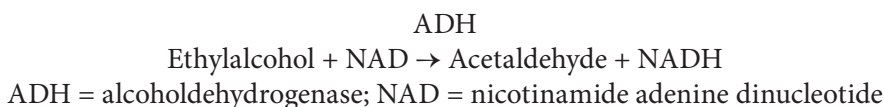

False-Positive Blood Alcohol

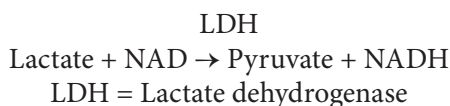
14

This chapter deals with several cases of false-positive blood alcohol levels. This can be due to analytical errors, interference from medication that the defendant was taking, or in the case of autopsy, the chest cavity may be contaminated by unabsorbed alcohol present in the stomach.

The enzymatic method of serum ethanol determination with alcohol dehydrogenase and NAD gave false-positive serum ethanol levels. The reason for this anomalous result of alcohol determination is given in detail in Chapter 3. To recap the principle of enzymatic alcohol determination, it can be seen that the automated analyzers utilize the following reaction:



However, it became evident that the following reaction interferes and generates falsely elevated serum alcohol levels.



These enzymatic methods are rapid, quick, and cheaper. Again, as stated in Chapter 3, determination of alcohol by GC is the gold standard. Forensic laboratories and police toxicology laboratories use GC for ethanol determinations. In cases of automobile accidents involving severe trauma, both lactate and LDH increase and the elevated lactate does not clear rapidly (1,3-5). For this reason, a toxicologist needs to ascertain the method by which serum alcohol levels are measured.

False-positives can happen due to interference from a drug that competes with alcohol during metabolism by the liver.

False-positives may also occur during autopsy. In this case, the chest cavity blood may be contaminated with alcohol present in the stomach. In this case, the blood needs to be obtained from an alternative site and alcohol levels need to be checked in vitreous fluid (6).

14.1 Presumptive DUI, Two-Car Collision, Doctor's Death

14.1.1 Legal Aspects: Wrongful Death

This case is about a doctor's widow who brought a civil suit against the state of Arizona. The widow sought monetary compensation for the death of her husband who she believes died because of the state's negligence in failing to repair a state highway. She alleged that a Jeep driven by a teenager, Ricardo, with two other teenage passengers, lost control, entered the opposite lane, and collided head-on with the car driven by her husband. This accident happened on the state highway AR 83 at 7:45 p.m. On the other hand, the state of Arizona contends that Ricardo lost control of the Jeep he was driving because he was intoxicated.

14.1.2 Medical Aspects

The teenage driver of the Jeep survived but suffered multiple fractures and traumas. He was transferred to Jefferson Medical Center by helicopter at approximately 8:50 p.m. The emergency room obtained his blood at 9:46 p.m. and sent it to the laboratory for toxicology analysis. The laboratory reported serum alcohol level of 162 mg/dL or 0.162%.

14.1.3 Factual Background

The doctor was driving his car home after work northbound on AR 83. At the same time, a Jeep driven by a teenager and two other teenage passengers was coming in the opposite direction, lost control, entered the opposite lane, and collided head-on with the oncoming car. The teenage driver of the Jeep, Ricardo, survived but suffered multiple fractures and traumas. Two other teenage passengers in the Jeep and the doctor driving in the other car died at the accident scene.

Ricardo is a Caucasian male, 15 years of age, and weighing 115 pounds on the day of the accident. He was transferred to Jefferson Medical Center by a helicopter at approximately 8:50 p.m. He was admitted to the emergency room with multiple fractures, head injury, shock, and coma. The patient underwent surgical procedures and was discharged after three weeks.

Since the patient was hypotensive, he received a total of 3 L of Lactated Ringer's solution en route to the hospital. A few minutes after completion of the infusion of Lactated Ringer's solution, the emergency room obtained his blood at 9:46 p.m. and sent it to the laboratory for alcohol determination. The laboratory analysis reveals several-fold elevations of liver enzymes including LDH in serum. This is not surprising due to the shock and multiple traumas the defendant experienced. The serum LDH levels were significantly elevated. The laboratory determined no lactate levels. The laboratory used

Abbot TDx methodology for alcohol determination in serum. This method utilizes ADH enzyme. The laboratory reported serum alcohol levels of 162 mg/dL or 0.162%.

Ricardo knew that he and his friends could not legally drink as they were below the legal age to drink. They obtained beer and went to a river to swim for a few hours. Ricardo admitted drinking beer between 2:00 p.m. and 2:30 p.m. They then left the river and were going back home when the accident happened.

14.1.4 False-Positive Blood Alcohol Levels

Because of his injuries and shock, Ricardo's blood lactate levels were expected to increase several-fold. Infusion of 3 L of Lactated Ringer's solution would further increase blood lactate considerably. Since there is no lactate utilization due to injuries, the overall blood lactate levels were expected to be extremely high at the time the blood was drawn for alcohol analysis (6,7). The laboratory analysis revealed a several-fold increase in liver enzymes including LDH.

In a normal healthy man weighing 200 pounds, one alcoholic drink is expected to give a BAC of 0.02%. Alcohol from blood is expected to dissipate at the rate of 0.02% in 1 hour (6,9). Ricardo weighed 115 pounds and admitted drinking two beers between 2:00 p.m. and 2:30 p.m. Consequently, his blood alcohol levels could go up to 0.07%. The accident occurred at approximately 7:45 p.m. There was a time lapse of approximately 5 hours from the time he drank the second beer to the time his blood was drawn. In those 5 hours, he would have eliminated any alcohol left in circulation completely. He had no alcohol in his body and was sober at the time of the accident. His serum was analyzed by the laboratory on the blood sample that was drawn at 9:46 p.m. The serum alcohol levels at this time were expected to be 0%.

