

Providence

## Providence Digital Commons

---

Providence Portland Medical Center Internal  
Medicine 2021

Providence Portland Medical Center Internal  
Medicine

---

5-2021

# Fentanyl-Induced Wooden Chest Syndrome Masquerading as Severe Respiratory Distress Syndrome in COVID-19

Grace Judd

*Providence Portland Medical Center, [grace.judd@providence.org](mailto:grace.judd@providence.org)*

Rachael Starcher

*Providence Portland Medical Center, [Rachael.Starcher@providence.org](mailto:Rachael.Starcher@providence.org)*

David Hotchkin

*Providence St. Joseph Health, [david.hotchkin@providence.org](mailto:david.hotchkin@providence.org)*

Follow this and additional works at: [https://digitalcommons.providence.org/oaa\\_ppmc\\_21](https://digitalcommons.providence.org/oaa_ppmc_21)



Part of the [Internal Medicine Commons](#)

---

### Recommended Citation

Judd, Grace; Starcher, Rachael; and Hotchkin, David, "Fentanyl-Induced Wooden Chest Syndrome Masquerading as Severe Respiratory Distress Syndrome in COVID-19" (2021). *Providence Portland Medical Center Internal Medicine 2021*. 5.

[https://digitalcommons.providence.org/oaa\\_ppmc\\_21/5](https://digitalcommons.providence.org/oaa_ppmc_21/5)

This is brought to you for free and open access by the Providence Portland Medical Center Internal Medicine at Providence Digital Commons. It has been accepted for inclusion in Providence Portland Medical Center Internal Medicine 2021 by an authorized administrator of Providence Digital Commons. For more information, please contact [digitalcommons@providence.org](mailto:digitalcommons@providence.org).



# Fentanyl-Induced Wooden Chest Syndrome Masquerading as Severe Respiratory Distress Syndrome in COVID-19

Grace Judd BS, Rachael Starcher MD, David Hotchkin MD



Case Presentation

**History**

- 47 yo M with no PMH presented with fever and respiratory distress
- Admitted for COVID-19 pneumonia

