

# Drunk Without Drinking: A Case of Auto-Brewery Syndrome

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## ABSTRACT

Information on auto-brewery syndrome is limited in the medical literature. This rare syndrome occurs when yeast overgrowth leads to ethanol fermentation in the gut. We present a patient presenting with symptoms of alcohol intoxication with objective laboratory data of elevated blood ethanol levels without a history of alcohol consumption. We reviewed the literature and have discussed the current diagnostic and therapeutic options.

## INTRODUCTION

There is limited information in the medical literature on auto-brewery syndrome, also known as gut-fermentation syndrome.<sup>1</sup> This rare syndrome occurs because of yeast overgrowth in the gut, leading to fermentation of ethanol, thereby causing symptoms similar to alcohol intoxication without ingestion of alcohol.<sup>1</sup> We present a patient with auto-brewery syndrome and review the available literature, including published case reports on the syndrome.

## CASE REPORT

A 25-year-old white man, with no medical history or previous surgeries, presented with a chief complaint of “drunk without drinking.” Two months ago, the patient noticed that he would feel very drunk after drinking his usual one or two 12-ounce beers in the evenings. This progressed to feeling drunk even when fully abstaining from alcohol. He continued to feel this way 1–2 times per week until his wife decided to bring him to the emergency department (ED) during one of his “attacks.” His wife described his symptoms as slurred speech, fatigue, stumbling, dizziness, and nausea. He would eventually “pass out” and wake up in the morning with no further symptoms. His symptoms were somewhat acute and often occur in the evenings, but without any identifiable trigger. On further review, he had recently started a ketosis diet for weight loss. He did not take any over-the-counter or prescription medications. His physical examination was unremarkable with normal vital signs. Although symptomatic during a previous visit to the ED, he had a full workup including a urine drug screen, basic metabolic panel, liver function tests, complete blood count, and thyroid studies, all of which were unremarkable. He did, however, have an elevated lactic acid level of 20 mg/dL and a blood alcohol concentration of 0.3 g/dL (also elevated on a subsequent ED visit) in the absence of alcohol consumption. His symptoms improved, and he was sent home with no further treatment.

In the outpatient setting, he saw a gastroenterologist and an endocrinologist, who conducted a celiac disease workup, basic stool studies with culture, thyroid, and hypoglycemia workup, all of which were unrevealing. His wife opted to buy a breathalyzer and found that in the absence of alcohol consumption and while asymptomatic, he would score from 0.04% to 0.07%. His wife served as a control and scored 0% during these occasions. Each time the patient had symptoms, he would test at an elevated alcohol concentration, often in the 0.2% range. Based on the above workup, other etiologies were ruled out and a working diagnosis of auto-

brewery syndrome was made. Subsequently, the patient was given an empiric trial of oral fluconazole 100 mg daily for 3 weeks to treat this presumed syndrome, in addition to continuing his normal diet. On completion of his therapy, the patient reported his symptoms completely resolved, with no further episodes on follow-up 4 weeks later.

## DISCUSSION

Data are limited on auto-brewery syndrome, also known as gut fermentation syndrome.<sup>1</sup> Xiaodi et al allude to approximately 58 described cases with a large proportion being from Japan.<sup>1</sup> There are no clear identifiable risk factors; however, Kaji et al noticed an association with previous abdominal surgeries and structural or functional disturbances, such as a dilated duodenum that can cause stagnant contents, possibly giving a favorable site for abnormal proliferation of the causative organism.<sup>2</sup> One case reported a possible risk factor of antibiotic use, as well as a reported coinfection with *Helicobacter pylori*.<sup>3,4</sup> Probiotics may also alter normal bowel flora, and although the role in this syndrome is unclear, it has been reported to predispose to *Saccharomyces* fungemia.<sup>5,6</sup> There was no discussion of ethanol fermentation in these patients; however, it is possible that probiotics could predispose patients to *Saccharomyces* proliferation. Many case reports were able to identify a causative pathogen, often by gastric aspirations, duodenal fluid, or fecal cultures.<sup>1</sup> Kaji et al identified that the most common organisms involved in “auto-brewery syndrome” were *Candida spp.* and *Saccharomyces*.<sup>2</sup>

