



American Society of
Anesthesiologists™

Central Line

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VOICE OVER:

Welcome to ASA's Central Line, the official podcast series of the American Society of Anesthesiologists, edited by Dr. Adam Striker.

DR. ADAM STRIKER:

Welcome to Central Line. I'm your host and editor, Dr. Adam Striker. Today, we have a great show planned for you. We're going to learn about the power of artificial intelligence and machine learning with the guest editors of November's ASA Monitor, Dr. Kumar Belani and Dr. Ronald Pearl. So Doctors Belani and Pearl, welcome to the show.

DR. KUMAR BELANI:

Great to talk to you again, Dr. Striker.

DR. RONALD PEARL:

Good to talk to you, Dr. Striker.

DR. STRIKER:

Well, this is a great topic, but before we jump into it, I'm interested in what got you interested in artificial intelligence and machine learning.

DR. BELANI:

The reason I became interested in this very, very interesting topic is that I've been reading a lot about artificial intelligence, which we are now referring to as AI, during the last several months. There's actually not a day when something or someone brings up the topic of AI and machine learning, or ML. So I decided to attend a recent panel session on AI and machine learning at the last AIRS meeting that was held in Denver, and this session was led by Dr. Ron Pearl, who's here with us today. And I actually

learned a lot more and thought it would be good to do this for the ASA Monitor so that many of us could be updated on this interesting, dynamic, and evolving field that everyone is talking about these days. The more I read about it, I realized that it was increasingly relevant to what we do every day in health care, and it is something that is going to have an impact on all of us.

DR. STRIKER:

Dr. Pearl?

DR. PEARL:

I have been interested in artificial intelligence for the majority of my life. Over half a century ago, I became interested in computers and recognized their ability to do complex calculations. I was also somewhat of a math geek, and IA in many ways is based on mathematical calculations. So it was a natural interest for me even back then. Also, as far back as elementary school, I was fascinated by science fiction stories, and many of those stories explore the theme of computers that can replace people, sometimes with positive and sometimes with negative consequences for humanity. I have also been somewhat of a futurist, and the coming impact of AI has been part of our future now for several decades. I practice both anesthesiology in the operating room and critical care in the ICU, and artificial intelligence is already making major impact on our care of patients in the ICU. Finally, as a physician and as a human being, AI represents a major opportunity to improve not just health care, but every aspect of our lives. So naturally, I am very interested in this topic.

DR. STRIKER:

Well, let's start with some definitions. What is artificial intelligence exactly, and what is machine learning? What is the difference? Dr. Pearl, do you mind answering that?

DR. PEARL:

The term artificial intelligence or AI, was first used almost 75 years ago. AI is a form of computer science that creates systems that can perform tasks that typically require human intelligence, such as reasoning, problem solving, decision making, perception, and language understanding. AI normally involves large amounts of data. It includes a wide range of techniques such as machine learning, neural networks, deep learning, natural language processing, computer vision and expert systems.

Current AI systems are considered to be narrow AI, meaning that they are designed to accomplish a specific task or a limited set of tasks. In anesthesiology, an example might be the Hypertension Prediction Index. Future AI systems may be able to achieve general artificial intelligence or strong AI. Such systems would appear to have human level intelligence and perform any task that a human might do. It is not known when or if this level of artificial intelligence can be achieved.

Machine learning, frequently termed ML, is a subset of artificial intelligence. It uses algorithms and statistical models to allow computers to learn and make predictions or decisions without being specifically programmed. There are multiple types of machine learning and statistical approaches. In general, machine learning uses multi-layer neural networks meant in many ways to stimulate what the brain does. Machine learning can identify patterns within large data sets, including multiple sources of data, as might occur in an electronic medical record, image analysis as might occur in a radiograph or CT scan, and the use of natural language processing to interpret voice and text information. Many ML systems are designed to learn from processing new data and thereby continuously improve their performance. Machine learning approaches have become the dominant form of artificial intelligence, so the two terms are often used interchangeably today.

DR. STRIKER:

All right. Well, let's talk about where we're at and specifically how we got here first. What's the history of AI and machine learning and how long has it been with us both as an idea and in practice? Dr. Belani, do you mind answering that one?