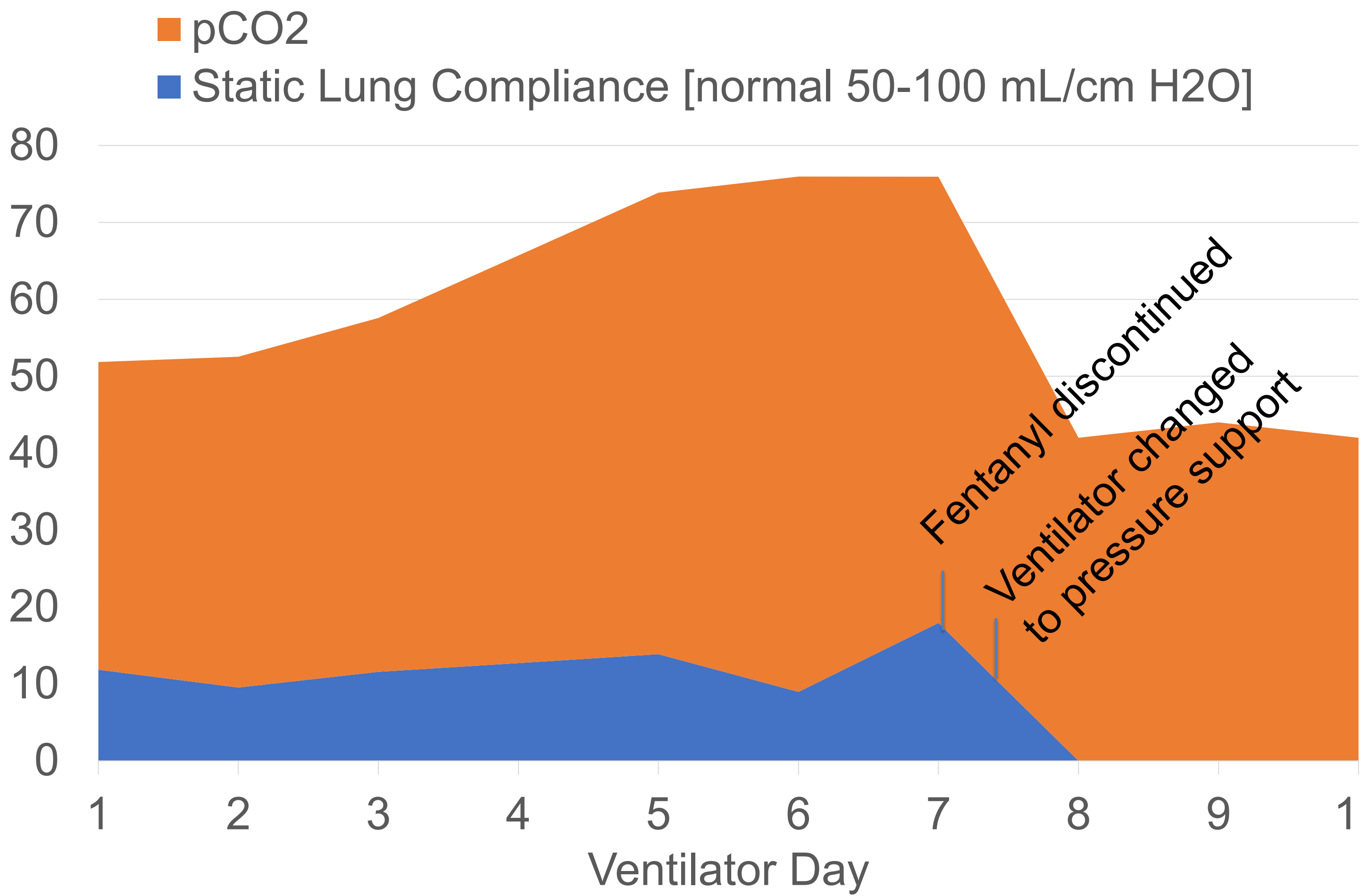
**Hospital Course**

- Intubated for moderate acute respiratory distress syndrome (ARDS) on hospital day 11
- Fentanyl infusion started
- Hypoxia improved within 36 hrs but plateau pressures consistently >30 cm H<sub>2</sub>O despite minimizing dead space
- Trial of airway pressure release ventilation worsened hypercarbia
- Bronchoscopy w/o mucous plugging, airway collapse, or purulent secretions
- Lung compliance worsened (P<sub>plat</sub>=50 on 4 cc/kg) w/o change in oxygenation
- Developed suspicion for wooden chest syndrome (WCS) and discontinued fentanyl

**Outcome**

- P<sub>plat</sub> nadired at 16 within one hour after stopping fentanyl
- Pt successfully extubated on VD 10