*Candida* species, as well as other fungi, are part of the normal gut flora.<sup>7</sup> Bivin and Heinen studied 5 infant food formulas with 4 common yeasts, including *Candida* and *Saccharomyces*. Their study found that all species produced ethanol in vitro, the highest of which was by *Saccharomyces* organisms.<sup>7</sup> Furthermore, one study performed in United Arab Emirates looked at 1,563 random subjects of different nationalities, ages, and sexes. They found that, in this population, the mean endogenous ethanol level was 0.113 mg/dL.<sup>8</sup> Although this was considered clinically insignificant, it suggested that at some basal level, these individuals may be fungal colonizers that produce minute amounts of ethanol.<sup>8</sup> Currently, gas chromatography is the gold standard to identify the presence of alcohol in the bloodstream, but serum measurements can serve as a reliable and more convenient measure of blood levels during an acute episode.<sup>2</sup> Breathalyzers have also been shown to be reliable in estimating blood alcohol levels.<sup>9</sup> In addition, the above patient also had an elevated lactic acid level, which may be related to ethanol metabolism.<sup>10</sup>

Although we cannot fully rule out malingering or occult drinking in this patient, we believe that the therapeutic trial demonstrating alleviation of symptoms after fluconazole provides the strongest supportive evidence for the correct diagnosis of this syndrome. Various diagnostic modalities have been proposed. Kaji et al reported 2 patients with suspected auto-brewery syndrome that

had stomach fluids, duodenal fluids, and fecal samples cultured on Sabouroud glucose agar and found *Candida albicans* and *Candida krusei*.<sup>2</sup> The main benefit of culture is to identify the sensitivities of the organism to antifungals. The current antifungal of choice is not known, particularly for *Saccharomyces*.<sup>11</sup> Some of these cases also had resolution with surgical intervention, such as gastrectomy.<sup>2</sup> Another suspected case responded to a course of fluconazole without recurrence.<sup>3</sup> Dosing and duration of therapy in the aforementioned case studies are variable, for example, Cordell and McCarthy reported resolution after a 3-week course of oral fluconazole 100 mg daily, followed by a 45-day course of nystatin taken 4 times daily.<sup>4</sup>

An elevated blood alcohol concentration in conjunction with symptoms consistent with intoxication and no ingestion of alcohol are grounds for suspicion of auto-brewery syndrome. It is necessary to rule out surreptitious ingestion of alcohol and laboratory error, and therefore, a good social history and repeat laboratory measurements during acute episodes are warranted. Approved breathalyzers, as used by this patient, may also assist with home detection during acute attacks and be supportive in the diagnosis. Interestingly, this difficult-to-diagnose syndrome has been used as a defense challenge against drunk driving cases.<sup>12</sup> Fungal stool cultures may provide a useful diagnostic study for growth and sensitivities, especially if the patient does not respond to initial therapy.

Clear risk factors were not identified in this patient. Previous cases suggested a high carbohydrate diet, whereas this patient had recently changed to a ketosis diet.<sup>2,3</sup> One speculation could be that sugar substitutes were used and could provide a means for fermentation. This, in combination with an undiagnosed alcohol hydrogenase deficiency, could have been predisposing in this patient. Ultimately, this patient had complete resolution of symptoms with a 3-week course of oral fluconazole 100 mg daily and a regular diet. Further studies and case reports are needed to fully characterize this interesting syndrome.

## DISCLOSURES

Author contributions: All authors contributed equally in the creation of this manuscript. BJ Akhavan is the article guarantor.

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Informed consent was obtained for this case report.

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