DR. BELANI:

Sure. Dr. Striker. Unknowingly to many, AI and ML has been in existence for quite a few decades. In my reading, I found that the term AI was actually first used at a workshop in 1956 known as the Dartmouth Workshop, where John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon organized a seminal event that marked the official birth of AI as a field of study. In the next few decades, researchers used to teach computers to play chess and solve simple mathematical problems. But because of lack of computing power, complex problems were difficult to handle with AI, and machine learning was a bit limited. There were a few decades of limited application of AI until funding and computing power both improved. At this time in the 1990s, there was a resurgence in both AI as well as machine learning. Researchers were able to embark on the use of algorithms because large data sets started to become available and these showed positive results. This then led to image and speech recognition and language processing resulting in where we are today. At present, both AI and ML have become

integral and not only in healthcare but various industries, finance, autonomous vehicles and much more. Companies like Google, Facebook and Amazon have heavily invested in AI research and development, leading to the creation of quite a few innovative products and services. Thus, the history of AI and machine learning has evolved from conceptual beginnings in the mid 20th century. Practical applications in the current century. Despite periods of stagnation and resurgence, AI has made remarkable progress, and this has been driven by advances both in technology, research, improvement in computers, the power. And it continues to shape our world in numerous ways.

DR. STRIKER:

Well, Dr. Pearl, let's reset just for a second and let's assume that our listeners don't know specifically how these applications are currently being used. I suspect most of us are dealing with things on a daily basis that are using AI or are a result of AI. Why don't we just lay the groundwork and set up exactly what it is we're talking about on a daily basis that we might encounter when it comes to AI?

DR. PEARL:

Dr. Striker you are correct that the applications of artificial intelligence are now so widespread that we frequently do not even recognize that AI is involved. In reality Almost any time someone interacts with a computer, the system involves artificial intelligence. AI often knows a great amount of information about us and is used to generate a personalized experience such as buying books, music or clothing. AI is responsible for the email advertisements you receive after you do a search on the web, AI determines the price to charge when you search for airline reservations. It is the technology that recognizes speech when you're asked by a machine to respond to questions on a telephone. It is used to optimize scheduling throughout a range of industries from business to health care. It is extensively used in finance and e-commerce. The fact is that the amount of data we generate and deal with on a daily basis has become so large that artificial intelligence has come to be part of our daily life.

DR. STRIKER:

Dr. Pearl, do you think that the term artificial intelligence has been unfortunately characterized or has become a misnomer so that people are more threatened by that concept than they otherwise would be if it was called something else?

DR. PEARL:

It is an excellent question. The term artificial intelligence for many people transforms their view of the technology from something which is really a computer doing statistical algorithmic approaches to the idea that the computer is actually thinking. This causes a significant number of problems. For example, people believe that ChatGPT, when it is giving you a perfectly written answer to a question, is actually thinking and how to develop that answer when in fact often it is completely wrong but it is following an algorithm that leads the computer to the wrong issue. People also get scared about the idea that machines are thinking about them, that they know things about them at a level which is different than just what they are doing algorithmically. So I think we in many ways would have benefited had we chosen a different term. It also gets back to what I talked about in terms of the definitions, the idea of weak versus strong artificial intelligence. Currently right now, the ones we have are weak. They are not truly thinking the way people would. They are completing tasks. If we ever do get to true strong artificial intelligence, then the concerns people have about what is artificial intelligence will become major concerns that society will have to deal with.

DR. STRIKER:

Dr. Belani, I want to get back to the anesthetic applications of this. But just real quick, since Dr. Pearl mentioned ChatGPT, do you want to elaborate a little bit and explain briefly to our listeners who may not be familiar with it what it is? And is this something that we should be as practitioners thinking about? Or how would you advise anybody dealing with ChatGPT on how to proceed with that application?

