

A Survey of Propofol Abuse in Academic Anesthesia Programs

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BACKGROUND: Although propofol has not traditionally been considered a drug of abuse, subanesthetic doses may have an abuse potential. We used this survey to assess prevalence and outcome of propofol abuse in academic anesthesiology programs.

METHODS: E-mail surveys were sent to the 126 academic anesthesiology training programs in the United States.

RESULTS: The survey response rate was 100%. One or more incidents of propofol abuse or diversion in the past 10 yr were reported by 18% of departments. The observed incidence of propofol abuse was 10 per 10,000 anesthesia providers per decade, a fivefold increase from previous surveys of propofol abuse ($P = 0.005$). Of the 25 reported individuals abusing propofol, 7 died as a result of the propofol abuse (28%), 6 of whom were residents. There was no established system to control or monitor propofol as is done with opioids at 71% of programs. There was an association between lack of control of propofol (e.g., pharmacy accounting) at the time of abuse and incidence of abuse at the program ($P = 0.048$).

CONCLUSIONS: Propofol abuse in academic anesthesiology likely has increased over the last 10 yr. Much of the mortality is in residents. Most programs have no pharmacy accounting or control of propofol stocks. This may be of concern, given that all programs reporting deaths from propofol abuse were centers in which there was no pharmacy accounting for the drug.

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With its characteristics that allow for a quick recovery time after induction compared to many other anesthetics (1-3) and minimal side effects (4-6), propofol has become the most widely used IV drug for induction of general anesthesia (7).

Although it has not traditionally been considered a drug of abuse in anesthesiology, subanesthetic doses have been described as possibly having an abuse potential (8). Subanesthetic and anesthetic doses of propofol increase dopamine concentrations in the nucleus accumbens (9), a core region of the brain reward system. This increase in dopamine concentrations is also observed after the intake of alcohol and other drugs, and is thought to reinforce substance intake (10). Propofol is self-administered by rats and

primates, demonstrating that it functions as a reinforcer, and suggesting that it has the potential for abuse (11,12). A study using nondrug-abusing volunteers also demonstrated that propofol has reinforcing properties (8). Another study examined the subjective effects of propofol in 10 volunteers with a "light" history of drug abuse and concluded 5 subjects liked large-dose propofol and 3 did not (13). In a case report of a physician addicted to propofol, the authors noted that there were 30 references which mentioned patient euphoria after propofol anesthesia (14). Aerosolization of propofol occurs and can potentially lead to a sensitization and later abuse of the drug in anesthesiologists and surgeons (15). Several case reports have described propofol abuse in nurses, anesthesiologists, and a layperson (6,14,16). For example, a 31-year-old general practitioner was reported to be injecting himself with propofol up to 100 times or more a day to reduce his feelings of boredom, inner tension, and depression (17). Some have contemplated greater pharmacy control of propofol, as evidenced by an *Anesthesiology* editorial in 1992 (18).

With this supporting information for the abuse potential of propofol, we attempted to determine the prevalence and outcome of propofol abuse in academic anesthesiology departments with residency training programs in the United States. We hypothesize that the incidence of propofol abuse among anesthesia personnel in academic centers is increasing,

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Table 1. Summary of Propofol Abuse Data and Outcomes

	Attendings	Residents	CRNAs	OR/Anes techs	Total
Number found	5	16	3	1	25
Deaths from abuse	0	6	0	1	7
Completed rehab.	4	7	2	0	13
Relapse of use	1	1	1	0	3
Still in anesthesia	1	2	0	0	3
Changed specialty	0	5	0	0	5
Left medicine	4	3	3	0	10

CRNAs = certified registered nurse anesthetists; OR = operating room.

and that lack of pharmacy control of propofol is associated with an increase in the incidence of propofol abuse at an institution.

METHODS

The Colorado Multiple Institutional Review Board (IRB) approved the survey and study protocol. Once approved, the survey (Appendix A) was sent via e-mail to the chairpersons of all of the anesthesiology departments with residency programs in the United States. One hundred twenty-six departments were determined to meet these qualifications. The Society of Academic Anesthesiology Chairs data were used to locate and contact appropriate programs. After initial e-mail surveys were returned, a second e-mail survey was distributed to the programs that did not respond to the initial attempt. Phone calls and personal e-mails were made to the departments that had not responded to the previous surveys. A second survey was developed and approved by the Colorado Multiple IRB to obtain specific case information about individuals found to be abusing propofol. The chairs of anesthesia departments with a department member found to be abusing propofol were contacted by phone or e-mail and asked to complete this secondary follow-up survey (Appendix B). Initial e-mail surveys were sent out in May 2005 and all survey collection was completed by June 2006. The survey asked departments to provide information on individuals found to be abusing propofol over the last 10-yr period.

