23. Heavy Metals: Mercury, Lead, and Arsenic

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DR BALK: Our next speaker is Dr. Claudia Miller. Dr. Miller is associate professor in environmental and occupational medicine in the Department of Family and Community Medicine at the University of Texas Health Science Center in San Antonio and is director of the South Texas Environmental Education and Research Center.

Dr. Miller is trained as an internist and has done a fellowship in allergy and immunology. Prior to medical school, she worked as an industrial hygienist for many years. Dr. Miller is going to speak to us about three important environmental toxicants, the heavy metals—mercury, lead and arsenic. Dr. Miller.

DR. MILLER: Thank you very much.

I was strolling the aisles of the supermarket one day about a month ago and was looking a book called Nutritional Healing. A woman came up to me and said "Oh, that's the most wonderful book. You know, it's really very informative." So I looked in it, and it had all kinds of medical conditions like acne and skin cancer. I read the sections on lead, arsenic, and mercury. They really weren't too bad, but there were problems, and I realized that a lot of the difficulties we deal with as physicians are patients who come to see us and they've read things like this. How is a practitioner supposed to be able to respond knowledgeably about these things? One of my crusades has been to get a single 1-800 number for the whole country, much like the national poison control center. A 1-800 number that all of the environmental agencies would help contribute to.

People could call, patients could call, physicians could call and get some sort of an expert information about a particular issue. Nobody knows all that stuff. I've got lots of books, but trying to find the right one at the right time is hard. If I knew who to call if I had a question concerning lead or asbestos or mercury, that would be so valuable. Right now, physicians often do not want to answer questions because they think it's not important since they didn't learn about it in medical school.

For example, a woman came to see me. She taught ice skating, and she worked in this ice skating rink where they had a Zamboni machine that would surface the ice. She was pregnant and the Zamboni machine gives out carbon monoxide, so she wondered if it was safe for her to continue to work there. I don't know how many books I would have to go to figure that out. It's a very difficult question, and you can't just give an answer off the top of your head because it may be wrong.

It is a dilemma getting information from different sources and trying to resolve all of this and just do the right thing. In a toxicology text, under lead poisoning, it says "Symptoms of lead poisoning typically come on over the course of several weeks in adults, several days in children. Children's symptoms also tend to be more severe. People with lead poisoning commonly have a case of severe gastrointestinal colic. Their gums often turn blue, and they may experience muscle weakness."

Well, the days of gums turning blue have really passed. We deal with much, much, much lower lead levels. Some of this is fairly old information. Today, if you see blue lines around the gums, it's more likely due to a tattoo from a mercury filling. But people jump to conclusions. One case report of lead leaching out of crystal, and people become afraid to use any of their crystal glassware. I want you to think carefully about how we are going to address questions, some of which we don't even have answers to. Hair analysis is a very complex issue, but people will come to you and say that they want to have this test done. It may not be an appropriate test but they want it.

As far as the three metals that we've chosen to talk about today—lead, arsenic and mercury, I would like to start by pointing out that the blood levels of lead in the general population has declined significantly. Leaded gasoline is gone, but other sources remain. For example, some candles give off lead fumes. Depending upon where those candles are from, China or even some from the U.S., they've found significantly high levels of lead coming off those candles, and we have no way of testing for that. I think it's now being controlled better through our import process, but these are things that we don't even think about. There might be as much as 50 percent lead in the wick to keep it vertical so that you can light it more easily and the candle burns better. When you light the candle what comes off is actually a metal fume—very tiny particles, very respirable particles. So, something that might seem innocuous is actually very significant.

When we went to the Lower Rio Grande Valley area, we found many candles, some of them with lead wicks, in homes of children with asthma. These are religious candles being burned in homes where the Hispanic tradition is to light religious candles, and I suppose if you have a child who's sick, you might light extra candles. The small particles are very respirable, and putting the lead issue aside, the hydrocarbons coming off the candles are not unlike what you find in diesel exhaust, so these are very irritating particles.

We used to think that small particles would be breathed in and breathed out again. Now there's new information that in fact these very tiny particles get into the airways and stay there. So particles so tiny that you can't even see them can still cause problems. Anybody know about what size particle you can see?

VOICE: About 150 microns.

DR. MILLER: One hundred fifty microns? Actually, the smallest particle that you can see with your eye is about 50 microns or so. If you took a chalkboard eraser and hit it in front of a beam of light, you could see the reflected light off of the particles.

Now, we've got particle monitors that can measure down to .03 micron, so there are very tiny particles that we can measure, but they are not visible at all. That always surprises people when we measure particles in the home.

We all know that lead can impair a child's neurological development. In dealing with a population with lead exposure you might have a shift in I.Q., with a doubling of the number of people who fall below what's considered retardation in our society, say, below 80. And you might cut in half the number of people who are in the so-called genius level. So looking at a population curve it's obvious, but the important thing about this is that you would not notice if an individual person—a patient or a friend —lost four I.Q. points. But if you do have a change in four I.Q. points, then for the population as a whole, you're talking about a major public health problem. So it's important to think about this in public health terms, even though on an individual basis, this would not be obvious to anyone.

