodone blood concentrations were 0.34 mg/L and 0.14 mg/L, respectively. Forty cases involved polysubstance overdoses with significant involvement of other drugs and ethanol. Mean oxycodone and hydrocodone blood concentrations were 0.18 mg/L and 0.29 mg/L, respectively. The list of other substances involved was extensive but included ethanol, amitriptyline, methadone, codeine, propoxyphene, and acetaminophen. The findings of this study report oxycodone values associated with a fatality at blood concentrations lower than previously reported. This may represent enhanced information because of the larger sample group. Hydrocodone values associated with a fatality were similar to previously published values.

KEYWORDS: forensic science, postmortem concentration, oxycodone, hydrocodone

There is limited data on postmortem oxycodone concentrations. Published reports consist of ten cases all with polypharmacy involvement (1,2). The majority of these cases were published before the marketing of Oxycontin®, a popular sustained-release form of oxycodone widely abused in our region. Baselt references six cases from unpublished communications with postmortem oxycodone concentrations. However, he provides very limited supporting data (3). Additionally, there is limited data on postmortem hydrocodone concentrations. Data from eleven cases are available but half of these are unpublished communications (4–7). In response to this limited data, a review of all fatalities involving oxycodone and/or hydrocodone in a ten county area was undertaken.

Method

All death records from ten counties were reviewed to locate and select any cases that involved oxycodone or hydrocodone on the postmortem toxicology report. All selected cases then had their autopsy and coroners report reviewed in conjunction with the postmortem toxicology report to evaluate cause of death and potential involvement of oxycodone or hydrocodone. All postmortem toxicology evaluations were performed at the same state public health department laboratory. All postmortem blood concentrations were confirmed by gas chromatography. Metabolite concentrations were not reported. The study involved deaths occurring over the two-year period: January 1, 2000 through December 31 2001. There is very limited information published on postmortem redistribution of oxycodone or hydrocodone, with only a single patient ($n = 1$) evaluated for both oxycodone and hydrocodone (8). The report from these single patient samples showed a ratio of heart blood concentrations to femoral blood concentrations for hydrocodone and oxycodone as 1 and 3, respectively. Blood samples for the cases reported here were drawn from a peripheral site, within one day of death. The volume of distribution of oxycodone is 2 L/kg to 2.5 L/kg in both adults and children (9–11) The elimination half-life is from 2.6 to 5.4 h, but may be prolonged in uremic patients (9, 11–13). An elimination half-life for hydrocodone is reported as 3.8 h (14).

Results

Eighty-eight cases were located in which oxycodone and/or hydrocodone played a primary or a significant role in the cause of death. The reason for exposure in these cases was drug abuse ($n = 38$, 43%), suicide ($n = 22$, 25%), therapeutic misadventure ($n = 15$, 17%), reason unclear ($n = 11$, 13%) and other ($n = 2$, 2%). Sixty-three (72%) were male. Age ranged from 19 to 79 years of age, with a mean of 39 yrs (± 10.9). All 88 cases were discovered in full arrest.

Twenty-four deaths (27%) were attributed to oxycodone alone. There were no drugs other than oxycodone and no volatiles located in postmortem analysis and no history to indicate other drugs or volatiles would be involved. The mean and median postmortem oxycodone concentrations were 1.23 mg/L and 0.43 mg/L, respec-

[1] Kentucky Regional Poison Center, Louisville, KY.
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TABLE 1—*Oxycodone postmortem concentrations by reason of exposure.*

Reason	Number of Cases	Mean (mg/L)	Median (mg/L)	Range (mg/L)
Drug abuse	10	0.45	0.3	0.12 to 0.9
Therapeutic misadventure	4	0.42	0.35	0.16 to 0.93
Suicide	5	3.9	2.5	0.6 to 8.0
Other/unclear	5	0.7	0.28	0.17 to 1.6