Low Lung Compliance with Worsening Ventilation



Compliance is Inverse to Transpulmonary Pressure

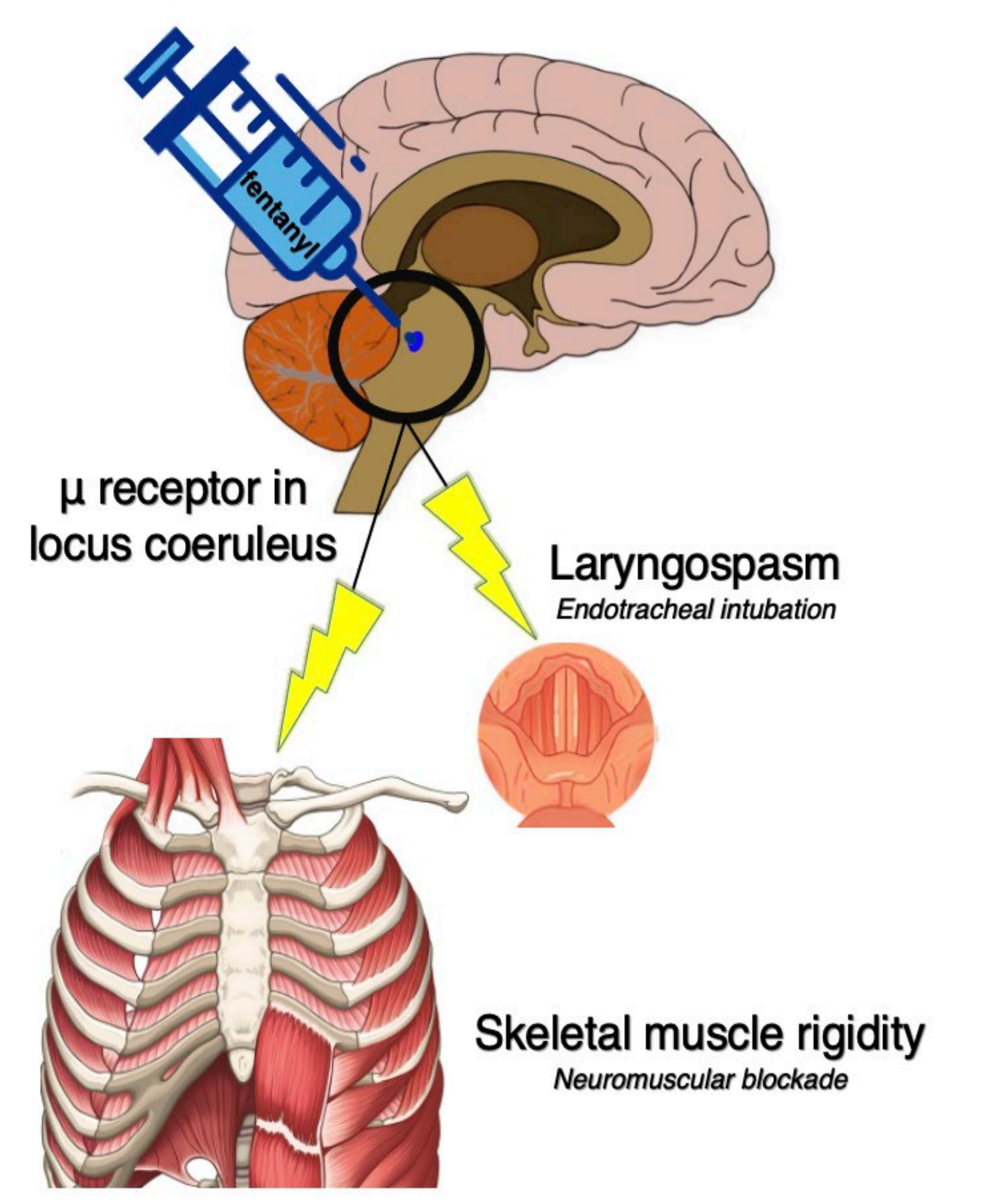
$$C = \frac{\Delta v}{\Delta p} = \frac{\Delta v}{p_{av} - p_{pl}}$$

C = lung compliance  
V = volume  
p<sub>av</sub> = alveolar pressure  
p<sub>pl</sub> = pleural pressure

