Effect of alcohol on surgical dexterity after a night of moderate alcohol intake

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Abstract

BACKGROUND: Alcohol misuse is commonplace among health professionals. The effects of alcohol on cognition and dexterity have been shown up to 14 hours after alcohol intake. The aerospace industry has restrictions on alcohol intake, and there is pressure for the health care industry to do the same. Few studies have addressed the lingering impact alcohol has on surgical performance, and none have measured surgical dexterity using well-established Fundamentals of Laparoscopic Surgery benchmarks.

METHODS: Twenty-seven surgeons participated in this study: 11 attending surgeons, 2 fellows, and 14 resident surgeons. Three Fundamentals of Laparoscopic Surgery tasks measured surgical dexterity: peg transfer, pattern cutting, and intracorporeal suturing. Performance on these tasks was measured before alcohol intake and the morning after a night of social drinking. Alcohol levels were measured via breathalyzer 20 minutes after completion of drinking and the following morning before testing. Time and accuracy were compared.

RESULTS: The mean blood alcohol level was .076 mg/100 mL blood. Times for peg transfer, pattern cutting, and intracorporeal suturing showed no differences. Accuracy in pattern cutting was not different, but accuracy for intracorporeal suturing was significantly worse the morning after alcohol intake.

CONCLUSIONS: The morning after moderate alcohol intake, the time to complete Fundamentals of Laparoscopic Surgery tasks was unchanged, but accuracy was worse.

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The effects of acute alcohol intoxication have been thoroughly documented. Alcohol has been shown to impair cognition, dexterity, and performance even when blood alcohol levels are at or below the legal limit for driving.1 Equally well documented is the “hangover effect”: the effects of alcohol the morning after a night of moderate or excessive alcohol intake. There is no consensus definition for what constitutes veisalgia (alcohol hangover), a term derived from the Norwegian kveis, “uneasiness following debauchery,” and the Greek root algia, “pain.”2 The physiologic and cognitive hangover effects of alcohol have been well documented and shown to decrease memory, psychomotor vigilance, and fine motor dexterity.1–5

The flight industry has studied the after effects of alcohol extensively, leading to the implementation of regulations. As a result, in the United States, Federal Aviation Administration regulations state that no pilot may fly a civilian aircraft within 8 hours after the consumption of any alcoholic beverage (also known as the “bottle-to-throttle” rule).6 The United Kingdom’s civil aviation authority advises pilots to abstain from alcohol for ≥24 hours before flying.7 A study performed by Yesavage...
and Leirer demonstrated attention deficits during hangover in pilots undergoing simulated flight. Those investigators also demonstrated a reduction in the ability to perform non-routine acts and suggested there could be potentially fatal interactions between hangover effects and task difficulty when an emergency or nonroutine situation arises.

The objective of this study was to determine whether there was a change in fine motor skills as measured by Fundamentals of Laparoscopic Surgery (FLS) tasks the morning after a night of moderate alcohol intake. Our hypothesis was that there would be a change in fine motor dexterity reflected by decreases in speed and accuracy the following morning.

FLS is a joint educational program sponsored by the American College of Surgeons and the Society of American Gastrointestinal and Endoscopic Surgeons. It involves hands on training with a laparoscopic simulator. The FLS curriculum and testing provide an objective measure of manual dexterity in surgical trainees. Multiple studies have assessed the accuracy of FLS tasks in measuring technical skills and hand-eye coordination in basic laparoscopic maneuvers. They have also shown that these simulated skills translate to operating room skill and proficiency.

Methods

The study design, methods, and procedures were approved by the institutional review board at the University of North Dakota.

Subjects

Twenty-seven surgeons at various levels of training volunteered to participate. There were 11 attending surgeons, 2 fellows, and 14 resident surgeons. The mean age was 39.6 ± 11.7 years. All participants were certified in FLS and had had prior real-life laparoscopic surgical experience.

Experimental design

Three FLS tasks were used to measure surgical dexterity and speed: peg transfer, pattern cutting, and intracorporeal suturing. Task completion was measured in accordance with FLS guidelines. All 3 tasks were timed. Pattern cutting and intracorporeal suturing were also measured for accuracy. Any pattern cut outside of the confines of the black lines was deemed inaccurate (Fig. 1). Intracorporeal suturing in which the needle did not pass through the black dot was deemed inaccurate. The knot on the intracorporeal suture had to be tied 3 times in square-knot fashion and subsequently cut. Once the task was completed, the knot was tested to ensure that it held. If it did not hold, the task was deemed inaccurate (Fig. 2).