DR. BELANI:

Okay. Dr. Striker, you you're correct. I came across ChatGPT when I first got interested in AI. I had never heard of this before. So then I tried to use it. When I logged on, the first thing I asked ChatGPT is about myself, and the answer came back quite quickly. It did not know anything about myself. It had a limited data set and had only information of well-known public figures. And that too before September 2021. Then asked if it had information of a well-known individual in anesthesia. You know, very well known, and even then, it did not know that person. Then I gave it a paragraph of a document that was not in proper English. And for this it returned it to me in reasonably accurate English. And this actually gave me a good impression about ChatGPT.

So ChatGPT is actually a generative program. It's created by a company in the Bay Area known as OpenAI. And it is an interesting language generating model that can converse with individuals and engage in relevant conversations. Thus, depending upon the questions asked, it can generate information from its database and provide reasonably accurate information. However, this may not always be accurate and it is

important to check with other resources. If this information is correct, does it need change? Things like that. At current, it is certainly not up to date because it relies on data that it has available for its access. So I think this is what people need to know about ChatGPT. And I'm sure that as the days go by, it will get better and better.

DR. STRIKER:

Well, I do want to talk about anesthetic and OR applications with AI. Before we do that, why don't we just go ahead now and take a short patient safety break. Please stay with us.

(SOUNDBITE OF MUSIC)

DR. ALEX ARRIAGA:

Hi, this is Dr. Alex Arriaga with the Patient Safety Editorial Board. Perioperative communication is just as vital to safety as it would be in air traffic control, nuclear power plants, or other high stakes environments. These types of organizations incorporate safety principles into their daily practice and leverage checklists, protocols, and other processes to ensure a systematic approach to safety. Effective perioperative communication is an exchange of information between individuals with the goal of mutually understanding the current situation and the plan for future actions. The complexity of health care systems creates the potential for communication breakdowns that can lead to preventable patient harm. Adherence to best practices in communication can help all members of the health care system share the same goals, thus focusing on coordinated patient care. A reliable organization supports, values and rewards a spirit of teamwork and collaborative communication.

VOICE OVER:

For more information on patient safety, visit asahq.org/patientsafety22.

DR. STRIKER:

All right. Well, Dr. Belani, let's continue on and discuss specifically how the applications of AI in perioperative care and anesthesia have evolved. Is this something we're using now commonly? And then we'll proceed to talk about the future. But let's start off with what we're doing right now.

DR. BELANI:

So many of us may or may not know that the current monitoring tools and the care we provide to patients in the operating room are also utilizing AI and data obtained from machine learning. For instance, our monitors during anesthesia care and the ORs have been trained to alert us when there has been a deviation from a normal range of vital signs. Continuous data that is being monitored is linked to the AI algorithms, and when a deviation occurs from these settings, there is an immediate alert. Another common example is the tone of the pulse oximeter. You all experienced that it decays as the oxygen saturation decreases and then returns as corrective methods are put into place. Our monitors have been programmed for EKG detection to alert us of any arrhythmias and even segment changes. Similarly, some of our brain and neuromuscular junction monitoring tools provide us with information about anesthesia sedation effects and extent of neuromuscular blockade. AI is also being increasingly used to summarize our patient's preoperative medical status and any unforeseen possible drug interactions that could be a possibility during their care. Automated drug orders with proper dosing are routinely being generated at the click of a button in our electronic health record systems. At our own institution, we have instituted alerts for patients with a known difficult airway. Also, an automatic letter will be generated to be given to the patient in situations of a new, difficult upper airway. More recently, I have heard that in a major medical center in the United States, with the help of AI physicians, notes are being automatically generated to reduce the clerical time of physicians. So AI as you know, many, many uses and it's currently being used and I'm sure there will be an increase in use in the future.

DR. STRIKER:

Well, let's talk about the future. Dr. Pearl, what are some of the possibilities of AI and machine learning that we might see in the operating room that we're not seeing now?

DR. PEARL:

I think that one of the ways of answering that question is to go through the different types of AI systems that we are using in terms of what they meant to do. And my apologies, because this will have, I think, a little bit of overlap with what Dr. Belani just said.