The surveys were hand-scored and data compiled. Descriptive analysis included determining proportions and percentages, as well as Fischer's exact test analysis. Incidence data were calculated as follows. We obtained the total anesthesia resident physician numbers for the last 10 yr from the American Board of Anesthesia FA 06 board book table on page 6, Table 5 (also called Attachment A) and assumed each resident's training period to be 3 yr (total = 15,686). We obtained the total number of anesthesiology attending physicians in the academic programs from the American Medical Association's FREIDA (Fellowship and Residency Electronic Interactive Database) website (total = 5179). The number of certified registered nurse anesthetists (CRNAs) was estimated by assuming approximately 20 per program, as these data were not readily obtainable from another source (total =

2520). Thus, the total number of anesthesia providers used as a denominator for calculations was 23,385. Although we have included the anesthesia technician as part of the positive results, we have not included this positive result in our calculation of incidence as the total number of anesthesia technicians was not included in the denominator. Analysis was performed using SPSS v. 14 (SPSS Inc. Chicago, IL).

RESULTS

The initial e-mail survey resulted in 67 responses; there were 8 responses (32% of total positives) which were positive for propofol abuse in this first set of responders. A second survey resulted in an additional 26 responses (total of 93 responses), which yielded an additional 13 positive responses (52% of total positives). The remaining program chairs were called or e-mailed individually to obtain their response (which yielded four additional positive responses). Of the 126 programs surveyed, 126 surveys were returned for a 100% response rate.

Our data revealed that 18% of departments (23 of 126) had one or more individuals abusing propofol in the last 10 yr and two departments had more than one incident. Seven deaths were reported, six of which were residents, with the other being an anesthesia technician. For all deaths, evidence of propofol abuse was discovered only when the individual was found dead (Table 1). In all cases, although other drugs of abuse may have contributed to death, propofol-filled syringes, empty vials, or other propofol paraphernalia were found in close proximity to the deceased. Thus, among all anesthesia-based providers found to be abusing propofol, the overall mortality rate was 28% (7 of 25). Among residents found to be abusing propofol, the mortality rate was 38% (6 of 16).

The incidence of propofol abuse among all anesthesia personnel (attendings, residents, CRNAs; total number = 23,385) was 0.10% or 10 persons per 10,000 "exposed" to propofol for 10 yr. Among attending physicians and residents ($N = 20,865$), the 10-yr incidence was also 0.10%. More residents died from propofol abuse (6 of 16) when compared with faculty (0 of 5).

From the 23 departments found to have an incident of propofol abuse or diversion, there were 18 (no. of

Table 2. Pharmacy Regulation of Propofol

	Abuse events	No abuse reported	Total
Propofol secured	3	33	36
Propofol not secured	22	68	90
Total	25	101	126

Fisher's exact test $P = 0.048$.

cases) individuals who were intervened upon (5 attendings, 10 residents, and 3 CRNAs). Of those 18 individuals, 13 elected to go to rehabilitation. Six individuals returned to anesthesia, with three relapsing (then leaving anesthesiology). Five individuals changed their specialty and 10 left medical practice. Thus, among anesthesia-trained caregivers, 12% of individuals found to be abusing propofol returned to a career in anesthesiology (Table 1). Of anesthesia physician caregivers, 14% successfully returned to anesthesia practice.

Data regarding the regulation of propofol by pharmacy personnel in the academic anesthesiology centers were evaluated. We found that 71% of institutions (90 of 126) did not regulate propofol. Among the 25 programs that had individuals who abused propofol, 3 programs had some pharmacy control of the drug at the time of abuse. Thus, most programs did not have any pharmacy regulation of propofol at the time the drug was diverted. Lack of control of propofol was significantly associated with positive diversion/abuse ($P = 0.048$) (Table 2).

In nine of the physicians found to be abusing propofol, more comprehensive case reports were compiled via departmental chairperson interviews and surveys. A summary of common features present in nine sample cases is presented in Table 3.

DISCUSSION

Our data reveal that propofol abuse has become a growing problem in anesthesiology. By comparison, a survey of controlled substance abuse in academic anesthesiology programs conducted between July 1990 and June 1997 revealed two cases of propofol abuse over that period (one resident and one attending anesthesiologist, based on 8111 residents and 3555 faculty; total = 11,666). The calculated 10-yr incidence of propofol abuse from this study was 0.02% (19). Although there has been no more recent survey of opioid abuse has occurred since 1997, the incidence of opioid abuse appears to be relatively constant over the past 30 yr at 1%–1.5% (19,20). Our data revealed 25 individuals in anesthesiology found to be abusing propofol between June 1995 and June 2005. This previous study did not examine CRNAs as we did, but this group comprised a relatively small number of the abusing individuals. Specifically, our data indicate that 5 attending anesthesiologists and 16 residents abused propofol over this period. This yielded an incidence in resident physicians and attending physicians of 0.10%, a fivefold increase from this previous study ($P = 0.005$).

Several limitations of this study make the calculated incidence uncertain. Some chairpersons surveyed may not have remembered all cases. In addition, because chairperson positions change frequently, some chairpersons may not have included cases that occurred before they arrived at an institution. Another limitation of this survey is that, to get a 100% response rate, approximately 1 yr was required to complete the survey. It is possible that there were additional propofol abuse cases in the earlier responders' institutions, and those cases would be missed. Thus, although we have made our best estimate of the incidence of propofol abuse, the true number remains uncertain.

In addition, there are also some limitations of reporting this statistically significant fivefold increase in propofol abuse. The previous study (19) was designed to consider all drugs of abuse, whereas our study aimed to discover only cases of propofol abuse, introducing a potential recall/response bias among responses by department chairpersons. Propofol is more widely available now than it had been during this previous study; however, it was still widely available during the last few years of this previous survey.

When compared with the abuse of other drugs, the incidence of propofol abuse is low. One previous 10-yr study of academic anesthesia programs from 1970 to 1980 revealed an overall 10-yr incidence of substance abuse of 1.1% (20). The aforementioned previous study from 1990 to 1996 found the incidence of all controlled substance abuse among faculty and residents to be 1.4% and 2.3%, respectively (19). Although low, the incidence of propofol abuse (0.10%) indicates a significant increase in the number of anesthesia personnel abusing the drug when compared with previous studies (19). The risk of death from propofol abuse is especially concerning for anesthesia residents, 38% of whom died when abusing propofol.

To evaluate the importance of propofol abuse in comparison with other causes of morbidity and mortality in anesthesiology, the incidence of suicide for all anesthesiologists in the 17-yr period from 1979 to 1995 was found to be 0.26%, which yields a 10-yr incidence of 0.15% (21). This number is relatively similar to the incidence of propofol abuse. One interesting finding is that the incidence of successful suicide increases with age in anesthesiology, whereas drug-related deaths in anesthesiology decrease with age. Our data would support this observation, as all of the propofol-related mortalities were in resident physicians. We do not know with certainty that propofol was used as a drug of suicide in these cases. In our follow-up interviews with department chairs, it appears that one of the deaths may have been a suicide, as this individual had had previous suicide attempts. In the other five cases, however, it appears that these deaths were not obviously suicide related, given the known history.

The attraction of propofol as a drug of abuse is not as clear as it is for other controlled substances, such as

Table 3. Summary of Case Report Data

	Abusing other drugs	Anesthesia as a second career	Psychosocial comorbidity	Previous risk taking behavior*	Pharmacy control of propofol present	Rehab	Relapse	Death	Left medicine
Case 1	X	X		X	N			X	
Case 2	X	X			N	X (with opiate use)	X (with opiate use)	X	
Case 3	X	X			N		X		X
Case 4		X	X	X	N			X	
Case 5	X				N	X (with opiate use)	X (with opiate use)		X
Case 6	X				N				X
Case 7	X	X			N	X			
Case 8			X		N			X	
Case 9			X		N			X	
Percentages	67	56	33		0	11	11	56	33

* Examples include: racecar driver, skydiver, and high-risk law enforcement.

opioids. The short half-life, narrow window of safety, and likelihood of unconsciousness rather than euphoria (or other desirable effects) make the growing abuse of this drug more difficult to understand. However, previous data have begun to indicate the potential for the abuse of this drug. Zacny et al. (8) reported that propofol has a reinforcing effect on self-administration in healthy volunteers (8). Recent research by Gold et al. (22) has confirmed the aerosolization of fentanyl and propofol (which are often used together), with the highest concentrations being found near the patient's mouth, where anesthesiologists spend many hours per day. This second-hand exposure to aerosolized propofol may lead to sensitization and an increased risk of subsequent abuse in susceptible individuals. Nonetheless, propofol abuse is still an order of magnitude less than opioid abuse.

Previous research has indicated that the greatest risk of addiction-related complications occur early in an anesthesiologist's career (21). This study reported that the highest rate of drug-related deaths in anesthesiologists occurred in the first 5 yr after medical school graduation. Our data would strongly support this, as all propofol-related deaths among physicians were in residents. These data are supported by our case reports, which are predominantly in resident physicians in their CA-1 or CA-2 yr (seven of nine case reports). It is interesting to note that no deaths were reported in individuals who underwent rehabilitation for propofol abuse, but many of these individuals left the field of medicine and were lost to follow-up.

Other hypotheses generating findings that can be drawn from the case reports were that a majority of the residents in the case reports had either switched to anesthesia from another specialty, or medicine was a second career (five of seven anesthesia resident cases). This large proportion of abusers who switched to anesthesia from another specialty may be explained by the simple possibility that the individuals made the change to obtain drugs. Five of the nine physicians reported significant stress in their personal lives around the time of the propofol use. Another interesting finding was that propofol was often the final drug

used in a pattern of controlled substance abuse often initiated with opiate abuse and then punctuated with propofol abuse after one or more relapses. This pattern may be because of the ease of obtaining propofol (not controlled or accounted for by the pharmacy in any of the case reports of abuse), short duration of debilitating symptoms, and lack of routine urine testing for this substance when compared with potentially prolonged debilitating effects of opioids and benzodiazepines. These potentially important risk factors deserve further study and follow-up by residency program directors.

Our data show 18% of the anesthesiology programs in the United States have experienced one or more cases of propofol abuse or diversion in the past 10 yr, but this percentage is likely an underestimate because of the challenges of detecting propofol abuse, as propofol is not a drug routinely tested for on urine screens. Many case reports discovered propofol abuse only after an incident such as death or when an individual is found unconscious.

Ninety programs (71%), did not have propofol secured and accounted for by the pharmacy as is done with other controlled substances (i.e., opioids). Our data indicate that there are more cases of propofol abuse at programs where there is no pharmacy control of the drug. However, whether propofol should be accounted for like other controlled substances is still a matter of debate. The incidence of propofol abuse is still at least 10-fold lower than that of other substances. Stricter pharmacy control of propofol would entail significantly increased costs and administrative oversight. One could also argue that any system instituted to account and control for propofol may result inpatient deaths from lack of drug in emergency situations, or could lead to diversion from patients who then do not get the amount of drug they need, resulting in awareness. It should also be noted that *despite* strict federal laws and local pharmacy control of opioids and benzodiazepines, these drugs still continue to be abused at much higher rates than propofol. Therefore, increased regulation may do nothing to decrease the risk of abuse.

APPENDIX A: INITIAL SURVEY QUESTIONS SENT TO ANESTHESIA DEPARTMENTAL CHAIRPERSONS

1. In the last 10 years have you had any member of your department known to be abusing or diverting propofol for personal use?
 YES NO
 2. If yes, was this person a: (if more than one please indicate number of each type of healthcare worker below)
 M.D. attending physician
 M.D. resident physician
 CRNA
 Medical Student
 Operating room nurse/technician
 - 2a. If yes, what was the outcome of this person(s)?
 Deceased of propofol abuse
 Intervened on and sent for rehabilitation
If intervened and sent for rehabilitation did they:
 Successfully return to anesthesia practice
 Return to anesthesia with relapse of use
 Change specialties
 Other outcome, please describe:
-
4. Is your propofol secured and accounted for by your pharmacy as other controlled substances (i.e. opiates)
 Yes No
 5. Please feel free to provide any other information on propofol abuse/diversion you feel is relevant from your experience.

APPENDIX B: SECONDARY SURVEY OF ANESTHESIA PROGRAMS FOUND TO HAVE INDIVIDUAL ABUSING PROPOFOL

1. What year was individual born?
 2. What year was abuse discovered or did it begin?
 3. When and how was abuse discovered?
 4. How long had individual been in the field of anesthesiology, or in worked in the OR, when abuse began or was discovered?
 5. How was propofol obtained?
 6. Does the individual have any other co-morbid psychiatric conditions?
 7. Does the individual have a family history of substance abuse?
 8. Is the individual known to have abused any other substances or drugs in their past?
 9. Were they abusing any other substances at discovery of propofol use?
 10. What dosages were used when abusing propofol? Was it always the same?
 11. How often was propofol abused? How long were the using sessions?
 12. Were there unusual amounts of stress or a single large stressful event (i.e. patient death, death in the family, divorce, marriage, etc.) prior to abuse?
- If death occurred:
1. How was the individual discovered?
 2. Was there any suspicion of drug abuse or change in behavior prior to discovery?
- If rehabilitation occurred:
1. What type of rehabilitation program did the individual attend? How long was in-patient rehab program that the individual attended? (If attended)
 2. Does the individual continue rehabilitation or drug monitoring activities?
 3. Did individual return to anesthesiology or to work in the OR?
 4. Has there been a relapse of propofol use? Relapse to other substances (alcohol, opiates etc)?

With the increasing availability and ease of obtaining propofol along with its difficulty of detection, its abuse will probably continue to grow. We believe our data indicate that anesthesia departments should consider increased pharmacy accounting of this drug. We also strongly support routine testing for propofol in drug screenings of suspected or at-risk individuals. Further research is needed to better identify the attraction of propofol as a drug of abuse, including the potential for aerosolized propofol exposure to lead abuse of this drug by anesthesia providers. Finally, improved early identification methods of propofol-abusing individuals seem vital to counteract the mortality and morbidity arising from the abuse of this drug.

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