Baseline measurement of task completion was first assessed when the participants had no prior alcohol intake. The participants then attended a social function among colleagues and friends and were allowed to drink alcohol until they chose to stop. No particular amount of alcohol intake was encouraged, nor were the participants encouraged to drink until they felt intoxicated. Estimated blood alcohol levels were measured via breathalyzer 20 minutes after participants had ceased alcohol intake. The participants were then instructed to get a good night’s sleep (8 to 10 hours). Their skills were reassessed with the same tasks the following morning. The time interval between alcohol intake and testing was 8 to 12 hours. Participants were screened via breathalyzer for any residual alcohol.

Questionnaire

Participants filled out a questionnaire immediately after both episodes of task completion. Questions asked evaluated the length and subjective quality of sleep. Participants also revealed their average weekly alcohol consumption. Participants were asked to subjectively grade their performance on the tasks they had just completed. Last, they were asked if they would operate at that time on the basis of how they felt.

Estimation of blood alcohol concentration (BAC)

A calibrated Alcoscan AL7000 Alcometer (AK Solutions USA, Palisades Park, NJ) was used to estimate BAC.
(milligrams of alcohol per liter of breath) from which, assuming a blood/breath ratio of 2,300:1, an estimate of BAC (mg alcohol/100 mL blood ± 6.6%) was derived.13

Statistical analysis

Analysis of the data was performed using SPSS version 18 (SPSS, Inc, Chicago, IL). P values < .05 were considered statistically significant. Wilcoxon’s signed-rank test was used to determine differences in time between tasks. McNemar’s test was used to look for differences in accuracy on pattern cutting and intracorporeal suturing. Spearman’s correlation analysis was used to examine correlations between estimated BAC and time differences on tasks.

Results

The estimated BAC the night of alcohol intake ranged from .025 to .172 mg/100 mL blood (median, .052 mg/100 mL blood; standard deviation, .046 mg/100 mL blood). All participants had BACs of zero the following morning.

There were no statistically significant differences found in time completion for the tasks. Mean peg transfer time the morning after alcohol consumption was 98.93 seconds, compared with 96.78 seconds at baseline (P = .51). Mean pattern cutting time the morning after alcohol consumption was 120.7 seconds, compared with 129.19 seconds at baseline (r = -.24, P = .083). Mean intracorporeal suturing time the morning after alcohol consumption was 232.7 seconds, compared with 226.6 seconds at baseline (P = .40).

No statistically significant difference was found in pattern cutting accuracy (odds ratio, 6; 2-tailed P = .13). There was, however, a statistically significant difference found on intracorporeal suturing: study participants were less accurate on this task the morning after alcohol intake (estimated odds ratio, 15; P = .016; Fig. 3).

We examined correlations using Spearman’s correlation analysis. There was no correlation between BAC and the time it took to complete the peg transfer task (n = 27, r = .13, 2-tailed P = .50). There was no correlation between BAC and the time it took to complete the pattern cutting task (n = 27, r = -.001, 2-tailed P = .998). There was no correlation between BAC and the time it took to complete the intracorporeal suturing task (n = 27, r = .013, 2-tailed P = .95).

Survey results

Survey participants revealed that they drank a mean of 3.71 ± 2.95 standard servings of alcohol per week (12 oz beer, 5 oz wine, 1.5 oz hard liquor). They slept a mean of 6.56 ± 1.38 hours before baseline testing, compared with 5.96 ± 1.29 hours before testing the morning after alcohol intake. The quality of sleep before baseline measurement was described as poor in 12% of participants, good in 57% of participants, and excellent in 31% of participants. In contrast, the quality of sleep after alcohol intake was described as poor in 28% of participants, good in 50% of participants, and excellent 22% of participants. In summary, 90% reported good or excellent sleep before alcohol intake compared with 72% after alcohol intake. When asked if they would operate the morning after alcohol consumption, on the basis of how they felt, 100% of participants answered “yes.”