Now, the diagram you have is a little different, but I wanted to give it to you because it actually gives you some numbers. But the concept is very similar. So people have looked at this, you know, and what happens if lead exposure or something else causes this change shift in I.Q?

In the old days, in the 1800s, workers making nitroglycerine would sit on a one legged stool. If the worker became overcome by the nitroglycerine, he would fall off and wake up. So it was a way of controlling the exposure. When I was an industrial hygienist, which was what I did before I went into medicine, the way of controlling lead exposures in workers was to remove them from the job when their blood lead level got too high and chelate them to get the blood level back down, say, below 80 micrograms per deciliter. Then you put them back on the job. So you might get them down to maybe 70 or 65, then you put them back on the job. That was routine practice in the smelting industry, for example. Now that would be unheard of because now we realize that lead is stored in certain compartments of your body, like in the bones, for long periods of time, and that when you chelate someone, you're only removing the lead that's in the blood and soft tissues. You're really not changing greatly the body burden of blood. So what we think of as reasonable practice, has changed gradually over the years.

Now, the half-life for lead in the body is about 30 years. Of course, it depends on the compartment, but once it's in the bones, a person has a body burden for a very long time. Arsenic, on the other hand, has a half-life of a few hours to a few days. Mercury in the blood is a few days, but for the body as a whole it's several months. So there are differences in how long the metal stays around. The form of the metal makes a difference. Methyl mercury, for example, is very soluble in lipids, so it's very neurotoxic, and methyl mercury is the form of mercury that has been used in gasoline. It's rapidly absorbed through the skin. In fact, a single drop of pure methyl mercury on the skin can be fatal.

What do you measure to see if a person has excessive amounts of these metals in their bodies? Well, for an acute or a recent exposure, both blood and urine can be very helpful. There are some cases in which hair levels can be helpful, for example, with methyl mercury, but usually not with other metals, mainly because of the problem of external contamination, environmental contamination of the hair. For most of the metals that we're talking about, the primary pathway is food, but it's certainly not the only one.

There are some major difficulties in sorting out which metals might be carcinogens and which might not. For example, arsenic is cancer-causing in human skin, carcinogenic for our skin, but not in animals, so animal studies don't help us there. In animal models, lead taken orally can produce cancer, but this has never been shown in humans. I'm trying to give you a sense of how complicated this is.

There are a number of other metals, like cadmium and nickel, that we know can cause cancer. Chelation is something that can be done, but it works best for something like lead where you've got cumulative persistent metal in the body. And even then, it tends to remove what is in the soft tissues and in the blood. You have to chelate again and again to start drawing the body burden down. There are some oral lead chelating agents available now, and those are preferred for children. Suximer is the one that's been used most for children.

I would like to point out there's no known safe level for lead. They're still debating whether arsenic is a necessary nutrient, but lead definitely is not. It is clear that as lead use in gasoline declined, there was a parallel decline in blood lead levels and a decrease in what we considered allowable blood lead levels. As we realized that what we considered acceptable levels, say in the late 1970s, were really toxic levels, we found ways to decrease lead exposure. The principle way was by removing it from gasoline, but also through efforts to reduce lead exposure in homes by avoiding leaded paint and lead water pipes.

Let’s talk about mercury. There was a very interesting case here in the South Texas area. It involved a 15-year-old boy who showed up with neurological signs and symptoms, extremely ill. They didn't know what was going on with him. He was referred to a neurologist in San Antonio who did all the tests he could think of, including doing some metal screen, probably thinking maybe it was lead. It turned out that this child had a very high mercury level.

They searched the house and couldn't find any sign of mercury. The brother of this child also had a high mercury level, but not nearly so high as the initial case. What they finally found was a cream that's used as a beauty cream, but this teenager had acne and was using it. Now, if you have acne and your skin is inflamed and has open lesions, the absorption of something like mercury will be enhanced greatly. So he had very high levels of mercury and it was found in a dozen or so other cases. Once this was recognized, they found other cases along the border, mostly involving women who had used this product. As one of my colleagues likes to say, it's the tip of the iceberg that ultimately reveals the iceberg. So, there could be many more cases than what we’ve seen.

Things like hyperactivity, criminal behavior, and delinquency have been linked to increased lead levels. There have been a number of articles in the lay press, such as this one from The New York Times—"Johnny can't read, sit still, or stop hitting the neighbor's kids. Why?" This article was done in conjunction with the Mount Sinai School of Medicine in New York, to try to bring certain health problems to people's attention. Other articles were run—"Why kids are getting more brain cancer." These articles have been criticized as being inflammatory, and industry has run counter ads. However, I think this has brought attention to issues that people had never paid attention to before.

The bottom line is that lead, arsenic, and mercury, while they're all heavy metals, all act differently and have different effects when in inorganic or organic form. Sorting this out takes some real detective work, and in the 12 or 15 minutes that most of us have to see a patient, this is not an easy task. I hope that will change in the future. We'll have to work on the insurance companies, but that is the goal. Otherwise, you will have kids who are permanently disabled, and you will have individuals going through the revolving doors of medicine. I'm going to stop here.