But the real goal of AI in the operating room is to make care safer and more efficient. The OR generates massive amounts of data such as vital signs, ventilatory parameters, blood pressure and respiratory waveforms, as well as the inputs from what are we actually doing and how did the patient respond to it. So the ORs really an ideal setting for applications of artificial intelligence. As noted, we're already using in the or without many people recognizing it. For example, processed EEG systems, the depth of

anesthesia use artificial intelligence methodology, as do many of the continuous non-invasive blood pressure monitoring systems people are using. The increasing use of AI in the operating room will fall into several categories. The first is the use of predictive analytics that will analyze patient data, including medical history, current vital signs, how vital signs evolve over time, and laboratory data to predict subsequent complications. And we already do have systems such as the hypertension prediction index systems, and more systems are in active development to predict almost any specified complication, including hemodynamic and respiratory issues. In many ways, these predictive analytics are a form of providing appropriate alerts.

The second role for AI in the operating room is clinical decision support. We already use these in electronic medical records, such as alerting us to drug allergies or drug interactions when we order medications, when it is time for the next antibiotic dose or the next glucose measurement. Clinical decision support can tell us what we should do and what we should not do. As AI systems develop, they may provide a diagnosis or at least a differential diagnosis of a problem such as hypoxemia or increased airway pressures. And the advances beyond that simple clinical decision support will be providing an assessment of what specific action should be taken, such as how to treat hypertension or manage hypoxemia in a specific patient. We already have such systems primarily that were developed for use in critical care.

The final stage of AI, which is not all that far away, is where it will not simply recommend an intervention, but will actually perform the intervention directly. And the FDA's already in the process of considering approval of such systems that, for example, could adjust vasoactive infusions to maintain optimum hemodynamic or optimize ventilator settings.

AI can have multiple other advantages in the OR and outside the OR. It can help us be more efficient. It could use natural language processing so that as opposed to entering information into an electronic anesthesia record, we could simply dictate our actions and drug administrations and have them imported into the record from that. AI can create preoperative notes and post-operative notes. They can improve the ability to supervise more than one location at a time by alerting the anesthesiologist to issues that may require intervention before they become concerns.

Finally, as we think about not just the operating room, but the whole perioperative continuum, the perioperative surgical home, artificial intelligence can help us effectively optimize patients before surgery, managing them in the operating room, and then allow early discharge where AI will continue to get data on those patients and allow us to recognize when there are issues and help us manage them effectively.

DR. STRIKER:

When. Dr. Belani, what are the limitations in terms of usage? What do we need to know about these algorithms or about artificial intelligence that we need to be careful of when it comes to, let's say, interpretation or making best use of these tools?

DR. BELANI:

Yeah. Dr. Striker, anything that is new will certainly need to be evaluated and its reliability and reproducibility checked out thoroughly. Now it may appear that AI and ML are new and as we explained earlier, is not the case. What is new is its application of resources with large data sets and adaptation into algorithms that are being increasingly used in clinical care. It is important for all of us to ensure that these machine derived algorithms are accurate. They have a true application in our field. And other specialties will need to do the same thing. It is very likely that AI algorithms can inherit biases present in the data they are trained on. It's vital to actively address bias to ensure that there are equitable health care outcomes in the patients we care for. Regular auditing and validation of AI systems are important. They will need to be robust validation and oversight for these algorithms. And human oversight is critical, especially in complex cases, to ensure that clinical judgment and patient safety are prioritized.

Another item is the AI needs to keep up with continual learning as drugs change, new drugs are introduced and new guidelines come about. These changes will probably occur automatically if AI is properly programmed and monitored. Thus, there needs to be responsibility, there needs to be accountability of the use of AI in health care. As anesthesiologists, we need to be adequately trained on this and the proper use of AI tools in clinical care. We need to know when AI systems can fail, and we should be prepared to revert to traditional methods when this happens. Cybersecurity is another important thing as there can be unwanted intruders interfering with the algorithms and close vigilance will always be necessary. So safeguards will be necessary in using AI.

DR. STRIKER:

Dr. Pearl, let's talk ethics. What are the concerns, I guess I mean, what's your take on the ethical concerns dealing with artificial intelligence in health care?

