

AHA COVID-19 Clinical Guidance Series
Critical Care Practice

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Recording:

Speaker 1:

Welcome and thank you for joining us for this podcast brought to you by the American Heart Association. This podcast is part of a series focused on sharing information with healthcare providers who are caring for patients during the COVID-19 pandemic.

Dr. Mark Gladwin:

My name is Mark Gladwin. I'm the chair of the Department of Medicine at the University of Pittsburgh Medical Center. This is your power bite. In this podcast, you're going to hear from specialists in cardiac and pulmonary critical care and emergency medicine. And you're going to learn how to approach the patient in the emergency department, what important modifications there are to standard resuscitation protocols, how to protect yourself with donning and doffing, how to approach the patient that requires resuscitation, has refractory hypoxemia, how to oxygenate a patient in innovative ways before you endotracheally intubate the patient and place the patient on mechanical ventilation.

Dr. Mark Gladwin:

We're going to share with you the simple one, twos, and threes of initial ventilator settings if you don't have a respiratory therapist with you. And more advanced approaches to oxygenating a patient with severe refractory hypoxemia. And finally, we'll talk a little bit about this pandemic and how it's affecting our lives and our thoughts on leadership.

Dr. Mark Gladwin:

Welcome to this podcast on critical care topics on Covid-19. I've had the opportunity to work caring for patients with Covid-19. Also, to work on health care systems surrounding the delivery of care for

patients with Covid-19. I'm joined here by two experts in resuscitation and in cardiac critical care. Dr. Perman, I wonder if you'd provide a brief self-introduction.

Dr. Sarah Perman:

Thanks Dr. Gladwin. My name is Sarah Perman. I'm an associate professor of Emergency Medicine at the University of Colorado. I'm also an active member of the scientific Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation (3CPR). And I sit on the leadership committee of the council as well as the former chair of the early Career Committee. So thank you for having me today.

Dr. Mark Gladwin:

Thank you Dr. Perman. And we have Dr. Dudzinski here.

Dr. David Dudzinski:

Hello, my name is David Dudzinski. I'm a cardiologist. I'm also an intensive care specialist. I work at Massachusetts General Hospital where I direct the cardiac intensive care unit. Since late March, that unit has been completely devoted to the care of Covid-19 patients.

Dr. Mark Gladwin:

So this podcast really represents the areas of the 3CPR Council, which really focuses on both clinical and research areas surrounding cardiopulmonary resuscitation and critical care, which obviously are both essential to the managements of patients with Covid-19. There is many common challenges that providers face in caring for critically ill Covid-19 patients and non-specialists are often called upon to help with this care.

Dr. Mark Gladwin:

In this podcast, we wanted you to discuss some of the common challenges we face with a focus on more introductory information for the health care worker. We particularly want to answer some of the many questions that we receive from non-specialists surrounding the care Covid-19 patients.

Dr. Mark Gladwin:

So I'd like to start my questions with Dr. Perman. As an emergency medicine physician, you're seeing patients really at our frontlines. And you've been an expert in resuscitation codes, AHA guidelines for ACLS and BLS algorithms and obviously, a lot of things have changed with the handling of Covid-19 patients. I wonder if you could just talk to us a bit about what alterations in BLS, ACLS algorithms have been implemented and what people really want to be thinking about when encountering these patients for the first time.

Dr. Sarah Perman:

Sure. I think it's important to distinguish where we're talking about resuscitating patients as we work very closely with our prehospital organizations as well as our emergency medicine colleagues. So I'll focus a little bit more on emergency departments right now. I think acute resuscitation is challenging in a sense that we are trained in how to run this resuscitation with teams, with people having specific roles with procedures that are fairly invasive. And now as we know, many of which are aerosolizing procedures, so we have had to think very closely about how we approach this.

Dr. Sarah Perman:

Fortunately, in April of 2020, there was guideline or an interim guidelines I should say that was released from the American Heart Association in collaboration with the American Academy of Pediatrics and ASAP from emergency physicians and critical care intensive and from anesthesia as well where they really convened to talk about ways that we can still provide good quality resuscitation the Covid-19 infected patients while focusing very much on protecting our teams.

Dr. Sarah Perman:

So a few of the major recommendations that I think are incredibly important for us to think about is the fact that when we are doing an acute resuscitation, which includes CPR and includes defibrillation and includes intubation and that these are all very aerosolizing procedures. So we want to make sure that our staff are incredibly protected with the appropriate PPE or personal protective equipment.