The GC method of alcohol determination is the gold standard but is expensive to maintain. It has no known interferences. Several enzymatic methods by several manufacturers based on the reaction of alcohol dehydrogenase on alcohol and the conversion of NAD to NADH and extrapolating the concentration of NADH so generated to alcohol are available in the market. Several hospital laboratories use them, as they are cheaper and quicker. They are accurate in the majority of cases. But they give false-positive blood alcohol levels under certain conditions. These methods measure NADH and correlate these levels to BAC. This stoichiometric relationship is fine as long as NADH is not generated by any other enzymatic reaction. Elevated lactate and LDH in blood also generate NADH, giving false-positive blood ethanol levels (3). Several manufacturers with FDA-approved reagent kits for procedures of alcohol determination by ADH acknowledge the findings and warn about the false-positive blood alcohol levels in cases of trauma and high blood lactate and LDH levels (8).

14.1.5 Conclusions

Based on the available evidence, it can be concluded with a reasonable degree of scientific certainty that:

1. Ricardo's blood alcohol levels were falsely elevated.
2. Extremely high blood lactate and LDH levels and the use of an inappropriate enzymatic method utilizing ADH by Abbot TDx to measure serum alcohol resulted in false-positive alcohol levels.
3. Based on the evidence of the number of beers Ricardo drank, the period in which he drank, and the time of the accident, it can be concluded that he was sober at the time of the accident.
4. Alcohol had no role in the unfortunate accident resulting in the death of the doctor.

14.2 Presumptive DUI and an Injured Motorcyclist

14.2.1 Legal Aspects: Presumptive DUI and Injuries to a Motorcyclist

This case is about an accident involving a motorcycle driven by Mr. Skip Edwards who, while trying to avoid a collision with a car coming from the opposite direction on Circus road, went onto the shoulder of the road. He lost control, went into a ditch, received lacerations, and was bleeding profusely. At the Rexport Hospital emergency room, his serum alcohol was found to be 0.13%. He contends that he drank only three to four beers and there must be a mistake in his serum alcohol measurement by the hospital laboratory.

14.2.2 Medical Aspects: Falsely Elevated Alcohol Measurements by Enzymatic Methods

The enzymatic methods use the ADH and NAD to measure serum alcohol. However, elevation of serum lactate and LDH are known to occur in patients with trauma and injuries, which interferes with enzymatic methods giving rise to falsely elevated serum alcohol levels.

14.2.3 Factual Background

Skip Edwards is a Caucasian male, 42 years of age, 5 feet 11 inches tall. He weighed 190 pounds on the day of the accident. It appears that the accident happened on a clear, sunny day at 5:30 p.m. The accident took place at a bend on Circus road. Skip and his friends were at Mr. X's bar between 4:00 p.m. and 5:00 p.m. Mr. Edwards admits drinking three to four 12-oz. beers while

eating a chicken dinner. He and his friends proceeded on Circus road on motorcycles with the intention of going to Mrs. Edwards's workplace. Mr. Edwards's motorcycle was the middle of the three motorcycles. Ben was riding the first motorcycle, the second motorcycle behind was that of Mr. Edwards, and the motorcycle behind him was that of Jerry. The motorcycles were going north on Circus road. The motorcycle in front was approximately 10 feet in front of Mr. Edwards's motorcycle. A car driven by Mr. Josh Combs coming in the opposite lane missed the motorcycle in front and came straight at Mr. Edwards. He had very little time to act and in order to avoid the collision, he quickly drove the motorcycle to the right side of the road to avoid impact with the car. He went off the shoulder and landed on rocks in a ditch. He was bleeding profusely and sustained multiple traumas, lacerations on the tongue and face, and a fracture in the right orbital area. The accident happened at 5:30 p.m. Since Mr. Edwards was bleeding profusely, Ben drove him on his motorcycle to his wife's place of employment and from there to Mrs. Edwards's place of work. His wife took him to Rexport Hospital emergency room. He was in the hospital for two days. His urinary drug screens were negative. His blood was drawn at the hospital at 7:45 p.m. and the alcohol levels in the serum were determined by Beckman enzymatic procedure. The serum alcohol levels were found to be 0.139%. Divide by 1.18 to get a blood alcohol level of 0.12%.

14.2.4 Cars and Motorcycle Accidents

It is generally the experience of forensic pathologists and medical examiners that operators of automobiles often do not see operators of motorcycles, either because of their low profile or because they are not attuned to looking for motorcycles. Automobiles will turn in front of a motorcycle and the motorcycle will crash into the car. Most experienced operators of motorcycles assume that individuals driving cars do not see them. Motorcycles involved in accidents always eject their operator. Generally, the motorcyclist sustains either head or neck injuries. The injuries occur from being thrown from the vehicle and hitting the ground or another object (6).

With the previous evidence from forensic pathology literature, it is essential to analyze the accident carefully. The three motorcycles were going on the road one after the other. The car came in suddenly at the bend and missed the first motorcycle, which was only 10 feet away from the second motorcycle driven by Mr. Edwards. This suggests that Mr. Edwards saw the car coming at him and had a few seconds to act. He was alert and quickly went to the right side, away from the car and avoided hitting it. This suggests that his mental faculties, CNS functions, and motor skills were under his control and were not consistent with a person whose blood alcohol levels

were 0.12%. Therefore, his blood alcohol levels, in all likelihood, were much below the legal limit (6,7).