DR. PEARL:

There are multiple ethical issues with the use of artificial intelligence in health care, and these are becoming an increasing topic of concern and discussion. They are not specific to anesthesiology. They involve AI in almost any health care setting.

The major concern has been one of patient privacy. AI systems require extensive amounts of data for training, and even when these data are de-identified, that amount of data may allow AI systems to link the data to a specific individual. That individual never knew that data would be used and they certainly never consented to that use, and having them identified could have adverse consequences. In addition, as AI increases its ability to identify individuals, such as through facial recognition, it is clearly an invasion of personal privacy and could be used for inappropriate surveillance. There are concerns that, as Dr. Belani mentioned, that the large data available to AI systems could be hacked and used for negative purposes.

A second major sort of concern that overlaps with ethics and was mentioned by Dr. Belani is that of bias. AI is trained on large databases. We have biases in the way we treat patients, and those biases basically get baked into the algorithms that AI uses which results in continuing inappropriate treatment of patients. And this is especially true of minority patients and those patients who are most susceptible to health care disparities.

There's a significant overlap between ethical issues and legal issues. For example, we need to face the question of does the patient have the right to ask for an anesthesiologist to provide care without using artificial intelligence? And if a poor outcome occurs as a result of a recommendation or an intervention based on artificial intelligence, who is legally responsible? Is it the manufacturer of the AI system or is it the person who is actually providing the care? And we will have to deal with these issues. I would note that the government and many of our health care organizations, the American Medical Association, the ASA, are already working on guidelines for these ethical issues.

DR. STRIKER:

Well, based on our previous discussion, shouldn't it be just another tool like a monitor? And so another piece of technology when you talk about medical legal ramifications. So if something untoward were to occur with an anesthesiologist using these systems, how is that different than interpreting a monitor that a company manufactures that we use in the operating room?

DR. PEARL:

This is an important topic. AI is already part of our monitors. Monitor right now in general is only providing sort of the first step towards making a decision and implementing it. But as AI continues to advance, it's going to take a larger role. The best analogy to where these become ethical and legal sort of questions has already been raised having to do with autonomous self-driving cars. And as cars are driving themselves when there is an accident, who actually is the person responsible for it? Is the way that people are framing the question and it directly applies to what happens to us as we use AI in health care settings.

DR. STRIKER:

Well, this actually gets to what probably is the the key question in this entire discussion for most of our listeners. And doctor Belani, I'm going to I'm going to ask you to elaborate a little bit on this, but what does this mean for the future of anesthesiologists, if that is true, if we use the analogy of a self-driving car, then I would imagine most individuals listening to this discussion might conclude that that's where we're headed. And therefore, there's going to be a computer driving the anesthetic, and that's where these questions come in. So what is the future for anesthesiology? For us personally as physicians and as health care workers? Is that something we need to be concerned with?

DR. BELANI:

Yeah, I think many people are concerned that AI might replace anesthesiologists, but that's not true. Neither AI nor machine learning will replace us. However, both AI and machine learning will help us in real time data analysis. It will help us in decision making. It will help us in improving the efficiency of patient care. And AI and ML are built in as part of our health care system. At another podcast that I heard the question of replacing of humans with AI was brought up. The speakers, I think this was in the Jama podcast recently, gave the example of several years ago about several programs like Lotus One, Lotus Two and now TurboTax and others that were made available to individuals for tax filing. It was believed that this will reduce the number of accountants in this country. No such thing happened. It just facilitates filing. It probably helps the IRS and ensures that few mistakes are made and additional forms that need to be filled. Similarly, in anesthesia, we will always be needed to ensure patient safety and be available to handle unforeseen problems. We have to be vigilant and act in a dynamic fashion. You know, the automatic cars that are driven and end up in accidents, the person who's sitting in the car needs to be vigilant and needs to be dynamic and react when it sees something that's untoward that's going to happen. And in the ASA Monitor, Dr. Ron Paul has an article on critical care. He has correctly mentioned that AI is available 24 seven, 365 days. It does not get tired and it's not, you know, lethargic. We

should rely on those attributes. Embrace AI to help us in enhancing patient care. The human element with its empathy, with its experience and expertise, will always be indispensable when we provide care to our patients. And we will certainly remain at the forefront of health care decision making.