Dr. Sarah Perman:

We also want to think very much about ways that we can even further protect our colleagues. One of which is to think about early intubation. So in these scenarios when you have somebody who is receiving CPR, acquiring an endotracheal tube and placing that tube can actually help to reduce aerosolization because then you can actually place the patient on a closed system with a HEPA filter.

Dr. Sarah Perman:

We always recommend that if possible, intubation with the video laryngoscopy can be helpful because it separates the operator from the patient. And allowing the person who has the best hope for first-pass success to be the individual to take a look to intubate. When it comes to CPR, we know that there is aerosolization in procedure. So what we like to think about is the potential to reduce your team as you provide CPR and so we are really advocating if you are capable of providing mechanical CPR, that this is a very good time to utilize that resource because again, you can reduce the number of people who are actively in the team.

Dr. Sarah Perman:

In situations where you're not ready to intubate a patient or there's a delay, there are some groups that are advocating for placing a supraglottic airway. What you can do in that scenario is then you can continue to ventilate as you don the appropriate PPE to get ready for a true intubation.

Dr. Sarah Perman:

So I think these are some of the major things that we're talking about right now in terms of our acute resuscitation in the emergency department when we have a patient who is in cardiac arrest.

Dr. Mark Gladwin:

Yeah, thank you very much. And I think it's worth just clarifying and pointing out that this virus is thought to be largely spread by droplet spread. So typically a sufficient protection for that would be a standard surgical face mask, gloves, gown, hand hygiene, and ideally, a six-foot distance. But as you said, some procedures that we do in emergencies like intubation, like running CPR chest compressions, even high flow oxygen and non-invasive ventilation can generate aerosols. An aerosol precaution or aerosol spreads requires protection with more advanced PPE, N95s or poppers, face shields, gowns, gloves, etc.

Dr. Mark Gladwin:

And one thing people don't realize Dr. Perman, of course, is that it's important to don but it's just as important with droplet and aerosol spread to doff appropriately. I know there's videos and training on this but you want to just comment briefly about the donning and doffing procedure?

Dr. Sarah Perman:

Sure. So that is something that we take very seriously in the emergency department, especially in these scenarios because I think we've found some literature that shows that the virus can actually exist aerosolized for an hour after the procedure. So I think it's incredibly important to think about making sure that we're safe when we're in the room.

Dr. Sarah Perman:

There are a lot of different approaches to this. We classically will talk a lot about N95. I wear an eye shield, wearing a gown, gloves of course. We do see full poppers being utilized especially for airway interventions. We tend to be a little bit more aggressive in protecting our staff in those situations. But just as you mentioned keeping the team small with few people in and out of the room is incredibly important so that we don't release those aerosolized particles into the rest of the emergency department where we have patients who are coming in with anything from a fractured extremity to maybe a pregnancy related complaint or potentially even a pediatric patient.

Dr. Sarah Perman:

So we want to be very careful about how we interact in and out of the room. And then certainly when we exit the room, we want to leave all of our dirty or contaminated supply at the room and then ensure that we adequately take off our masks. And at that times, we keep the mask on for the full duration of a shift or we potentially revert back to a surgical mask if we're going in to see a patient who's not receiving an aerosolized procedure. So very important to contain that location and contain that room so that we don't spread to patients who are potentially uninfected and the rest of the department.

Dr. Mark Gladwin:

And I think Dr. Dudzinski, do you want to add a comment? Obviously, you're taking care of patients that are known to have SARS-CoV-2 that are infected and that you're going to be in a negative pressure room with full PPE. And when you leave the room, you're doffing procedures likely to be monitored and something you're going to be very careful about. Do you want to comment at all on that doffing procedure?

Dr. David Dudzinski:

That's exactly what I was going to add, Dr. Gladwin, to what Dr. Perman said, which was excellent. The doffing procedure is thought to be the most vulnerable period and at our institution we generally have that procedure witnessed and critiqued in real-time by another care team member. Be it a nurse or another physician, so we can make sure that if there was any potential breach that it's arrested and corrected in real time to prevent any transmission.

Dr. Mark Gladwin:

Yeah, and there's excellent videos showing both the donning and the doffing procedures and we'd recommend that you look at those. And we'll provide a link to that. So Dr. Perman, patients that arrive

in the emergent department are often not an extremist. So we don't have to do CPR. We don't have to emergently innovate them. How can we best ascertain which patients are likely to decompensate?

Dr. Sarah Perman:

So I think that's been a challenge and I think that's something that we're hoping for more evidence and more data to help support our decision-making because we did, especially at the very beginning of this pandemic. We did see a lot of people who are coming into the emergency department with the request to be tested or to be evaluated for potential infection who weren't an extremist and didn't really have any alterations in their vital signs.