TABLE 2—*Hydrocodone postmortem concentrations by reason of exposure.*

Reason	Number of Cases	Mean (mg/L)	Median (mg/L)	Range (mg/L)
Drug abuse	7	0.63	0.47	0.12 to 1.6
Therapeutic misadventure	3	0.32	0.32	0.32 to 0.33
Suicide	4	0.7	0.7	0.4 to 1.0
Other/unclear	3	0.34	0.34	0.26 to 0.42

tively. The range was 0.12 to 8.0 mg/L, with 13 cases (54%) ≤0.5 mg/L. There was a significant difference in postmortem blood concentrations based on the reason for exposure, with suicide cases having the all the blood concentrations ≥1.0 mg/L (Table 1).

Seventeen deaths were attributed to hydrocodone alone. There were no drugs other than hydrocodone and no volatiles located in postmortem analysis and no history to indicate other drugs or volatiles would be involved. The mean and median postmortem hydrocodone concentrations were 0.53 mg/L and 0.40 mg/L, respectively. The range was 0.12 to 1.6 mg/L, with 11 cases (65%) ≤0.5 mg/L. There was no significant difference in postmortem blood concentrations based on the reason for exposure (Table 2).

There were seven cases where the cause of death was attributed to the effects of a combination of hydrocodone and oxycodone. Mean oxycodone and hydrocodone concentrations were 0.34 mg/L and 0.14 mg/L, respectively.

Forty cases involved polysubstance overdoses with significant involvement of other drugs and ethanol. Mean oxycodone and hydrocodone concentrations were 0.18 mg/L and 0.29 mg/L, respectively. The list of other substances involved was extensive but included ethanol, amitriptyline, methadone, codeine, propoxyphene, and acetaminophen.

Discussion

Unintentional death and intentional death involving oxycodone and hydrocodone may be more common than previously documented. This study reports oxycodone values associated with a fatality at blood concentrations lower than previously reported. This may represent enhanced information because of the larger sample group. The groups with the lower postmortem blood concentration values were only slightly above what would occur after ingestion of one of the larger doses available of Oxycontin®. Oxycontin® is available in 10 mg, 20 mg, 40 mg, and 80 mg dose tablets. Twenty milligrams of oxycodone in a 70-kg patient will produce a blood concentration of approximately 0.02 mg/L (15). The therapeutic window is extremely narrow when using these large dose tablets. An adult patient on chronic oxycontin® therapy might risk serious consequences with the addition of a single extra 40 mg or 80 mg tablet on top of their regular regimen. A small child would potentially be at risk with the ingestion of any of the oxycontin® tablets. Ingestion of a single 20 mg tablet in a 12 kg toddler would produce an estimated blood concentration of approximately 0.11 mg/L: very near the lower range associated with fatalities.

Olkkola et al., suggested that, in children, oxycodone appears to have a more potent respiratory depressant effect than comparable analgesic doses of other opioids (10). However, review of our data in adults dose not reveal any significant difference in the postmortem blood values of oxycodone and hydrocodone associated with a fatality.

One issue of concern is the portion of fatalities attributed to therapeutic misadventure. In both oxycodone and hydrocodone, it was 16 to 17% of the fatalities: one out of every six cases. This is an area for possible education efforts to both physicians and patients, that advancement to supra-therapeutic doses, however well intentioned by the patient, may carry a grave risk.

Hydrocodone postmortem concentrations associated with a fatality were similar to published values as well as those of oxycodone reported here. In cases involving both oxycodone or hydrocodone, a majority of cases had blood concentrations ≥0.12mg/L and ≤0.5mg/L.

Conclusion

This study reports oxycodone values associated with a fatality at blood concentrations lower than previously reported. This may represent enhanced information because of the larger sample group. Hydrocodone values associated with a fatality were similar to published values.

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Additional information and reprint requests:
Henry Spiller, M.S., D. ABAT
Director, Kentucky Regional Poison Center
PO Box 35070
Louisville, KY 40232-5070
E-mail:—henry.spiller@nortonhealthcare.org