Reducing Adverse Drug Events Related to Opioids:

An Interview with Thomas W. Frederickson MD, FACP, SFHM, MBA

The following is a transcript of part two of an interview with Dr. Thomas Frederickson. For part one, please visit ppahs.org.

Pat

I'd like to focus on the monitoring issues associated with caring for patients at risk for respiratory depression. We know that use of opioids is commonplace in healthcare and we can get complacent about their use. What are the potential adverse effects of opioids?

Tom

Well, we've already talked a lot about the most important one which is sedation and the related respiratory depression, but there are many and they can be anywhere from bothersome to serious. And, certainly if you're the patient, they're at best bothersome. They include nausea, vomiting constipation, hypotension, and then, very common particularly in the elderly population, delirium. All these are potential complications and then you need to have monitoring intervention strategies.

Pat

I know I've seen all of those as a nurse taking care of patients and typically what happens is once they experience those side effects their provider changes the medication and looks for something that's going to be more easily tolerated. What are the peak effects of parenteral opioids and oral opioids?

Tom

So parenteral opioids usually have their peak effect pretty quickly - within thirty minutes - typically fifteen to thirty minutes. Oral opioids tend to be a little longer, usually about an hour.

Of course, that has implications for monitoring sedation. We talked before about how you see you know often the kind of monitoring regimen involves hour to hour checks. So, when you have your peak effect within thirty minutes, that needs to kept in mind.

Pat

I know that in healthcare, we have almost an automatic reaction that when a patient is receiving opioids that they should receive some supplemental use of oxygen. What is the connection between the risks associated with giving oxygen to people who are receiving opioids?

Tom

Well, it has to do with a recognition that, in opioid-induced respiratory or opioid induced respiratory failure, decrease in the oxygen saturation is a late marker rather than early warning sign. So, if you're monitoring oxygen saturation as a strategy to detect respiratory failure early, you have to understand that it's not an early warning sign - in fact is a late sign.

So, if you add oxygen supplemental oxygen it delays that effect even further. So, they could have be in respiratory failure - in terms of starting to accumulate carbon dioxide or increase pressure pressure that carbon dioxide or decrease in minute ventilation - but the oxygen saturation remains stable for a longer period of time because of this because because of the supplemental oxygen, thus delaying recognition of impending respiratory failure.

Pat

Could you get into the physiology for us a little bit more and describe how opioids depress respirations?

Tom

Certainly. Its central nervous system effect and the basic mechanism is it decreases minute ventilation, and it does this in a couple of different ways. It decreases the respiratory rate, but it also decreases the tidal volume or the of the air or the amount of air exchanged during each respiration. And, kind of a late effect as it can even affect the rhythm - kind of disrupting the regular rhythm that we're used to and replacing it with a more irregular rhythm.

Pat

I know that some facilities have looked very carefully at the issue of using pulse oximetry on all of their patients who are receiving opioids. Is that a strategy that would be sufficient to detect respiratory depression?

Tom

Well, that depends on the situation. Certainly, it can be a good strategy. There's a couple things to keep in mind. The first is that there have been studies that have shown that continuous pulse oximetry, as part of a comprehensive monitoring program, that includes monitoring of vital signs and nurse monitoring of sedation, has decreased the rate of unexpected transfers to the ICU or decreased the need for rescue medications.

But, it's important to keep in mind that those are parts of a comprehensive strategy. It's not simply continuous pulse oximetry; and it is continuous pulse oximetry, it's not intermittent pulse oximetry.

There are a number of limitations even though it can be an effective strategy. Certainly, the limitation that we just talked about - decreased oxygen saturation tends to be a late marker of respiratory failure, not an early marker.

In addition, there's this whole issue of alarm fatigue. Studies have shown that about one third - when pulse oximetry is deployed correctly - only about one third of the alarms are true alarm. So, it's two thirds and a false positive or false alarms kind of contributing to this environment of alarm fatigue that our nurses are in all the time.

So, while it can be a good strategy, I think for some patients it's it's it's not sufficient. Perhaps for the most high risk patients, it may not be sufficient.

Pat

And, I know that facilities have also looked at the use of capnography as an alternative. What are the benefits of that technology and are there limitations associated with capnography?

Tom

Well, there's always limitations, but there certainly are some benefits to capnography.

One benefit is for the highest risk patients - the patients with sleep apnea, for example, the patients who are in the morbid obesity category who have the undiagnosed sleep apnea or new diagnosis of sleep apnea, those patients on PCA pumps.

So, for some of these high risk patients, there's a potential benefit. And, the benefits are really derived because it gets at more of the early warning signs of respiratory depression and respiratory failure. It approximates that minute ventilation that we talked about, by looking at the approximation of end tidal CO2 and kind of continuously monitoring the respiratory rate.

So, it does give you a little bit of an insight - more of an insight than pulse oximetry would to what's happening in terms of early warning for impending respiratory failure.

Now having said, that there are some downsides. I mean probably the biggest downside is it really hasn't been thoroughly studied and randomized controlled trials. There's been trials of

kind of lesser strength and lesser rigor that have shown some advantages to capnography monitoring. Capnography monitoring also tends to be somewhat uncomfortable for patients. And, lastly, there aren't you know this whole idea of where you set the alarms can be difficult and that's particularly so with capnography when they look at it trends. Trends and end tidal CO2 tend to be much more important than absolute numbers, and that's harder to monitor a trend than it is an absolute number.