Dr. Sarah Perman:

And so a lot of those individuals, we did a fair amount of public health and public counseling but I think it's a challenge. It's a challenge because we've all seen patients who have started to look like they are doing well. And we prepare them for discharge only to find that they decompensate. And so we really are looking at patients' presentation. We're looking at how they maintain during the course of their ED visit and we're looking at their comorbidities.

Dr. Sarah Perman:

So we're thinking about what risk factors they potentially had that put them in a higher level of risk. And that we're really trying to be very thoughtful about who we admit to the hospital and who we are sending home. And we do send a fair number of people home who are well enough to be discharged to home with very, very strict return precautions about signs and symptoms to look forward to return to the emergency department.

Dr. Sarah Perman:

But I think our classic approach is clearly patients who have significant oxygen requirements or potentially have other organ dysfunction as a consequence of this virus. And those individuals clearly are meeting criteria to be admitted to the hospital. But as for kind of hard and fast rules about who comes in and who goes home, I think what we're learning on a day-to-day basis about this virus is that we need more information.

Dr. Mark Gladwin:

So this is obviously really an evolving area. We're increasingly managing patients at home even with some respiratory symptoms, potentially even with supplemental oxygen. And when you look at our hospitalized patients with Covid-19, oftentimes the patients, most of them are requiring oxygen and more than half of them are mechanically ventilated, indicating that we're really taking care of a sick cohort of patients in the hospital as this epidemic has progressed.

Dr. Mark Gladwin:

I'm going to ask another question to Dr. Dudzinski and it's about this evolution of care that we're seeing. Early on because we wanted to avoid aerosol spread, we were doing rapid intubation, early intubation in a very controlled environment with full PPE and using video laryngoscopy. Now, we're starting to move this back a bit. We're increasingly concerned that we might be driving ventilator-associated lung injury and perhaps we should try to prevent intubation and mechanical ventilation using modalities like awake pronation where we flip people around to try to improve V/Q matching using early inhal

vasodilators using non-invasive ventilation or high flow oxygen.

Dr. Mark Gladwin:

So we've been sort of moving more aggressive interventions to the earlier stage as a disease and Dr. Dudzinski, I wondered if you could comment a little bit about where you see things moving in terms of this timing of intubation and how you're using these other modalities even before someone's mechanically ventilated.

Dr. David Dudzinski:

Sure. This is certainly an area where there is practice variation among institutions and there has been evolution in thinking. At my institution, there is definitely a bias towards avoiding non-invasive positive pressure ventilation and high flow oxygenation in favor of intubation. If we are going to use those modalities, it's carefully considered with our nursing staff, our critical care consults and our triage physicians. And if possible though we've been experiencing capacity issues to try to do those only in negative pressure suites.

Dr. David Dudzinski:

As you mentioned, there are other modalities, which may help us improve a patient's oxygenation. Among those you mentioned are awake proning. We know from clinical trials of intubated patients with moderate to severe ARDS that prone ventilation improves oxygenation and improves outcomes. Those mechanisms should translate to the nonintubated patient to improve oxygenation and they include improving V/Q matching, improving lung recruitment by reducing compression and homogenizing and reducing the strain and stress on lung tissue.

Dr. David Dudzinski:

We do not yet have the data for the outcomes of prone ventilation in the nonintubated awake patient but in a paper published from our Institution yesterday in the American Journal of Respiratory and Critical Care Medicine, we know that proning on our intubated patients improved the (pulmonary blood flow) PBF ratio from 150 to 232.

Dr. David Dudzinski:

So we've started to bring proning outside of the intensive care units to all the units. We've engendered a culture change and trained all the nursing staff on proning and the benefits and the nursing concerns with that. We've instituted proning teams, especially for those patients in the intensive care unit but it's certainly a modality we're using to try to improve oxygenation early on in the course of Covid-19 patients who are not yet intubated.

Dr. Mark Gladwin:

So I'm going to try to make this really challenging for you on an audio podcast to have you try to explain to us or describe to us how you actually do a proning maneuver in a patient that's not endotracheal in a tracheal intubated paralyzed on cisatracurium, etc.

Dr. David Dudzinski:

So on a non intubated patient, well I think you have an opportunity there to talk to the patient and assess for potential contraindications. So some of the contraindications overall are if there are spine or

pelvic fractures or instabilities. Certainly if there are issues with the abdomen or chest, chest tubes and open chest, open abdomen, pregnancies are concerned, elevated intracranial pressure and certain vascular accesses or things that need to be you need to be mindful of.