14.2.5 Blood Alcohol Levels

As stated earlier, BAC depends on several factors (6,7). In a normal healthy individual weighing 200 pounds, one alcoholic drink is expected to result in a blood alcohol level of 0.02%. Alcohol dissipates from blood at the rate of 0.02% per hour (6,7). Mr. Edwards weighed 190 pounds on the day of his accident. One 12-oz. beer was expected to give a blood alcohol level of 0.021%. He was at the bar from 4:00 p.m. to 5:00 p.m. He admits drinking 3 to 4 beers along with his chicken dinner within this one hour. The four beers were expected to give a blood alcohol level of 0.084% at 6:00 p.m., the time at which he was expected to reach peak blood alcohol levels. There was a time lapse of 30 minutes from his last drink at 5:00 p.m. to the time of accident at 5:30 p.m. In these 30 minutes, he was expected to dissipate 0.01% of alcohol from blood. This would result in 0.032% blood alcohol at the time of his motorcycle accident. At the time of his blood draw at 7:45 p.m., a time lapse of 2 hours and 15 minutes, he would have dissipated an additional 0.04% of blood alcohol. This was expected to give a residual blood alcohol of 0% at the time of his blood draw. Yet, the laboratory reports 0.139% of alcohol in serum, which works to be 0.12% of whole blood (6). To these one has to add 0.06%, the amount that was expected to be dissipated from his blood starting from 5:00 p.m., the time he left the bar, resulting in a blood alcohol level of 0.18%. To get these blood alcohol levels, Mr. Edwards was expected to consume between 9 to 10 beers in a matter of 1 hour while eating his dinner. This was unlikely. He was alert and was quick to avoid the impact of his motorcycle with the car. Therefore, the four beers he reports appear to be accurate. His behavior at the time of accident was more consistent with blood alcohol levels of 0.04% rather than the toxic levels of 0.12%. There is an inconsistency between the blood alcohol levels determined by the laboratory and the number of beers Mr. Edwards reports that he consumed. Mr. Edwards is reporting that he consumed four beers and the blood alcohol levels determined by the laboratory might be falsely elevated. GC determination of blood alcohol is the gold standard. That is why forensic blood alcohol determinations are done by GC. Rexport Hospital laboratory is not a forensic toxicology laboratory and does not use a GC in alcohol determination. They used the Beckman enzymatic method, which gives accurate blood alcohol levels in a majority of cases and is enough for patient management. However, elevated circulating lactate and LDH generated in patients with trauma are known to give false-positive blood alcohol levels (3). Several reagent manufacturers of enzymatic alcohol determinations now warn of this possibility in their package inserts.

14.2.6 Conclusions

It can be concluded with a reasonable degree of scientific certainty that:

1. Mr. Edwards's blood alcohol levels determined by Rexport Hospital laboratory were falsely elevated by the enzymatic method.
2. Due to Mr. Edwards' multiple traumas, lactate and LDH were released in his blood, which interfered with the enzymatic method used for serum alcohol determinations. This resulted in falsely elevated serum alcohol levels.
3. Consequently, his blood alcohol levels at the time of the accident were much below the legal limit.
4. His blood alcohol levels were such that they were not expected to cause any impairment in his judgment, motor skills, reflexes, or reaction times, and he was fit to drive.
5. This was also corroborated by the fact that with very few seconds available to him, he reacted instantaneously and immediately and avoided a collision with oncoming automobile.
6. Because of his alertness, he avoided a more serious accident to himself and to the occupants of the car.

14.3 DUI, Fatal Accident, Homicide

14.3.1 Legal Aspects: DUI and Vehicular Homicide

This case is about Mr. Rod Davilio, who lost control of his car, skidded off the highway, and ended up in a ditch hitting a tree 10-in. in diameter. Three of the occupants were ejected and were thrown out, as they were not wearing seat belts. There were serious injuries and the death of Oreana Lanan, Rod's girlfriend. The police arrested Rod Davilio for vehicular homicide and DUI. Rod contests the blood alcohol result obtained from the hospital laboratory.

14.3.2 Medical Aspects: False-Positive Blood Alcohol Levels

Serum alcohol analysis at the hospital laboratory by automatic enzymatic instrumental analysis involving ADH enzyme can give falsely elevated serum alcohol levels particularly if the patient was injured. In these patients, serum lactate dehydrogenase and lactate levels are known to be elevated. These interfere in the instrumental analysis and give false-positive serum alcohol levels. Under these circumstances, it is advisable to do serum alcohol analysis by a GC.

14.3.3 Factual Background

This motor vehicle accident involving serious injuries and a fatality happened on Saturday, March 19, 1995. According to Renagal State Police, the accident happened at 8:00 p.m.