Figure 2 Accurate vs inaccurate intracorporeal suturing.
Comments

Surgery is known to be a demanding, high-stress field. Laparoscopic surgery in particular has many psychomotor challenges and places a high level of demand on cognitive, perceptual, and visual-spatial abilities. Research on the effects of alcohol intoxication (hangover) is limited, and data on known effects in the setting of manual dexterity and surgical skills are even more scarce. This is the largest prospective study done to date with experienced laparoscopic surgeons as subjects.

In medicine, there is no professional regulation on the use of alcohol before performing clinical activity, as long as there is no evidence of intoxication while performing those clinical duties. The effects of both acute alcohol intoxication and postintoxication effects in surgery have not been thoroughly studied. In 2002 Dorafshar et al. demonstrated significant impairment in simulated surgical performance during acute alcohol intoxication but no change 10 hours after a moderate dose of alcohol (1.05 mg/kg). This study was performed on 2 groups of 14 medical students each. Kocher et al. studied 6 surgeons and found some impairment in surgical performance the morning after a night of alcohol intake. There was an increase in the time needed to complete simulated surgical tasks. Most recently, Gallagher et al. found that excessive consumption of alcohol appeared to degrade surgical performance the following day. The study subjects consisted of 16 students, 6 experienced laparoscopic surgeons, and 2 experienced simulator users.

In this study, we evaluated 2 parameters of performance in a commonly used simulated surgical environment, time to completion and accuracy, after the intake of a moderate amount of alcohol the night before. The morning after a night of alcohol intake, there was a trend toward faster completion of laparoscopic tasks assessed, but this trend was not statistically significant. In the evaluation of accuracy, 2 of the 3 tasks did not show any significant change. Intracorporeal suturing, arguably the task that requires the most psychomotor coordination and concentration, did have a statistically significant finding. Participants were less likely to complete this task accurately the morning after alcohol intake.

Alcohol-induced sleep has been shown to be of shorter duration and poorer quality compared with normal sleep. It can disrupt the normal sleep pattern and decrease the time spent in rapid-eye-movement sleep, resulting in a less restful night. It is possible that sleep quality and pattern is a confounding variable for this study: these alterations in sleep may affect performance on tasks the morning after alcohol intake.

Does performance on these tasks correlate with performance in the operating room? If so, this study demonstrates that alcohol intake may not significantly alter the time needed to complete certain tasks. It may, however, have implications for accuracy when completing complex operating room tasks.

There are no rules or guidelines for surgeons involving alcohol consumption the night before operating. Studies have suggested but so far have provided no conclusive evidence that operative skills are decreased or patient outcomes affected when a surgeon had been drinking the night prior.

This study demonstrated that alcohol intake did not significantly change the time to complete certain FLS tasks, but it did affect the accuracy with which these tasks were completed.

This study improves on the existing literature for this topic. We used validated instruments to objectively measure both intoxication (breathalyzer) and performance (FLS skills). Although this study did have statistically significant findings, study results were relatively modest. These modest findings could explain why surgeons stated that they felt well enough to operate. This study also reiterates the unclear effects and manifestations mild hangovers have on performance. It remains unknown whether the decrease in accuracy seen in this study translates to a decrease in operating room manual dexterity and (most important) patient outcomes.

Conclusions

The aftereffects of alcohol were examined in 27 experienced laparoscopic surgeons at varying levels of training. Results revealed a decrease in accuracy of task completion on 1 task the morning after alcohol intake. Additional studies are needed to further investigate the effects on patient outcomes and real-life surgical dexterity.

References

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Discussion

Sean Langenfeld, M.D. (Omaha, NE): I want to congratulate Dr Van Dyken and colleagues on an excellent presentation addressing a topic of great social and professional relevance. Instead of focusing on excessive alcohol intake combined with sleep deprivation, which is sort of a statistical layup at this point, they focus on a more common scenario: moderate alcohol followed by a full night of sleep. In addition, they improve on the soft data from previous studies by using Fundamentals of Laparoscopic Surgery and a calibrated Department of Transportation approved breathalyzer, both of which are validated instruments, to obtain objective proof of intoxication and an objective proof of performance. Based on the survey results, they determined that moderate alcohol intake caused a subjective decrease in the quality of sleep. In addition, they concluded that moderate alcohol intake followed by a full night of sleep has no effect on time to complete tasks, but has a deleterious effect on accuracy.

I have 3 specific questions: (1) As you mentioned in your talk, if alcohol is known to decrease the quality of sleep, which is supported by your survey, couldn’t one just as easily conclude that instead of alcohol, it was simply lack of good sleep that led to decreases in accuracy and task completion? (2) I know that all participants were FLS certified, but are you aware of the frequency and timeline of practice on the FLS tasks prior to this experiment? The reason I bring it up is that if a great deal of time had passed since the participants last played with the FLS simulator, could the baseline measurements done the night before on FLS speed and accuracy have actually served as a practice period? This may have led to an artificial improvement in performance post intoxication. (3) The third question, which probably is the most important one: all participants are grouped together to calculate a mean for intoxication, sleep, and task performance, but they represent a relatively heterogeneous group of people. They have different levels of experience and different amounts of baseline alcohol consumption with a standard deviation that reached almost 3. More importantly, the range of estimated blood alcohol content was quite large, from 0.25 up to .172. Based on your graph, 9 subjects were above the legal limit to drive, while 18 were not. Can all this be classified as moderate consumption? With such a large variation in alcohol intake and subsequent intoxication, should these performances truly be lumped together, or perhaps studied separately?

Once again, congratulations on a very intriguing study, very nice presentation, nice PowerPoint, and thank you Southwestern Surgical Congress for the opportunity to review and discuss this presentation.

Irminne Van Dyken, M.D. (Grand Forks, ND): Thank you Dr Langenfeld. Your first question about sleep—I absolutely agree that alcohol can result in decreased quality of sleep. In my opinion, you cannot separate the quality of your sleep from alcohol intake. When you drink alcohol, your sleep is going to be changed. You have decreased REM sleep which is the restorative sleep and there definitely will be an effect. I don’t think there is a study where you would be able to control for that. For your second question, as far as prior practice in FLS tasks, I agree as well. My participants, I did give them a chance to try to get warmed up and hopefully redevelop their skills prior to the actual timing of the tasks. When they felt that they were ready, that is when we started our timing. For the third question regarding moderate consumption, I agree. We did have blood alcohol levels all over the board. To be more thorough in the future I think more studies are needed to study maybe heavy alcohol intake or above the legal limit and compare that to what you consider moderate. Moderate is a very subjective term.

Sharmila Dissanaike, M.D. (Lubbock, TX): Wonderful study; congratulations. Two questions: when you did your statistical analysis, did you look at each individual before and after alcohol as a pair and look at the difference between the 2 or did you just look at mean times for the entire group? Because I would propose that the former will be a much more accurate way of truly determining intraindividual variability I think. Number 2: we know from studies on sleep deprivation that what usually gets impaired is not so much our technical skills but our judgment and cognitive skills. So I suspect that alcohol may have a similar effect as envisioned by 100% of us thinking we are just fine even if the data shows otherwise. So, do you have any plans to look at the cognitive component of a hangover? Great study, again.

Dr Van Dyken: Thank you. As far as the variability, that’s a great question. We did look at the individuals and their difference in times and accuracy. In talking with the statisticians, we did come to the conclusion that a larger sample size would give us better results and a better trend. For your second question about the judgment, again I agree, it would be nice to somehow separate the cognitive component, but that is difficult to do. I’m sure it could be done.
One observational thing that I did notice is that it seemed that the morning after when people were completing their tasks, they had an attitude—I just want to get it done with—maybe that had to do with the accuracy component as well.

Richard Frazee, M.D. (Temple, TX): Dr Van Dyken, it was an excellent study. I must admit I’ve been eager to hear this result for a year. As a study participant a year ago, I was curious if you had any correlation between the peak level of alcohol and performance. There was such a wide variation and I know you’ve looked at averages. But is it that the people who overimbibed that drew down the results for the group.

Dr Van Dyken: We did. We took a look to see if there was a correlation between blood alcohol level and tasks and there was none.

Shanu Kothari, M.D. (La Crosse, WI): One final question. What is your personal thoughts? Do you think a night of alcohol intake impacts performance more than a poor night of sleep? In other words, do you think poor sleep affects surgeons’ performance more than the alcohol?

Dr Van Dyken: I think I have to say I am a member of the younger generation and I do subscribe to the theory that lack of sleep is to me the equivalent of either a night of alcohol intake prior or having a drink and coming to operate.