Dr. David Dudzinski:

When you do prone a patient, some of the things you have to watch out for are facial edema and suffusion, atypical sites of pressure ulcers and dislodgement of lines and tubes. Many of those will not apply to the nonintubated patient who presumably does not have lines and can assist you in the positioning as well as report to you if they're having a nerve entrapment syndrome like a brachial plexopathy. So for-

Dr. Mark Gladwin:

So you're essentially just asking the patient to flip over on their belly and keep their face mask on?

Dr. David Dudzinski:

Yes. I think at the crux of it that's what it is and we have a nursing protocol for where to place pillows and how to position the patient on their stomach in terms of the angles they would take and where pillows may be placed. And then there's a frequent check-in by the nursing staff in terms of vital signs and industry of oxygenation, as well as attention to comfort and are we causing any harm or complication by that maneuver?

Dr. Mark Gladwin:

So in one of our ICUs, I actually witnessed a device, a special device, many Covid-19 patients one of the risk factors is obesity. And one of the devices essentially had a ring almost a doughnut for the belly to go through to elevate the hip or the waist. Can you comment a bit if you have to stay ... Typically with proning with mechanical ventilation, we will prone people for 16 hours and then move back to supine for 16 and eight.

Dr. Mark Gladwin:

Obviously in a non mechanically ventilated patient, that's probably pretty difficult to do. What are sort of the flipping intervals in any strategies about body position? I'm just really curious about this one.

Dr. David Dudzinski:

Yeah, so it's a great question. The trial data for proning an intubated patient was generally a 16-hour period. At our institution, we have elongated that period for the intubated patient to sometimes allow the proning interval to be in excess of 20 to 22 hours return to supination to allow for nursing care and other routine care after the change of morning shift.

Dr. David Dudzinski:

For the nonintubated patient, the protocol that we have at our institution is allow the patient to reposition themselves almost every hour. We don't want to cause people discomfort or anxiety about having to remain in a particular position.

Dr. Mark Gladwin:

Great. Thank you so much. Dr. Perman, we're now talking about proning people outside of the intensive care unit. And is this something that's happening in the emergency departments?

Dr. Sarah Perman:

So it actually is. This is an area of medicine that I thought I probably wouldn't be participating in the emergency department but we are actually finding that in scenarios where we have patients who have hypoxia but are in a place where they can actually respond or cooperate with us, we are trying to actually flip them over. We're placing patients into prone positions. We're following some of the protocols certainly not the 16 hours because we tend to like for patients to be elsewhere within 16 hours. But nonetheless, we are actually trying some of these strategies and have seen some successes.

Dr. Sarah Perman:

I will say from a resuscitation standpoint, the proning does offer a complexity should your patient arrest but there are some groups who are starting to actually advocate for providing chest compressions on patients' backs if they are prone when they lose their pulse. I don't know that I have enough data to really advocate for that but there are some groups that are advocating or suggesting that you can actually provide chest compressions about T7 if somebody is prone.

Dr. Mark Gladwin:

So thank you. I think we just recommend to the listeners to keep your eyes open and look at this field. It's a rapidly emerging area and that is when do you need to innovate your patient. Can you prevent intubation and mechanical ventilation with early proning, high flow oxygen non-invasive ventilation? Is that going to be safe and effective. And also I think people are even beginning to look at inhaled vasodilators to improve V/Q matching.

Dr. Mark Gladwin:

So inhaled nitric oxide, for example. The nitric oxide molecules when you breathe them go to the well-ventilated region and then dilate the blood vessels, so recruit blood flow to better ventilated regions. So by doing that, that improves ventilation perfusion matching an oxygenation. And there's a number of clinical trials that are now looking at inhaled vasodilators early before intubation and after intubation while on mechanical ventilation.

Dr. Mark Gladwin:

Maybe I'll just briefly comment on a question that I frequently get and the question is what's the basic ventilator setting? How do I set up a ventilator if I'm a dermatologist and somehow I then ended up in an ICU? The respiratory therapists are all in quarantine, the intensivists is supposed to call in by telemedicine from the University of Pittsburgh Medical Center and somehow we're not showing up. What do I do?

Dr. Mark Gladwin:

And I think really understanding a very basic ventilator setting when you start and maybe I'll just start up with our approach for initial settings and see if then Dr. Dudzinski wants to go into more detail about how to deal with challenging oxygenation problems. But I think if you're going to set up a basic ventilator, it's nice to probably just stick with one simple mode. Probably the simplest mode is the assist control mode with a volume control breath and often we call that AC-VC.