Rod Davilio is a Caucasian male, 23 years of age, and weighing 133 pounds on the day of the accident. He was driving a 1993 Ford Mustang with his girlfriend, Oreana Lanan, 16 years of age, sitting in the front passenger seat. Joshua Lanan, 11 years of age, and Keith Clarke, 22 years of age, were in the backseat. It seems none of them was wearing seat belts. They pulled out of Quick Go store and were going to see Rod's brother. Rod was driving south on Highway 47. After a few miles, he lost control of the car, skidded off the highway, and ended up in a ditch hitting a 10-in. thick tree. Three of the passengers were ejected. Oreana was thrown in the middle of the trees and died. Joshua was seriously injured and was taken to a hospital. Keith was not seriously injured. Rod was injured and was taken to Peace on Earth Hospital. The police arrived at the accident scene at 8:47 p.m. After interviewing people at the scene, the police arrived at the hospital. Rod had lacerations and the emergency care unit treated him for these injuries. His blood was drawn by a nurse at 9:50 p.m. and the analysis of serum alcohol was done by Abbot TDX[®], which gave a result of 0.13%. To convert serum alcohol levels to blood alcohol levels, 0.13% is divided by 1.1, which gave a BAC of 0.11%. He had no drugs in his system. The police arrived at the hospital and interviewed Rod at approximately 11:30 p.m. Rod had a moderate odor of alcohol on his breath, slurred speech, and unsure balance. The police arrested Rod at 12:00 a.m. for vehicular homicide and DUI, and requested Rod's blood sample, which the nurse drew for police at 12:10 a.m. The blood alcohol analyzed by the state police crime laboratory gave a reading of 0.06%. The method by which this analysis was done is not known.

14.3.4 Blood Alcohol Concentration

As stated previously, BAC depends on several factors (6,7). Rod weighed 133 pounds; one alcoholic drink is expected to give a BAC of 0.03%. At the same time, alcohol from the blood is expected to dissipate at a rate of 0.02% per hour. Rod contends that he drank only two beers at noontime at home. These two beers were expected to give a BAC of 0.06%. However, he is expected to dissipate at the rate of 0.02% per hour. Since the accident happened at 8:00 p.m., there was a time lapse of 8 hours. Therefore, the BAC due to these two beers should be 0% at 8:00 p.m. However, after the accident, the hospital drew his blood at 9:50 p.m., which showed a BAC of 0.11% (conversion of serum alcohol levels of 0.13% to BAC), and the blood drawn at the hospital for police

at 12:10 a.m. gave a BAC of 0.06%. Therefore, Rod must have consumed alcoholic beverages later and possibly at a time closer to the accident.

14.3.5 Alcohol Intoxication

There is commonsense and scientific presumption that conviction should only occur if the BAC at the time of the accident is at or above the legal limit, which in turn reflects the alcohol reaching the brain, which in turn indicates the degree of acute alcohol-induced impairment of driving ability. The fact that BAC at 9:50 p.m. in the blood sample drawn at the hospital was 0.11% and in a sample drawn for police at 12:10 a.m. was 0.06% is not proof enough that Rod's BAC at the time of the accident impaired his driving ability.

BAC at 9:50 p.m. and at 12:10 a.m. contradicts his contention that he did not drink beer after he drank two beers at noontime at his home. Therefore, Rod did drink alcohol before the accident. Based on the deposition statement of several witnesses, it is possible to answer the following questions.

1. What was the possible time at which Rod consumed his last drink?
2. What was Rod's BAC at the time of the accident and its possible role in the impairment of his driving abilities?

14.3.5.1 *What Was the Possible Time at Which Rod Consumed His Last Drink?*

Deposition testimony of Rod was evasive and he never admitted drinking more beer other than the two beers he says he had around noon at his house. Therefore, it is not possible to get from him the time at which he had his last drink. He only admitted going to the Quick Go store and talking to others in the parking lot. He does not remember how long he was at the store. He remembers that Oreana and Joshua came to the store later. According to the deposition testimony of Joshua, Rod did not drink the night before. He was not drinking the whole day. According to Joshua, Rod did not appear intoxicated. Joshua further states that there was a big pothole in the road and Rod hit the pothole, lost control, and went into a ditch. According to the deposition testimony of Keith, who is Rod's cousin, Quick Go store does not care if you buy beer and drink it in your car in the parking lot if no one sees you drink. He saw Rod talking to people at the Quick Go store. According to deposition testimony of Toby Grahm, Rod was at Quick Go store. He saw the storeowner lock up the store at 7:30 p.m. He did see Rod drink beer. According to deposition testimony of Steven Blank, he saw Rod at the Quick Go store in and out of the store three times. When Rod pulled up into the parking lot, he was alone. According to Blank, he saw Rod buy a six-pack of

beer. Based on this evidence, it is safe to assume that Rod did drink his last beer at 7:30 p.m., the time when Oreana and Joshua arrived at the store.

14.3.5.2 What Was Rod's BAC at the Time of the Accident and Its Possible Role in the Impairment of His Driving Abilities?

From the deposition testimony of several people, it can be clearly established that Rod bought beer at Quick Go store. He probably did drink beer not seen by others, including Joshua who came to the Quick Go store when it was closing. Based on these testimonies, it can be assumed that Rod's last beer was at approximately 7:30 p.m. The accident happened very close to the Quick Go store on Highway 47. Therefore, the assumption that his last beer was at approximately 7:30 p.m. is a reasonable estimate. Based on this assumption and on the BAC at two different times, it can be concluded that Rod was still absorbing alcohol from his stomach up until the time of his first blood draw at the hospital. Evidence from the literature shows that some individuals are in the absorption phase for 2 hours or more after alcohol consumption. Based on this evidence, his BAC at various times can be calculated as follows:

Time (h)	BAC (%)	Comments
7:30 p.m.	0	Last drink at parking lot
8:00 p.m.	0.02	Accident
8:30 p.m.	0.04	
9:00 p.m.	0.06	
9:30 p.m.	0.08	
10:00 p.m.	0.10	Hospital blood draw
10:30 p.m.	0.09	
11:00 p.m.	0.08	
11:30 p.m.	0.07	
12:10 a.m.	0.06	Blood draw for police

Based on these calculations, it can be concluded with a reasonable degree of scientific certainty that Rod's BAC at the time of accident was 0 to 0.02%. It is apparent that alcohol did not play any role in the motor vehicle accident. As stated earlier, the estimated blood alcohol levels were such that they could not cause impairment of Rod's driving abilities at the time of the accident. Deposition testimony of Rod shows that the road has no shoulder where he lost control of his car. According to the deposition testimony of Joshua, there was a big pothole in the road and it is presumed that Rod hit the hole and lost control of his car. According to Mr. Blank, the road was in bad shape where the accident took place.