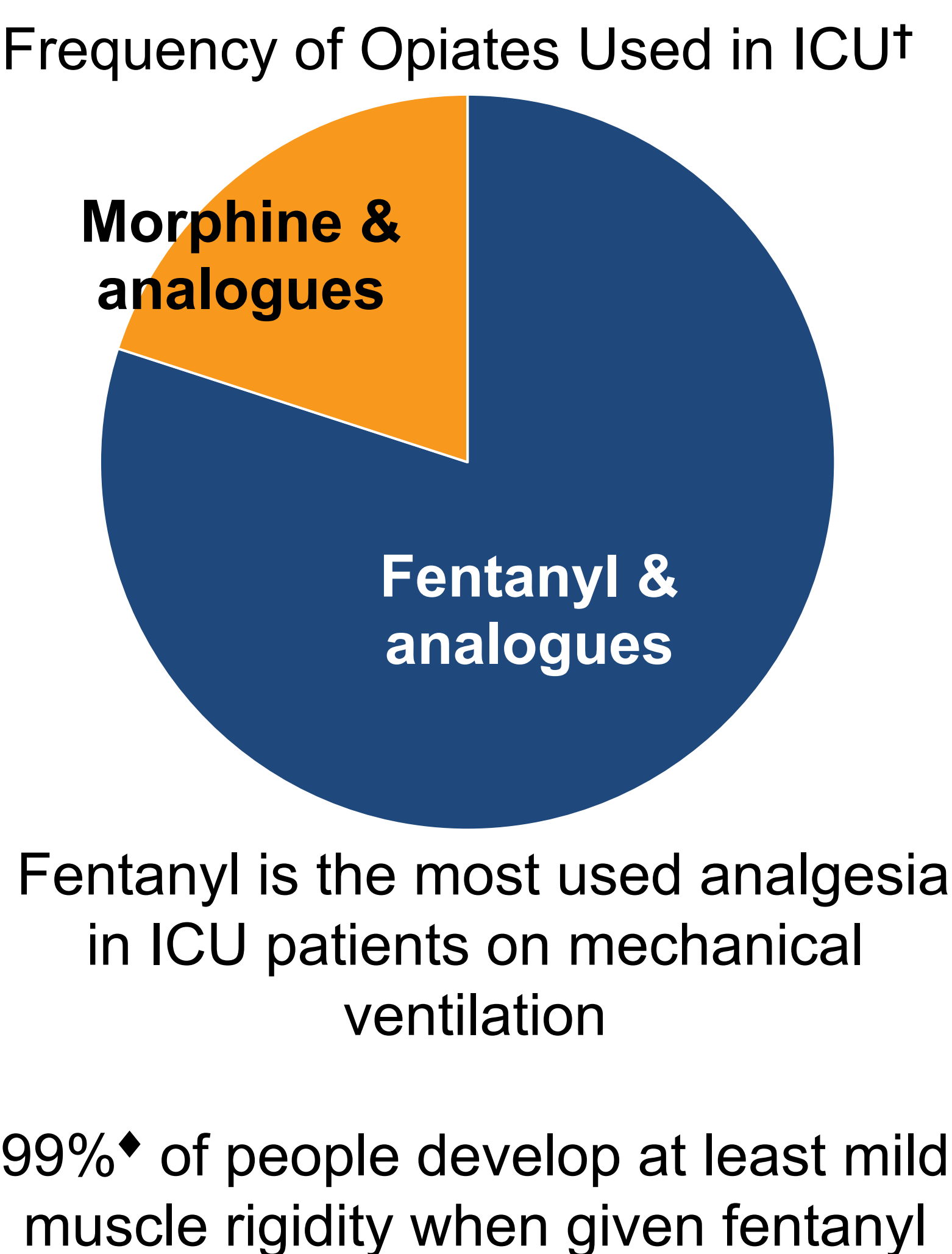
Poor Compliance in both ARDS and WCS

	COVID-19 ARDS	Wooden Chest Syndrome
Plateau pressure	High	High
Lung compliance	Low	Low
Alveolar pressure	High	Low
Pleural pressure	Low	High