Dr. Mark Gladwin:

So you're going to give a volume control breath. So the number one setting there is that is a volume or a tidal volume. Almost everybody that's intubated with Covid-19 has acute lung injury and ARDS. And so we want to target low tidal volume ventilation to avoid ventilator associated lung injury.

Dr. Mark Gladwin:

And that would be starting with a six milliliter per kilogram of ideal weight tidal volumes. So six milliliters per kilogram as you're starting tidal volume. And then you would start at a pretty standard breath rate. You'd be giving 16 to 25 breaths per minute. So let's just say your first setting would be 20 breaths per minute. You're going to want to target with that respiratory rate a pH between 7.35 and 7.45 but as patients get more ill, you're going to want to limit the amount of pressure that they're breathing, the amount of tidal volume you're giving them.

Dr. Mark Gladwin:

And so you're going to let that CO₂ rise in a process called permissive hypercapnia and you're going to let that pH drop. But your initial setting again 6 cc's per kilogram, a respiratory rate at about 10 and you're going to be targeting a normal pH.

Dr. Mark Gladwin:

What we would then do is you need to set a flow rate if you're in AC-VC mode. So you would want to set your initial inspiratory flow rate at about 60 liters per minute, probably choosing a decelerating waveform. And with that setting you'd be targeting an inspiratory time of about 0.8 seconds.

Dr. Mark Gladwin:

And since you're giving a target tidal volume and you are setting an inspiratory time, by definition there you're setting flow. So in a volume mode, you're really giving a tidal volume and an inspiratory time and you're controlling that flow rate. And then the next thing you want to deal with is your oxygenation. And usually when you first intubate, you're going to put them on a high FiO₂ 90 to 100% and you're probably going to set your first PEEP or positive end expiratory pressure at eight.

Dr. Mark Gladwin:

We would then recommend after those settings in 15 to 30 minutes get your first blood gas and you would adjust your ventilatory rate to target that pH value of 7.35 to 7.45. And then you would adjust your PEEP as a first step to try to increase your oxygenation.

Dr. Mark Gladwin:

Maybe with that I sort of gave you the absolute simple first steps but the very first challenge you're going to face is how to now oxygenate this patient and often can be difficult to oxygenate them. In general, the way you're oxygenating is you're recruiting alveoli. And recruiting alveoli requires sustained pressure and there's really three ways you can deliver sustained pressure. You can increase PEEP, which is pretty easy. You can increase your inspiratory time, which is a little more challenging if you're not an expert in mechanical ventilation. Or you could increase your peak airway pressure but that runs the risk of ventilator-associated lung injury.

Dr. Mark Gladwin:

So let's just stick with PEEP which is the most straightforward. And I'll turn this to Dr. Dudzinski and ask him a little bit about how you find that best PEEP, how you manage PEEP and how you increase oxygenation once you're on the ventilator here. And by the way, feel free to correct me with those initial vent settings.

Dr. David Dudzinski:

Thank you Dr. Gladwin. I think the ventilator setup you mentioned closely mirrors the protocol we would do in our hospital for an initial patient on AC-VC mode with Covid-19 associated ARDS and respiratory failure. So the goal once you have those initial settings and reports back including the arterial blood gas is to further optimize the settings you have. Among those would be trying to minimize the chance of ventilator induced lung injury. We know the ventilator does not treat the underlying disease. It's a bridge giving the patient oxygenation and time.

Dr. David Dudzinski:

And so during that interval, we have to minimize harm and we do that by generating some reports from the ventilator about pressures. So with respect to PEEP, there is an optimal setting, which will maximize compliance of the lung that the respiratory system static compliance will optimize oxygenation, which we can measure by the P2F or PiO2 to FiO2 ratio. And we'll also minimize the pressures on the lung in terms of two measures we track, which are the plateau pressure, which is a direct measure of the pressure on the alveoli. And the driving pressure, which is the difference between the plateau pressure you measure on the ventilator and the PEEP you apply.

Dr. David Dudzinski:

And that Delta, that driving pressure is thought to reflect the cyclic deformation and strain on the alveoli and more strain probably leads to biotrauma and inflammation in the alveoli, which we want to minimize because that strain probably leads to biotrauma or inflammation of the alveolus, which can worsen outcomes.