Pat

I know that in healthcare, the tradition used to be that all surgery was done in the hospital and then surgeries started moving into the outpatient setting, including freestanding surgery centers as well as physician offices. There are patients who ask their physicians, "Why do I need an anesthesiologist if you're doing this procedure in my office in your office. What are the recommendations for surgeries that are performed in physician offices?

Tom

Well, certainly if deep sedation or even conscious sedations being used, the recommendations are the same as for ambulatory surgery centers which includes anesthesiologist monitoring and interventions, if needed, and there's a good reason for that. Really the physiology you know even for a minor surgery, if you're undergoing heavy sedation or conscious sedation, there are associated risks, and the anesthesiologist is the expert at monitoring and mitigating those risks - whether that be protecting your airway, whether that be recovery from the untoward effects of anesthesia or opioid medications. whether it be the person that you

Certainly, the anesthesiologist is the expert in knowing when it's safe to discharge from from from the center that's performing the surgery.

So, really for all those reasons, it's a good idea to have the expert there and involved in your care, if you're undergoing sedation.

Pat

I know that you just mentioned that it's difficult to monitor trends, and I think it would help our listeners if you could identify if there are any generally accepted thresholds at which point a provider should become alarmed about a patient.

Tom

Certainly, there are and they're published and there's not necessarily a lot of agreement but there certainly is some.

When it comes to impending respiratory depression, probably the things that need to be monitored are respiratory rate. Low respiratory rate - certainly anything lower than eight would be considered a warning sign.

And, the same thing with oxygen saturation. Any oxygen saturation less than ninety percent would be considered a warning sign. But, remember that oxygen saturation, especially in the setting of supplemental oxygen, is a late indicator rather than an early indicator.

For other types of medical insults, there's lots of other things that need to be monitored, for example, vital signs and including blood pressure, heart rate, and usually the accepted parameters that clinicians would be used to would be that where alarms are often set for these parameters as well.

Pat

And, I'd like to finish this program by focusing on unexpected hospital deaths - a phrase that puts a chill into every health care provider's body to think about people who are not expected to die during that admission. It seems the more that we can learn about the symptoms that and science that lead up to those deaths, the more we can intervene.

I know your report talked about three clinical patterns of unexpected hospital death and I know our listeners would want to know about these three types so that they could recognize the patterns and intervene before an unexpected hospital death. Could you share with us what your studies revealed and what your report shared in terms of the each type of those unexpected hospital deaths and how providers can intervene?

Tom

Absolutely.

So, we talk about three different types of respiratory failure that can lead to unexpected hospital death. But, it's important as we talk about these three types to understand that they're not necessarily discrete and that can be a lot of overlap and an individual patient can have more than one type at any given time.

It's also important to recognize that the you know since the topic is opioids and how opioids can play a role in these types of deaths. While it's central to type two respiratory failure, which we'll talk about in a minute, it can play a role in all three types.

So, the first is type one and that's the type that, as hospitalist, I often need to be very aware of and that has to do with tissue injury - it has to do with an insult to the body. This could be trauma, or congestive heart failure, sepsis, pulmonary embolism - any of those types of medical or trauma type insults that cause tissue injury because the resulting underlying physiologic disturbance tends to be metabolic acidosis.

So, what we see when we look and monitor vital signs and so on is an increased respiratory rate - tachypnea. And, that's really a compensatory mechanism in these folks with the type one potential respiratory failure.

The way these patients can get into trouble is worsening of their clinical situation. At some point, the underlying metabolic acidosis takes over and the patient is unable to compensate and respiratory failure ensues.

What clinicians need to be aware of is the tachypneic patient when the respiratory rate slows down, it certainly could be because the physiologic disturbances improved but it also could be that the patient's losing the ability to compensate and that could be a sign of impending respiratory failure.

Type two is really mitigated by medications - the medications we've been talking about opioids but also other respiratory sedating medications. This tends to be associated with a lower respiratory rate, decreased minute ventilation, and the slow increase in end tidal CO2.

This can happen over a fairly short period of time - fifteen minutes - but, it can also happen over hours. What happens is eventually - as the end tidal CO2 or the partial pressure of carbon dioxide increases, and the patient's ability to compensate again is lost - and respiratory arrest ensues and that's what causes the patient's death.

Type three - the prototype for Type three is sleep apnea and this is that arousal dependent and this is the patient who is arousal dependent to keep his respiratory mechanisms in place. So, the patient with sleep apnea has this cycle of frequent arousals and physiologically he or she is dependent upon these arousals to keep breathing.

When you add a sedating medication such as an opioid into that mix, the patient's ability to depend on arousal and to keep the respiratory mechanisms in place is impaired. And, that's when the partial pressure of carbon dioxide continues to go up, oxygen saturation precipitously falls, and this patient - from the period of time when they no longer arouse themselves, when they no longer wake up to respiratory failure - it's literally just a matter of minutes.

So, those are the three types, but again keep in mind that opioids certainly can play a part in all three, and that there are overlapping mechanisms of action.

Pat

Well thank you, Tom. This has been wonderful information for our listeners.

I've been speaking with Tom Fredrickson, who is the medical director for hospital medicine at CHI Health and the lead author of a publication that came out in 2015 called "Reducing Adverse Drug Events Related to Opioids."

If our listeners wanted to be able to access a copy of that publication, where would they go, Tom?

Tom

They can go to the Society of Hospital Medicine website and they can download it for free. It's under the quality improvement section.

Pat

Great, I appreciate that information and thank you for sharing your expertise with our listeners. We really appreciate it.

Tom

You're welcome. It's been a pleasure.