14.3.6 Conclusions

Based on the available facts from the medical and scientific literature, it can be concluded with a reasonable degree of scientific and medical certainty that:

1. Rod's blood alcohol levels at the time of accident were between 0 and 0.02%.
2. These blood alcohol levels cannot cause alcohol intoxication leading to impairment.
3. Alcohol had no role in this unfortunate motor vehicle accident resulting in the death of Oreana and serious injuries to Joshua.

14.4 Presumptive DUI: Car and Oil Tanker Truck Collision

14.4.1 Legal Aspects: False-Positive Blood Alcohol Levels

This case is about Veronica Bennet, who was driving her car and had a head-on collision with an oil tanker truck coming in the opposite lane. An ambulance took her to the hospital emergency room. She had multiple traumas and injuries. Based on the hospital laboratory analysis, she was arrested for presumptive DUI. She contends that her blood alcohol levels should be below the legal limit because she consumed only two beers.

14.4.2 Medical Aspects: Blood Alcohol Determinations by Enzymatic Methods

Blood alcohol measurements by automated analytical instruments involving the enzyme ADH and NAD are known to give false-positive blood alcohol levels in the presence of high serum lactate and LDH levels. In the case of Veronica, with multiple traumas and injuries, circulating lactate and LDH are expected to be elevated and give false-positive blood alcohol levels.

14.4.3 Factual Background

Veronica Bennet is a 20-year-old Caucasian female, weighing 140 pounds on the day of the collision. The accident happened at 4:20 p.m. on State Road XP 48. Veronica was the driver of the car and her friend Susan Whitesides was her passenger. The truck was driven by Skip Straightarrow, who is an experienced driver and has been driving an 18-wheeler oil truck for many years. It was drizzling and the road was wet with low visibility. Mr. Straightarrow did not sustain any injuries but the driver and the passenger of a KIA black sedan sustained

multiple injuries and traumas. The driver, Veronica, suffered a concussion and became unconscious. The driver and the passenger were both pulled out of the wreck and transported to the Dellmonte Medical Center by an ambulance. During transport, the paramedic in the ambulance infused 1000 mL of Lactated Ringer's solution with an 18-gauge needle at a rate of 500 mL per hour. Upon arrival, Veronica was crying and confused, but very quickly became oriented after a brief discussion. Her right jaw was swollen, and there were lacerations on her face. It became apparent that she had multiple fractures. The attending physician, Dr. Jagan Singh, thought that her behavior immediately upon arrival at the hospital could be due to intoxication or due to closed head injury. Therefore, a blood alcohol test was ordered. Blood was drawn at 5:12 p.m. and alcohol levels in serum were determined by Kodak Ectachem 700 by ADH method at 5:50 p.m. The serum alcohol levels were found to be 241 mg/100 mL (dL) or 0.241%. This works out to be 219 mg/dL or 0.219% in whole blood. The factor to convert serum alcohol to blood alcohol was taken as 1.1 (1). Her blood alcohol level was twice the legal limit in the state of Xenovia.

After the accident, the police officer interviewed both Veronica and her friend Susan in the emergency room and noted that the driver of the car, Veronica, had no alcoholic smell on her breath whereas the passenger, Susan, had alcoholic breath. Because of the serious trauma and injuries, Veronica was transferred to a surgical unit.

14.4.4 Blood Alcohol Levels

BAC depends on several factors as stated earlier. In general, blood alcohol levels increase by 0.02% for one drink in a normal healthy man weighing 200 pounds. Females achieve slightly higher alcohol levels than males. It is expected that approximately 0.02% of alcohol is eliminated from the blood in one hour (6,7).

Veronica went to Goodtimes bar with her friend Susan at 12:45 p.m. Veronica had her first drink at 1:00 p.m. She probably had her second drink an hour later. She admitted that she had two drinks and did not have any drinks the previous day. Therefore, Veronica's blood alcohol levels should be consistent with these two drinks. Veronica weighed 140 pounds at the time of the accident. One drink would result in a blood alcohol level of 0.03%; two drinks would result in a blood alcohol level of 0.06%. She was expected to eliminate 0.02% of alcohol per hour from her blood. The accident happened at 4:20 p.m., approximately three hours after her first drink. Her blood was drawn at 5:12 p.m., one hour after the accident. Her residual alcohol level at the time of accident should be 0% and at the time of her blood draw, it should be 0%. The blood alcohol levels reported by the laboratory were 241 mg/dL or 0.241%. These alcohol levels were unrealistic numbers and there might be a serious analytical error by the method used for blood alcohol determination

by the laboratory. For the sake of argument, if this value is taken as a true result, then a value of 0.08% that would be eliminated in 4 hours needs to be added to 0.241%. This works out to be 321 mg/dL or 0.321%. To get to these blood alcohol levels, Veronica would have had to consume at least 11 drinks in a matter of three hours at the bar. This is highly unlikely. Therefore, the blood alcohol levels determined by Dellmonte Medical Center were flawed.

The enzymatic method gives false-positive results (3). It was shown that elevated lactate and LDH generated in the body could also convert NAD to NADH without the presence of alcohol. It is known that lactate and LDH levels increase in injury and trauma and in various other situations. In addition, lactate is not cleared rapidly during trauma and injury (8). Kodak Company recognized these findings and clearly stated in their procedure manual that elevated lactate and LDH give false-positive blood alcohol levels and that the levels obtained in postmortem and anti-mortem blood specimens should be confirmed by GC (8).

Veronica was involved in a serious automobile accident, which resulted in her injuries, trauma, and multiple fractures. Her condition was serious enough to warrant her transfer to Dellmonte Medical Center, a well-known trauma center. The injuries she sustained would definitely result in very high circulating lactate and LDH. Moreover, she was infused with 1000 mL of Lactated Ringer's solution resulting in further elevation of lactate in her blood. Because of this high lactate and LDH, the Kodak Ektachem 700 machine gave a false-positive blood alcohol level even though she did not have any alcohol in her blood at the time of the accident.

14.4.5 Conclusions

Based on the facts, it can be concluded more probably than not that:

1. Veronica had no alcohol in her blood at the time of the accident and at the time of her blood draw.
2. The use of a method that was shown to give false-positive blood alcohol levels due to elevated lactate and LDH gave falsely elevated blood alcohol levels.
3. Thus, alcohol had no role in this unfortunate accident.

14.5 Presumptive DUI, Truck and Motorcycle Collision

14.5.1 Legal Aspects: Death of a Motorcyclist

This case is about a fatal accident involving a van and a motorcycle at 12:34 p.m. on a clear day on May 22, 2001. Lawrence Estes was driving a Honda

motorcycle when a truck pulled away from the curb and came in front of him. The motorcycle crashed into the truck, which resulted in multiple traumas and the death of Lawrence. His wife, Mary, brought a civil suit against the driver of the truck, Keith Kelly for wrongful death of her husband. The defendant and his insurance company allege that Lawrence was drunk and was unfit to drive a motorcycle.

14.5.2 Medical Aspects: Falsely Elevated Pleural Cavity Alcohol Due to Contamination

The blood from the pleural cavity of the deceased gave an alcohol level of 0.12% or 120 mg/dL. Gastric fluid gave an alcohol level of 1090 mg/dL. There was no alcohol in the urine and the vitreous fluid clearly indicated contamination of the pleural cavity blood by the unabsorbed alcohol from the stomach.

14.5.3 Factual Background

The details of this accident reveal that Keith Kelly, who did not sustain any injuries, drove a 1996 Ford truck that sustained damage to the passenger side. The motorcyclist was Lawrence Estes, 33 years of age, Caucasian male, 6 feet tall and weighing 218 pounds. He was a software engineer for a university medical center. He stopped for lunch for approximately 30 minutes. His co-workers were with him for lunch. This was confirmed by the server. The server also confirmed that the decedent consumed only one beer. After lunch, Lawrence was going westbound on Atwood Street where his office was located. The truck suddenly pulled away from the curb and made a right-hand turn in front of Lawrence. The motorcycle struck the truck on the right side. Lawrence was thrown off the motorcycle and landed under the truck. This accident happened just 10 minutes after Lawrence left the lunch place. The paramedics pulled Lawrence out from beneath the truck and found him alive but unresponsive with low blood pressure. He was transported to the William Penn Hospital emergency room. He was found to be unresponsive even to pain stimuli with poor respiratory status. He was in the emergency room for 20 minutes and was then taken to the operating room. Observations in the operating room reveal that Lawrence sustained injuries to the head, chest, and spine, with multiple rib fractures. A large amount of blood was found in the left hemothorax and the stomach was clearly visible in the left chest, indicating massive disruption of the left hemi-diaphragm. Large bone fragments were found up and down the vertebral column and large amounts of blood flowed freely from this. Despite the doctor's best efforts, the patient expired. He was pronounced dead at 2:05 p.m.

14.5.4 Autopsy Report

The autopsy report needs a special comment with regard to blood alcohol (1). This autopsy was performed on May 23, 2001 at 8:20 p.m., approximately 30 hours after death. Dr. Ruben Rabin, Deputy Medical Examiner, Dutchess County, Virginia, performed the autopsy. To understand the results of the autopsy, reference must be made to the hospital records. There were contusions on the lung, bilateral hemothorax, ruptured thoracic aorta, heart laceration, and brain contusion. The abdomen was protuberant. The notes written by Dr. Greg A. Martinez indicate that the stomach was clearly visible in the left chest indicating a massive disruption of the hemi-diaphragm. Moreover, large fracture fragments were found up and down the vertebral column and large amounts of blood flowed freely from this. The autopsy showed abrasions of the nose, left hip, left knee, and both ankles, and fractures of the right wrist and multiple ribs. There were 1500 ml of blood in each pleural cavity. It is significant to note that there was 700 ml of unidentified early digested food in the stomach and the urinary bladder contained 40 ml of urine. A sample of blood from the thoracic cavity, urine, vitreous fluid, and gastric fluid were sent for analysis to the toxicology laboratory. The blood from the pleural cavity gave a blood alcohol level of 0.12% or 120 mg/dL. The gastric fluid gave an alcohol level of 1090 mg/dL. There was no alcohol in the urine or the vitreous fluid. The absence of alcohol in urine and vitreous fluid clearly indicates contamination of the pleural cavity blood by the unabsorbed alcohol from the stomach (6,9).

14.5.5 Contamination of Blood from the Pleural Cavity

During severe traumatic injury when unabsorbed alcohol is present in the stomach, contamination of the blood drawn by transthoracic puncture or the blood drawn from the pleural cavity results in artificially elevated BAC. It is recommended that in cases of traumatic injury, blood from the intact heart chamber as well as blood samples from additional sites and additional body fluid be taken and analyzed for alcohol. This is to ensure that the BAC used for forensic interpretation is accurate. If alcohol from the GI tract permeates the thoracic cavity due to trauma, the samples from the chest cavity are contaminated. It is important that the BAC is representative of the circulating alcohol. A positive blood ethanol from the sample obtained from the chest cavity and the absence of alcohol in the vitreous fluid and urine suggest contamination of pleural cavity blood from unabsorbed ethanol from the stomach (6,9).

14.5.6 Blood Alcohol Concentration

As stated previously, BAC depends on several factors. A 200-pound man is expected to reach a BAC of 0.02% with one alcoholic drink (6,7). The decedent spent approximately 30 minutes eating lunch and had only one beer. He came out and drove his motorcycle on Atwood Street. Only 10 minutes after he left the lunch place, the truck pulled in front of him resulting in his fatal accident. Thus, the time between the decedent's drink, the fatal accident, and his death was a matter of 30 minutes. It would be impossible to attain a BAC of 0.12% after one beer (6). No alcohol was found in the urine, which means he was not drinking prior to arriving at the lunch place. There was no alcohol in the vitreous fluid, which means that alcohol was not absorbed into the bloodstream and diffused into the vitreous fluid. Therefore, the blood drawn from the chest cavity was contaminated from the alcohol in the stomach (3). The alcohol content in the stomach and the alcohol content in 3000 ml of chest blood actually add up to the alcohol in one beer. The decedent weighed 218 pounds and one beer would have given a BAC of 0.018% (2). To get a BAC of 0.12% as reported, the decedent had to consume at least 6 to 7 beers within 30 minutes at the lunch place.

14.5.7 Cause of the Accident

Generally, during accidents, motorcyclists sustain severe trauma including head and neck injuries. The injuries occur because of being thrown away from the vehicle and hitting the ground or another object (6). In this accident, the truck pulled from the curb and came suddenly in front of the motorcycle. In spite of his best efforts to stop his motorcycle, Lawrence crashed into the truck and sustained fatal injuries.

14.5.8 Conclusions

Based on the available evidence, the following conclusions can be drawn with a reasonable degree of scientific and medical certainty that:

1. Lawrence Estes was not intoxicated with alcohol and alcohol did not play any role in this fatal accident.
2. The blood obtained by the forensic pathologist from the pleural cavity was contaminated with the unabsorbed alcohol from the stomach.
3. The accident was caused by the negligence of the truck driver who pulled his truck from the curb in front of the motorcycle.
4. The driver of the truck bears responsibility for the untimely and unnecessary death of Lawrence Estes.

14.6 DUI, Alcohol, and Tylenol

14.6.1 Legal Aspects: False-Positive Blood Alcohol

This case is about Stanley Hathook, who was involved in traffic accident where his Jeep lost control and hit a mailbox and a pole. The police arrested him for presumptive DUI. However, Stanley contends that he drank only two beers and his blood alcohol level must be below the legal limit.

14.6.2 Medical Aspects: Tylenol and False-Positive Blood Alcohol

The liver metabolizes both Tylenol and alcohol. Drinking alcohol when taking Tylenol reduces the metabolism of alcohol and consequently elevates blood alcohol levels. Taking Tylenol and drinking alcohol may lead to liver failure.

14.6.3 Factual Background

Mr. Stanley Hathook is a 25-year-old Caucasian male, weighing 200 pounds on April 30, 2000, the day of his accident and his arrest by the police for possible DUI. The defendant was driving his Jeep on State Road 63, lost control of the vehicle, and struck a mailbox and a pole at approximately 12:15 p.m. The defendant was thrown out onto the paved road and sustained a blow to the left side of his head. He also sustained cuts and bruises on his knee and on other places on his body. The defendant used the telephone of the property owner at the accident site and notified his girlfriend. His girlfriend drove him home. The defendant admits that he drank one beer at home at approximately 11:45 a.m. prior to the accident. It is relevant to note that the defendant is a regular beer drinker and says that he drinks 10 to 12 beers per week. Two days prior to his accident, the defendant injured his right middle finger with a sledgehammer at work and saw his doctor at 3:00 p.m. He has been taking Tylenol every four hours and says that he probably took eight tablets that day. He telephoned the police about the accident from his home. The police arrived at his home and the defendant says that the police saw him drinking at his home. The defendant was transferred to the hospital and was interviewed by police at 2:40 p.m. On suspicion of possible DUI, the police requested that two tubes of blood be drawn from the defendant. Tubes of blood were drawn at 2:50 p.m. by the hospital technologist and were sent to the State Police Erie Regional Laboratory where the blood was analyzed for alcohol by headspace GC. The blood alcohol level was found to be 0.258%.

14.6.4 Blood Alcohol Levels

BAC depends on several factors as elucidated earlier (6,8). The defendant weighed 200 pounds and consumed one 16-oz. beer at home at 11:45 a.m. prior to the accident. A 16-oz. beer is expected to result in a blood alcohol level of 0.026% at the time of the accident. This level would not be expected to result in intoxication in a regular beer drinker. Yet, he lost control of his Jeep and was involved in an accident. One of the possible reasons might be the synergistic toxicity of eight tablets of acetaminophen and alcohol. Subsequent to his accident, he went home and drank six beers. Six beers are expected to give a blood alcohol level of 0.156%, from which 0.06% need to be subtracted to take the dissipation of alcohol in three hours at a rate of 0.02% per hour into consideration. The blood draw was at 2:50 p.m. Therefore, his final blood alcohol level was expected to be 0.096%. However, the laboratory reported a blood alcohol level of 0.258%. This discrepancy needs to be reconciled. The police laboratory used a GC. The value as reported by the laboratory appears to be accurate and there are no grounds to challenge this result. This discrepancy can be explained by the combined and synergistic toxicity of Tylenol and alcohol.