Dr. David Dudzinski:

Things we have to monitor when we titrate PEEP include possible adverse effects. So when we increase intrathoracic pressure, we increase the afterload of the right ventricle (RV). We also can impair venous return. So we want to find that sweet spot, which doesn't cause too much distension of the lungs, recruits the lung but not over to send some segments and does not cause a hemodynamic insult.

Dr. David Dudzinski:

Conceptually, that idea that there's an optimal PEEP is straightforward but this hypothesis has been tested in a number of trials in ARDS albeit in the pre-Covid era. Most of those trials are negative and one actually in JAMA, the ART trial actually showed harm from trying to frequently recruit patients and give them higher PEEP to do a trial of where you would find the so-called best PEEP.

Dr. David Dudzinski:

So if you don't have the ability with a respiratory therapist and expertise at the bedside, one thing you could do is use what's called the ARDS net tables. There we use the low PEEP table. So it's just literally a table of FiO2 versus PEEP, and it comes from expert consensus and practice recommendations to say if you're on this much FIO2, try this much PEEP and to adjust FIO2 and PEEP in a pairwise manner.

Dr. David Dudzinski:

If you want to individualize therapy and try to really dial in on the ventilator, what's this patient's best PEEP by looking at all these reported values like the plateau pressure and driving pressure. What we do at our institution is we apply for example, plus two centimeters of water of PEEP from where we are. Assess oxygenation in terms of PF ratio. Assess the plateau pressure. Assess the driving pressure and as a surrogate for cardiac output in venous return, look at any invasive hemodynamics we have as well as the heart rate and blood pressure.

Dr. David Dudzinski:

And we may perform that trial and we'll stop that trial if we see that as we apply more exogenous pressure, we're getting a decrement for example or an adverse setting in the driving pressure or plateau pressure.

Dr. Mark Gladwin:

So I'm a little bit of a simple country lung doctor. And so let me see if I can translate that. When we add PEEP, our goal is to recruit alveoli and increase oxygenation. So when we do a PEEP trial, let's say we're going to up that peak from five to seven or five. Maybe we're bold and we're going to go from five to 10. Before and after that increase in PEEP, we want to measure an arterial PaO₂ and make sure that we got a bang for our buck, that that PaO₂ increased.

Dr. Mark Gladwin:

But at the same time, we know it's not all about oxygen tension. It's about the delivery of oxygen and we know the delivery of oxygen is the hemoglobin, the fractional saturation of oxygen on that hemoglobin and the cardiac output. So we've got to make sure that we're increasing the oxygen saturation of hemoglobin but the cardiac output has to stay the same.

Dr. Mark Gladwin:

And as you said, when you increase PEEP, when you increase and intrathoracic pressure, your cardiac output sometimes can drop. So sort of the easy way to look at cardiac output would be to look at your blood pressure, your heart rate. Make sure they're stable. Make sure your skin perfusion stable at each PEEP level. That would be sort of the poor man's approach. A more sophisticated approach would be to measure a mixed venous saturation and do a thick calculation before and after the PEEP. And I guess if you have a noninvasive or invasive measure of cardiac output, you could really measure that cardiac output.

Dr. Mark Gladwin:

Now when you do a PEEP trial when you take someone from five to 10, do you typically use sort of that poor man's approach or are you using sophisticated measurements?

Dr. David Dudzinski:

Generally at our institution, we would at the bedside in conjunction with our respiratory therapists, measure all the variables that you said. The arterial blood gas, the pressure metrics we can achieve off the ventilator and the heart rate and blood pressure. Most of our patients with Covid-19 in the ICU do not have a PA line and so we wouldn't have the ability to measure mixed venous oxygen saturation. And non-invasive cardiac output monitors are not very commonly used at my institution.

Dr. Mark Gladwin:

Yeah. So that's just a good way to think about this concept of best PEEP. It's the PEEP that's giving you the best increase in partial pressure of oxygen, the best increase in the hemoglobin oxygen saturation but doing it without impairing your cardiac output. So your delivery of oxygen is improved with each PEEP maneuver.

Dr. Mark Gladwin:

And we have to point out there's some people that have a paradoxical response to PEEP or they don't improve their oxygenation or it worsens. But the main thing you're looking for is that adverse effect on cardiac output.

Dr. Mark Gladwin:

The other modification we do in managing people with bad ARDS who you're having difficulty oxygenating them would be to consider paralysis with cisatracurium, proning maneuvers, which we mentioned before, adding inhaled vasodilators whether it's nitric oxide or prostacyclin. And at some point, you actually want to look at your hemoglobin concentration and make sure you have an adequate hemoglobin. For a very severe hypoxemic patient, a hemoglobin trigger of seven, which we increasingly use may not be adequate. We may have to take that hemoglobin up to 10.