Fentanyl Activates Muscles



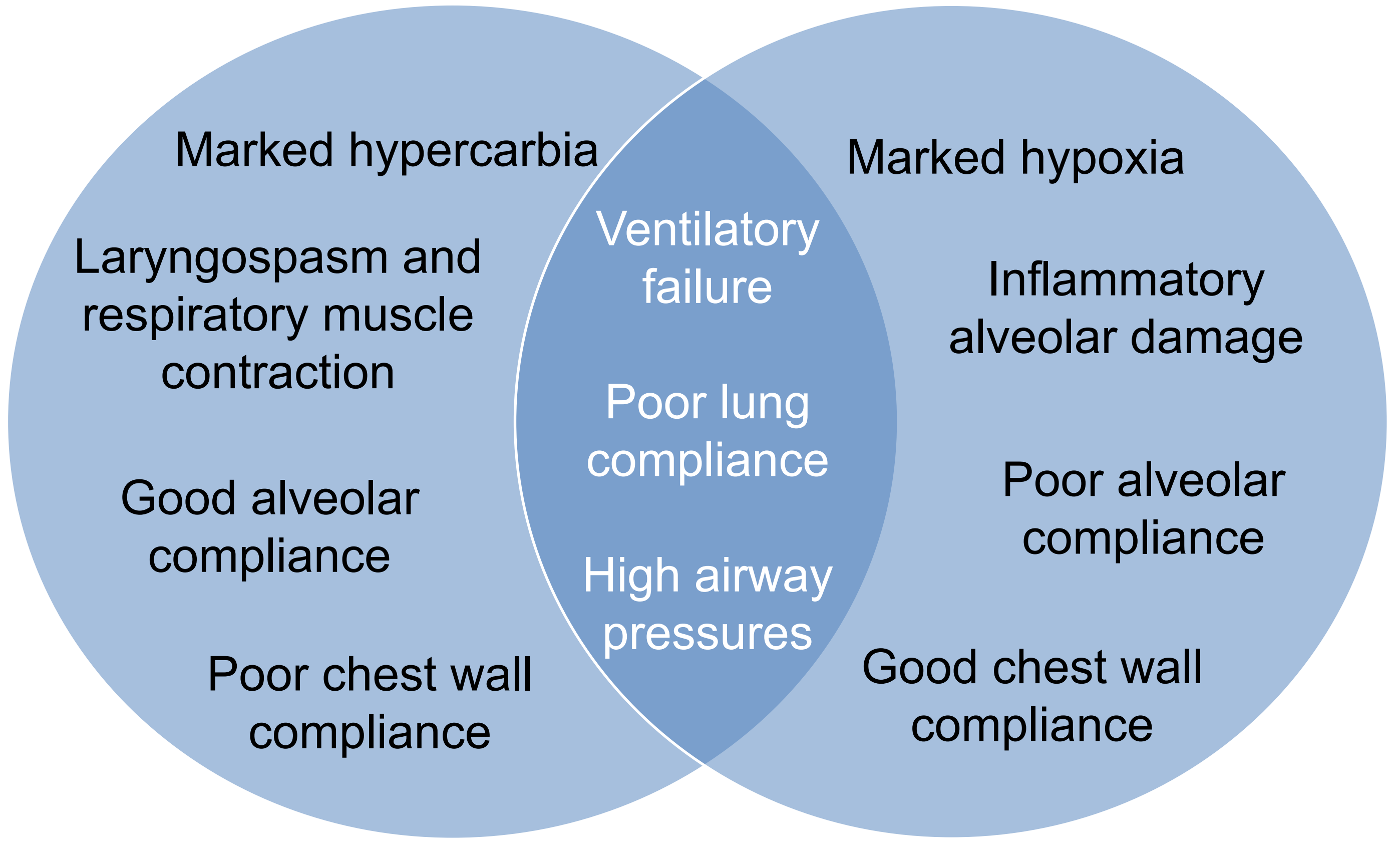
Likely Prevalence



Fentanyl is the most used analgesia in ICU patients on mechanical ventilation

99%♦ of people develop at least mild muscle rigidity when given fentanyl

Wooden Chest Syndrome v. COVID-19 ARDS



Takeaway Points

Fentanyl uniquely activates laryngeal and respiratory muscle potentially leading to a fatal syndrome known as Wooden Chest Syndrome (WCS) manifested by poor ventilation

- *It is likely more common than clinicians realize*

**Implications in practice:**

- Maintain a high index of suspicion for alternate or overlying physiologies when treating persistent ventilatory failure in ARDS in COVID-19

**Recommendation:**

- Discontinue fentanyl if lung compliance and ventilatory failure seem out of proportion to hypoxia

References

Burns, Lisa D., David R. Williamson, Marc M. Perreault, Louise Rose, Deborah J. Cook, Niall D. Ferguson, Stephanie C. