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High-Risk Behaviors and Hospitalizations Among Gamma Hydroxybutyrate (GHB) Users

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Abstract

Introduction—Little is known about behaviors linked to gamma hydroxybutyrate (GHB) morbidity.

Methods—We surveyed 131 GHB users, using logistic regression to test the associations between the high risk behaviors and hospital treatment for GHB (26 [20%] of subjects).

Results—Increased risk of GHB hospital treatment was associated with: co-ingestion of ethanol (OR 5.2; 95% CI 1.7–16), driving under the influence of GHB (OR 3.2; 95%, CI 1.3–7.8), use of GHB to treat withdrawal symptoms (OR 2.9; 95% CI 1.1–7.9), and co-ingestion of ketamine (OR 2.7; 95% CI 1.1–6.7).

Conclusion—Targeted prevention activities could focus on selected high-risk behaviors.

Keywords

Gamma hydroxybutyrate; GHB; high-risk behaviors; hospitalization

INTRODUCTION

Gamma hydroxybutyrate (GHB) emerged as a major new drug of abuse over the past two decades (1). Despite its dramatic and rapid upswing in popularity in the 1990s, recent data suggest that GHB-related morbidity may have reached a plateau or even declined since 2000 in the USA (2) although its use appears to be on the upswing elsewhere (3). Variations in GHB overdose incidence data may be due, in part, to changing patterns of adverse outcomes that are severe enough to lead to hospital treatment. This explanation is speculative, because little is known about the determinants of GHB-associated adverse events within the population abusing this substance. For other types of substance abuse, certain key risk behaviors associated with adverse outcomes are well established, such as uncertainty in the strength or purity of the substance used, co-ingestion of multiple substances, or driving while under the influence of drugs or alcohol (4,5,6,7,8).

In this paper, we report the results from our structured GHB survey, analyzing a set of specific high risk behaviors in relation to reported hospital treatment for GHB intoxication. We also analyze the association between socio-demographic characteristics and the risk-taking behaviors of interest, since these could help direct prevention activities to targeted groups.

METHODS

Overview

We have previously described the process by which we constructed the GHB-specific survey instrument (the FORGE survey), which also addresses GHB precursors and analogues, including gamma butyrolactone (GBL) and 1,4-butanediol (BL) (9). In this paper, the term "GHB" is used to refer to this specific compound as well as the related moieties.

In this analysis, we defined hospital-based treatment (emergency department care with or without a hospital stay overnight or longer) for GHB-related complications as the indicator of GHB-related adverse outcome. We examined socio-demographic variables and developed a set of ten "high-risk behaviors," defined *a priori*, that we believed might be linked to GHB-associated hospital treatment. In studying these associations, we recognized that certain socio-demographic risk factors for adverse GHB-outcomes might work through the high-risk behaviors in question.

Survey Participation

We utilized two distinct recruiting strategies. One group of subjects was identified through California Poison Control System (CPCS) surveillance, comprised of persons sufficiently symptomatic from GHB use to result in a consultation. A second, non-CPCS group was recruited via postings on Erowid and Project GHB websites; through placement of flyers in public venues (e.g. bars, clubs, and laundromats); through physician referrals; and by "snowball sampling" via subject recruitment generated from other GHB users. Subject eligibility in this second group was confirmed through a brief screening questionnaire completed on initial subject-initiated contact. Those ≤16 years-old were excluded. Recruitment for the CPCS cohort was initiated 7/1/2003 and the non-CPCS group, 1/1/2004. Enrollment for both groups closed March 1, 2006. Volunteers provided written or verbal informed consent prior to enrollment depending on the recruitment cohort. The Committee on Human Research at UCSF approved the study.

Altogether, 146 consented subjects were contacted, 14 from the CPCS group and 132 from non-CPCS recruitment. Of the 146 subjects, 131 interviews were successfully completed (90%).

Survey Administration

We engaged an outside professional survey research firm to administer the structured telephone interviews utilizing computer-assisted telephone interview (CATI) software. Data was exported in a format compatible with a standard computer statistical analysis package (SAS 9.1).

Among 131 interviews administered, the mean administration time was 33±10 minutes. Additional details of the administration of the interviews have been previously documented (9).

Defining Sociodemographic Characteristics

We defined socio-demographic characteristics of the study subjects based on interview responses. We used a categorical approach to variable characterization, seeking where possible to divide the study group dichotomously consistent with observed distribution. The selection of certain key variables for study inclusion was informed by our earlier analysis of GHB focus-group discussions we conducted as part of the FORGE study (10). Socio-demographic information garnered from that study indicated that GHB users tend to be predominantly white, older, unmarried (living alone or in non-traditional family arrangements), relatively well-

educated, with stable employment, of middle class or high income levels, and with a substantive subset of users that identified as gay or bisexual.

Defining Risk Taking Behaviors

We defined *a priori* 10 high risk behaviors as follows: 1) driving a motor vehicle while under the influence of GHB, 2) having sex while under the influence of GHB (including those who responded "maybe" when queried as to whether this had occurred), 3) using GHB while alone, 4) co-ingestion of GHB with ecstasy (methylenedioxymethamphetamine or MDMA), 5) co-ingestion of GHB with ketamine, another common "Club Drug" 6) co-ingestion of GHB with alcohol, 7) lifetime use of GHB 20 times or more, 8) using GHB to prevent GHB-withdrawal symptoms, suggesting a state of specific GHB dependence, 9) ever using heroin, and 10) using precursors or analogues of GHB (e.g. gamma butyrolactone or 1,4-butanediol).

Driving or engaging in sexual activity while under the influence of a drug that can alter reaction time and impair judgment are inherently dangerous behaviors (11). Co-ingestion of GHB with other drugs of abuse as a high-risk behavior was determined by the findings of our GHB focus groups, described above (10). This is consistent with other data indicating that drug co-ingestion with GHB is common (12).

GHB dependence was of particular interest to us because of previous analysis of CPCS data (2). We included heroin use at any time (not necessarily together with GHB) as a traditional marker for "hard-core" drug abuse (13). Finally, in the mid-1990's, as GHB itself became more difficult to obtain, use of GHB precursors and analogues skyrocketed. Thus, variability in adverse outcomes might be linked to use of different precursors for which regular GHB users had difficulty gauging the potency of effect, consistent with other drugs of abuse such as fluctuating purity of heroin (4), MDMA (5), and street fentanyl ("China White") (14).

Data Analysis

We used logistic regression analysis to test the associations of these behaviors with reported hospital treatment for GHB intoxication. We also analyzed the associations between socio-demographic characteristics and the risk-taking behaviors leading to hospital treatment, as well as independently analyzing associations between user characteristics and hospital treatment.

RESULTS

Among the 131 survey participants, 26 (20%) reported GHB-related hospital treatment on at least one occasion. Of the participants recruited through CPCS, four of 11 were hospitalized for GHB-related complications. Three of the four patients were admitted after an acute overdose, of whom two were admitted for one day and one for 3 days. The remaining patient was admitted for 5 days for GHB-withdrawal symptoms with an additional 28 days in an inpatient detoxification center.

Demographic and related characteristics of the 131 GHB survey participants are summarized in Table 1. As shown in Table 1, none of the ten demographic factors we analyzed was associated with a statistically significant increased likelihood of ever having hospital-based treatment for GHB. The prevalence of each behavior and its associated risk for GHB-related hospital treatment are presented in Table 2. Of the ten high risk behaviors, four were associated with significantly increased odds for such events: co-ingestion of GHB with ethanol (OR 5.2; 95% CI 1.7–16.1), driving under the influence of GHB (OR 3.2; 95% CI 1.3–7.8), the use of GHB to treat withdrawal symptoms (OR 2.9; 95% CI 1.1–7.9), and co-ingestion of GHB with ketamine (OR 2.7; 95% CI 1.1–6.7). In addition, lifetime use of GHB of more than 20 times

was associated with more than double the odds of hospital treatment, although this estimate did not exclude the "no effect" level (95% CI 0.9–5.3).

Table 3 summarizes the association between subject characteristics and the high risk behaviors of study interest. Having sex while under the influence of GHB and co-ingestion of ecstasy with GHB were each associated with four demographic factors. The only demographic factor statistically associated with multiple high risk behaviors was male gender (sex under the influence, driving under the influence, and use of a GHB analogue or precursor). We assessed whether multiple high risk behaviors manifested a cumulative effect on the risk of hospital treatment for GHB. We based cumulative risk on the six high risk behaviors with the highest point estimates of risk shown in Table 2 (OR's ranging from 1.8 to 5.2). There were 26 of 131 (17.6%) subjects who reported none of these six high risk behaviors (all subjects reported at least one of the complete set of 10 high risk factors). Compared to participants who did not engage in any of these six high risk behaviors, those reporting 3 to 6 behaviors (45; 34%) had more than a ten-fold increased odds of hospital treatment for GHB (OR 12.5; 95% CI 1.5–101). Those reporting only one or two such high risk activities (60; 46%) manifest an intermediate point estimate of risk that was not statistically significant (OR 5.0; 95% CI 0.6–41). We retested the model of cumulative risky behaviors adding age, sexual orientation and BMI. None of the additional variables was significantly associated with the odds of hospitalization in this model, and the estimated association with cumulative risk behaviors was not substantively impacted.

DISCUSSION

Although the reported incidence of GHB abuse in the U.S. has declined recently (2), illicit substance abuse fluctuates over time, as with, for example, LSD, ecstasy, and marijuana (15). It is very possible that GHB abuse will increase again. Recent reports from Sweden identify an upswing in GHB abuse there (3,16).

The only demographic factor associated with multiple risk-taking behaviors was male gender, consistent with other studies (17). Selected public education efforts for GHB risk-reduction might best be targeted to males, especially for driving under the influence of GHB.

Four risk-taking behaviors in our analysis were associated with GHB-related hospital treatment. One of these behaviors, co-ingestion of GHB and ethanol, has been reported by others to cause serious medical complications (2,18,19). High GHB concentrations and marked physical effects have been reported for those found driving under the influence of GHB (20). Nearly 30% of our participants admitted driving under the influence of GHB; this group was more than three times as likely to require hospital treatment. GHB is physically addicting, with serious adverse effects associated with withdrawal (21). Treatment of GHB withdrawal can require multi-day hospital admission (2). Consistent with this, study participants who used GHB to treat withdrawal symptoms were almost three times as likely to have had hospital treatment, and higher lifetime use of GHB was associated with more than double the odds of hospital treatment.

It is a general belief among GHB users that GHB should not be used when alone, but rather only when in the presence of a trusted friend because of the drug's health dangers (10). We found that use of GHB while alone was associated with almost double the risk of hospital treatment.

In addition to these individual risk factors, we also found that engaging in multiple high risk behaviors carried a cumulative effect on the risk of hospital treatment for GHB. Those reporting 3 to 6 risky behaviors had more than a ten-fold increased odds of hospital treatment for GHB as compared to participants who did not engage in any of these high risk behaviors.

There are limitations to this study. Recruitment of subjects was comprised of two cohorts: subjects identified through CPCS surveillance and those recruited from the general public. Inclusion of subjects from the general public was dependent on self-reported GHB use, rather than laboratory confirmation. Also, this study was comprised of a convenience sample of subjects who voluntarily consented to participation and does not necessarily reflect the experience of all GHB users.

Despite such potential limitations, our survey sheds light on specific behaviors that are strongly associated with adverse GHB outcomes. In particular, neither co-ingestion of GHB with ethanol nor driving under the influence of GHB has been widely appreciated as the potent risk factors for adverse outcome that they appear to be. Prevention activities should consider these and other risk-taking behaviors in focused efforts to reduce GHB-related morbidity.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Characteristics among 131 Interviewed Subjects and associated risk of hospital treatment for GHB