Dr. Mark Gladwin:

And the other modification during the course of the care of your patient is you're going to want to continue to monitor that plateau pressure. And even if you're at 6 cc's per kilo low tidal volume ventilation. If that plateau pressure rises over 30 centimeters of water, you're going to want to lower that tidal volume. And according to the ARDS net protocol, we can go as low as 4 cc's per kilo. To achieve those small tidal volumes, we often have to give bicarbonate to keep the pH over 7.2.

Dr. Mark Gladwin:

And again these are complex management issues. Now one thing, once your PEEP is maximized, let's say your PEEP's 15, let's say you've proned your patient. You're on inhaled prostacyclin. Your plateau pressure, you're very stressed about it but you've pushed that plateau pressure up above 30. One of the next strategies we can employ is to increase that inspiratory time to increase mean airway pressure or sometimes we have to go to ECMO.

Dr. Mark Gladwin:

Do you want to comment on those final measures? Like how much do you push your inspiratory time to expiratory time ratio and maybe when you think about ECMO?

Dr. David Dudzinski:

Yeah, thanks for the question Dr. Gladwin. It's really critical as you said to monitor the plateau pressure. We know from trial data when that pressure is too high that that can be a marker of adverse outcome. So the playbook you mentioned is very similar to what we do at our institution. For refractory hypoxemia, you try the PEEP inhale vasodilators, consider neuromuscular blockade and then as you said, adjustments to the inspiratory, expiratory time ratio.

Dr. David Dudzinski:

If oxygenation goals cannot be met or if they can only be met at pressures, which are too high and cause a risk of injury, then VV ECMO is certainly a consideration. At my institution ECMO candidacy is evaluated by the ICU attending and a central ECMO team with reference to institutional guidelines on candidacy of the patient, goals and overall system resource use.

Dr. David Dudzinski:

Certainly if you're evaluating any patient for VV ECMO, you should also ask yourself the question, do they need circulatory support? Because acute cardiomyopathy with cardiogenic shock has been reported in Covid-19. If you are evaluating a patient for veno-venous ECMO, it's worth asking yourself if the patient would need circulatory support. This is because acute cardiac dysfunction and cardiogenic shock has been reported in Covid-19 and so it'd be important to decide if the patient needs Venous arterial or VA ECMO at the time you're performing or considering cannulation.

Dr. Mark Gladwin:

Thanks so much. I could ask a million questions. I guess one last question is in many of the case series of patients with Covid-19, the mechanically ventilated patients also suffer from cardiac dysfunction or cardiovascular dysfunction. We know the risk factors for severe disease include diabetes, hypertension, chronic kidney disease, obesity, perhaps smoking and there appears to be a cardiovascular predilection for this disease.

Dr. Mark Gladwin:

And as many as 70% of intubated patients in some series require norepinephrine to maintain vasomotor tone. We're also witnessing a lot of shock in the patients that are mechanically ventilated. Could you comment on your approach to the hypotensive patient with Covid-19?

Dr. David Dudzinski:

Sure. Another great question. At my institution, we just reviewed the world's experience with vasopressor requirements and shock phenotypes in Covid-19 patients from China and other parts in the US. The study from New York City which had a rate of vasopressor use among intubated patients as 95%, that number actually mirrors exactly our use in the first about five dozen patients from our intensive care units. Some of that it's hard to sort out is if medication related to sedation.

Dr. Mark Gladwin:

In many of the series of cases of Covid-19, we're seeing a very high prevalence of shock in patients that are on mechanical ventilation. For example, the Seattle experience as many as 70% of people required norepinephrine. What are you seeing with regards to shock in mechanically ventilated patients with Covid-19 and what's your approach to the management of that?

Dr. David Dudzinski:

Thanks for the question. We are also seeing among our intubated patients in the intensive care unit high rates of requirement for vasopressors. Some of that may be related to the adverse effects of sedation in terms of trying to parse if there's actual shock due to cytokine release, due to Covid-19 itself or due to comorbid infections. It's hard to parse out yet but we're seeing a use of vasopressors among the first several dozen of our patients of about 95%.

Dr. David Dudzinski:

And those are sustained uses not related only to the peri-intubation period. The choice we're using is norepinephrine with vasopressin being an adjunct and lesser amounts of patients on other adjunct agents.