14.6.5 Tylenol, Alcohol, and Liver Failure

It is indeed fortunate that the defendant did not die. He lost control of the Jeep he was driving, was thrown out onto the paved road, and escaped with a few bumps and bruises. He took eight tablets of Tylenol and drank six beers, a dangerous toxic combination. He was nauseated and vomiting, suggesting that he developed acute liver toxicity and fortunately recovered without liver failure. The defendant drinks beer regularly and can be considered a chronic alcohol user. Alcoholics are predisposed to acetaminophen toxicity (10-12).

Alcohol as well as fasting enhances hepatic toxicity of even small doses of acetaminophen (5). Severe acetaminophen toxicity in chronic alcoholics by intake of alcohol has been reported. Moreover, acetaminophen hepatotoxicity appears to be increased in humans and in experimental animals by prior alcohol abuse (11). For these reasons, alcoholics should be cautioned about the simultaneous use of acetaminophen. Acetaminophen toxic symptoms include neuralgic signs and coma, hematological abnormalities, pancreatitis, vomiting, and liver failure. Nausea and vomiting may occur 12 to 14 hours later. Thus, ethanol enhances acetaminophen toxicity even with small doses and it appears that acetaminophen inhibits ADH, an enzyme involved in the metabolism of alcohol, and decreases its clearance from blood. Consequently, acetaminophen elevates blood alcohol levels (10-12).

Thus, the defendant, a regular alcohol user, took nearly 8 to 10 tablets of Tylenol and drank one beer prior to the accident. This combination is enough

to enhance the toxicity of Tylenol and probably resulted in neurologic problems leading to the loss of his coordination even when the blood alcohol levels were not more than 0.026%. A level of 0.258% alcohol at blood draw as reported by the police laboratory can be explained by the fact that the Tylenol tablets he took inhibited the clearance of alcohol from blood and elevated their levels (10–12). If, indeed, the number of beers the defendant drank prior to the accident as well as after the accident are correctly reported, then the defendant's blood alcohol levels at the time of the accident would be below the legal limit. He was not intoxicated due to alcohol but suffered toxicity of Tylenol.

14.6.6 Conclusions

It can be concluded with a reasonable degree of scientific certainty that:

1. The defendant's blood alcohol levels were much below the legal limit at the time he was involved in the accident.
2. The defendant suffered Tylenol toxicity and was lucky to be alive without going into liver failure.

References

1. Burtis, C.A., Ashwood, E.R., and Burns, D.E. (Eds.) *Tietz Textbook of Clinical Chemistry and Molecular Biology*, 4th ed. W.B. Saunders Company, Philadelphia, PA, 2006.
2. Jortani, S.A. and Poklis, A. Emit ETS plus ethyl alcohol assay for the determination of ethyl alcohol in human serum and urine. *J. Anal. Toxicol.* **16**:368–71, 1993.
3. Nine, J.S., Moraca, M., Virji, M.A., and Rao, K.N. Serum-ethanol determination: Comparison of lactate and lactate dehydrogenase interference in three enzymatic assays. *J. Analytical Toxicol.* **19**:192–196, 1995.
4. Abramson, D., Scales, T.M., Hitchcock, R., Trooskin, S.Z., Henry, S.M., and Greenspan, J. Lactate clearance and survival following injury. *J. Trauma* **35**:584–590, 1993.
5. Didwania, A., Miller, J., Kassel, D., Jackson, E.V., and Chernow, B. Effect of lactated Ringer's solution infusion on the circulating lactate concentration: Part 3. Results of respective, randomized double-blind, placebo-controlled trial. *Crit. Care Med.* **25**:1851–1854, 1997.
6. DiMaio, V.J. and DiMaio, D. *Forensic Pathology*, 2nd ed. CRC Press, Boca Raton, FL, 2001, 516–519.
7. Williams, R.H. and Leikin, T. Medico-legal issues and specimen collection for ethanol testing. *Lab. Med.* **30**:630–637, 1999.
8. Test Methodology. Alcohol VITROS. Procedure Manual, Johnson & Johnson Clinical Diagnostics, Rochester, NY, 1996, 1–10.
9. Winek Jr., L.L., Winek, L.L., and Whaba, W.W. The role of trauma in postmortem blood alcohol determination. *Forensic Sci. Int.* **71**:1–8, 1995.

10. Seifert, C.F., Lucas, D.S., Vondracek, T.G., Kastens, D.J., McCarty, D.L., and Bui, B. Patterns of acetaminophen use in alcoholics. *Pharmacotherapy*. **13**:391–395, 1993.
11. Whitcomb, D.C. and Block, G.D. Association of acetaminophen hepatotoxicity with fasting and ethanol use. *J. Am. Med. Assoc.* **272**:1845–1850, 1994.
12. Zimmerman, H.J. and Maddrey, W.C. Acetaminophen (paracetamol) hepatotoxicity with regular intake of alcohol: analysis of instances of therapeutic misadventure. *Hepatology*. **22**:767–773, 1995.