Demographic	N (%)	Hospital Treatment Risk OR (95% CI)
Gender		
Male	92 (70.2)	0.9 (0.4 – 2.4)
Female	39 (29.8)	
Age		
< 30 years	73 (55.7)	0.6 (0.3 – 1.5)
> 30 years	58 (44.3)	
Race		
White Non-Hispanic	94 (71.8)	0.9 (0.3 – 2.2)
All Others	37 (28.2)	
Education		
Some College or Less	76 (58.0)	1.2 (0.5 – 2.9)
College Graduate	55 (42.0)	
Employment Status		
Not Currently Employed	44 (33.6)	1.5 (0.6 – 3.8)
Employed Part-Time of Full-Time	87 (66.4)	
Annual Personal Income		
< $20K	49 (37.4)	0.5 (0.2 – 1.3)
> $20K	78 (59.5)	
Unknown/Refused	4 (3.1)	
Household Size		
3 or more persons	47 (35.9)	0.9 (0.4 – 2.3)
1 or 2 persons	84 (64.1)	
Sexual Orientation		
Gay, Bisexual, or Transgender	35 (26.7)	0.6 (0.2 – 1.7)
All Others	96 (73.3)	
Body Mass Index (BMI)		
Overweight/Obese (BMI = 25)	38 (29.0)	2.1 (0.9 – 5.2)
Normal Bodyweight (BMI < 25)	93 (71.0)	
Cigarette Smoking Status		
Current Cigarette Smoker	61 (46.6)	1.2 (0.5 –2.8)
Ex-Smoker or Never Smoker	70 (53.4)	

Table 2

Prevalence of risk-taking behaviors reported among 131 interviewed subjects and associated risk of hospital treatment for GHB

Risk Factor	N (%)	Hospital Treatment Risk OR (95% CI)
Engaging in Sex under the Influence of GHB	84 (64.1)	0.9 (0.4 – 2.1)
Co-Ingestion of Selected Agents with GHB		
Ethanol	76 (58.0)	5.2 (1.7 – 16.1)
Ecstasy (*Methylene Doxymethamphetamine*)	51 (38.9)	1.5 (0.6 – 3.5)
Ketamine	30 (22.9)	2.7 (1.1 – 6.7)
Lifetime Use of GHB > 20 times	55 (42.0)	2.2 (0.9 – 5.3)
Use of GHB while Alone	50 (38.2)	1.8 (0.8 – 4.4)
Driving under the Influence of GHB	38 (29.0)	3.2 (1.3 – 7.8)
Use of a GHB Precursor or Analog	36 (27.5)	1.5 (0.6 – 3.8)
Use of Heroin, Ever	29 (22.1)	0.4 (0.1 – 1.4)
Use of GHB to Treat Withdrawal Symptoms	22 (16.8)	2.9 (1.1 – 7.9)

Table 3

Subject characteristics associated with risk-taking behaviors

High Risk Behavior	Subject Demographic Characteristics Associated with Behaviors	OR (95% CI)
Sex Under the Influence of GHB	Male Gender	4.1 (1.9 – 9.0)
	Age < 30 Years	0.4 (0.2 – 0.9)
	Gay, Bisexual or Transgender	4.7 (1.7 – 13.1)
	Large Household Size (3 or more Persons)	0.4 (0.2 – 0.9)
Co-Ingestion of Ecstasy and GHB	Male Gender	2.3 (1.0–5.3)
	Currently Employed	3.0 (1.3 – 6.9)
	Large Household Size (3 or more Persons)	2.5 (1.2–5.3)
	Current Smoker	2.6 (1.3 – 5.3)
Use of GHB while Alone	Gay, Bisexual or Transgender	0.2 (0.1 – 0.6)
Driving under the Influence of GHB	Male Gender	3.0 (1.1 – 7.7)
Use of GHB Analogue/Precursor	Male Gender	6.7 (2.0 – 23.5)
Ever using Heroin	Annual Income < $20,000	3.0 (1.2 – 7.1)

None of the subject characteristics was significantly associated with co-ingestion of ethanol or ketamine with GHB, with lifetime use of GHB > 20 times, or with use of GHB to treat withdrawal symptoms. Race, education, and BMI were not statistically associated with any high risk behavior.