Dr. Mark Gladwin:

I think it's worth pointing out that this is another rapidly evolving area. Many of the series have seen low rates of secondary infections, opportunistic infections that would explain this shock, suggesting that it's a direct consequence of the viral infection. But again, it's something we really do not completely understand. There's been a number of studies that are beginning to think about hemostatic activation and is there a role for thrombosis?

Dr. Mark Gladwin:

But again, whether it's direct vasoplegia caused by the virus, whether it's secondary bacterial infections, whether it's related to thrombosis or hemostatic activation, I think we really don't know yet. But clearly most teams are using norepinephrine cautious fluid resuscitation and vasopressin.

Dr. Mark Gladwin:

So maybe I'll just end for fun and it's been an incredible time in human history. It's been incredibly stressful for many people and I'm going to ask the question that you haven't had time to think about but any reflections on leadership through this? And maybe I'll start with one while you have time to think. I've just been so impressed by how many health care providers, from our med students who have signed petitions to volunteer, to our house staff who are sort of fearlessly staying in the frontlines in our institution, to our hospitalists, our ER physicians, our intensivists. So many people are just so committed.

Dr. Mark Gladwin:

You know our outpatient physicians just at the frontlines and then a lot of non health care professionals. There's people in the service business that are just keeping everything going. It takes incredible, incredible courage to work at the frontline. So we've just been so impressed with so many people throughout this.

Dr. Mark Gladwin:

In terms of leadership though, I've just been impressed at how our clinical operations experts and operations experts really had to rise to this occasion. The supply chain, the shift organization, strategy around managing patients with less utilization of PPE. There was such a supply chain operations know-how that was needed in this.

Dr. Mark Gladwin:

I was also impressed that it was such a crisis that it was a time that you really couldn't tolerate drama and you can't tolerate cynicism. The best functioning units were focused on strategy and operations and had no time for drama and no time for cynicism. And that really this optimistic attitude carried the day. But I'm just wondering Dr. Perman, any reflections on leadership and then Dr. Dudzinski and we'll call it a day.

Dr. Sarah Perman:

So I think it's been it's been really interesting to watch our team come together. In emergency medicine, we often talk about mass casualty events. So we often are prepared for this kind of emergent notification that there's been some catastrophe that we have to prepare for. And some of us are actually called this or equated this to kind of a slow-moving mass casualty incident (MCI) because you kind of know that something is about to unfold and you've seen it happening elsewhere.

Dr. Sarah Perman:

And so watching our group mobilize experts and leaders to really put together protocols to keep as many of our communities safe and healthy was really tremendous. And I think in emergency medicine, we all come with a little bit of a different angle or a little different vent and seeing my EMS colleagues work closely with my critical care EM colleagues, working closely with folks who've had experiences internationally and low resource environments dealing with pandemics. It's really been fascinating and it's really been inspiring. And I would say that I would agree with you the dedication that all of us as a team from our techs to our clerical staff working the phones to people in the rooms with us, respiratory therapy, nursing, it's been phenomenal.

Dr. David Dudzinski:

I might reflect that this is perhaps the only time in my life where I could say that literally the whole world is unified on one single goal. Truly every initiative and energy in the entire globe is being concentrated on this single effort. I think you can find inspiration in a lot of places. I think we all looked at Dr. Fauci who has been through a number of epidemics as a government leader. I'm also quite partial to the leadership emails from Dr. Smith at Columbia. He writes and publishes on the Columbia website.

Dr. David Dudzinski:

But I think on a day-to-day basis, it's really the people around us, the nurses and nurses that I work with and floating to other surgeon novel created intensive care units in my hospital, physicians, cardiologists, anesthesiologists, radiologists, primary care physicians. They're all coming into the hospital to work in surge units or in clinics abutting the hospital. There's inspiration in this time.

Dr. Mark Gladwin:

Great. Well, I want to thank both of you and I've learned so much and Godspeed. Well, on behalf of Dr. Dudzinski, Dr. Perman and myself, I want to thank everybody for listening to this. We hope it was helpful. This is a rapidly changing field and probably everything we've said is outdated now by a few hours. So please stay on top of the literature. Hopefully we can do another update to this. And please stay safe and stay well and keep nurturing each other. This is a very stressful time and we're very worried now that we're going to face second waves of this pandemic. We're going to face nonCovid-19 disease. We're going to face waves of challenge based on the economic challenges we're going to face.

Dr. Mark Gladwin:

And our health care providers and the people in the front line are going to face challenges, psychological challenges. And so please look out for each other, support each other, nurture each other and we hope to meet you in person in the future.

Speaker 1:

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