DR. STRIKER:

Dr. Pearl, do you think that based on what Dr. Belani just said, that we're always going to need anesthesiologists, this is going to complement our care as physicians, but do you think there is a danger in how adept anesthesiologists are at their practice when they are leaning so much on an artificial intelligence, if you will?

DR. PEARL:

It is a possible concern. But I think at this stage where we are right now, it's not so much that we should think of these as artificial intelligence, but they are augmenting our own human intelligence. We recognize many things that these devices will not be recognizing. We know that right now and in the near future, they will be unable to provide care on their own. They basically are functioning in many ways similar to a very advanced alarm system. They recognize patterns, but they don't do so infallibly. And we often have knowledge that they do not know. So I think that we will be partnering with artificial intelligence type systems. They will help us take better care of patients, but in no way will they result in us losing skills or not becoming as good anesthesiologists. In fact, I think we may become better anesthesiologists because we will be focusing more on the patient and allow the AI systems to do the more mundane observation of what's going on.

DR. STRIKER:

Well, one last question, and this one is to both of you before we let you go. What surprises does this issue have in store for readers, something unexpected that either of you took away or that you think that we as readers should be paying attention to. Dr. Pearl, let's start with you.

DR. PEARL:

Yes, an excellent question. And it, I think, builds on what we were just talking about. What I've really been surprised about with artificial intelligence, as you look at the literature, is how it is not infallible, how often it makes major mistakes and that it's almost inevitable that that will happen. Just two types of examples. One of them is the use of artificial intelligence for prediction, for diagnosis, for prescribing treatment,

especially in the area of critical care where I spend part of my clinical time. We have had a huge number of artificial intelligence systems. When they are then tried out, they often -- when say often 90% of the time -- they fail. And we've come to learn that even minor changes in the patient population and the way people approach treatment result in the algorithms just not being effective. And so the idea that we can simply rely on them there does not work. The other example I would give goes back to ChatGTP. Recognizing ChatGTP, although it may come across as though it is thinking, what it actually primarily does is it takes one word and then algorithmically figures out what the next word should be. And so we recognize that often you get beautiful answers and the answers are completely wrong. A phenomenon that we call hallucination. It is making up the answer, sometimes even making up the references for it. And when you read it, you cannot tell whether it's an accurate answer or not. So I've been really surprised that, certainly at this point in time, we cannot simply trust what we see from artificial intelligence to be accurate and to be effective, and that we will really continue to need to pay attention to these issues as we implement them into our patient care.

DR. STRIKER:

Dr. Belani, let's give you the last word.

DR. BELANI:

I, for one, was surprised at how much is already known and being done in AI and machine learning. One of our writers in this issue of the ASA Monitor, and this has been brought up earlier by Dr. Pearl, that AI should now actually be called augmented learning. And I find this to be true because AI is truly augmented learning. It requires human input along with the data sets that are available for it to use. I was also fascinated by the wide array of uses of AI, not only in health care, but almost in every aspect of our daily lives. An item I heard recently, as you all know, that the Next World Congress of Anesthesia will be in Singapore in March next year. It was mentioned that when one arrives at the airport, Singapore will not require passport identification. Immigration will be cleared a lot faster with our physical information detection that will be made available to them at the airport of departure. So things are, you know, changing. Now when we join medical school, we informed that this field of medicine will require continuous learning and there will be continuous change and there will be improvements. Thus, we need to keep an open mind and learn the new perspectives, the challenges and opportunities that arise in the dynamic field of healthcare. And AI is certainly one of them.

DR. STRIKER:

Well, thank you both for joining us to discuss this really extremely important topic. A topic that's going to be a part of all of our lives over the next coming years as it pertains to anesthesiology. So thank you both for coming on and sharing your expertise and your insights.

DR. BELANI:

Thank you.

DR. PEARL:

Thank you, Adam.

DR. STRIKER:

No problem. To our listeners, if you want to learn more about this issue or read the articles we're referring to in this month's monitor, check it out online at asamonitor.org. Please tune in again next time and take care.

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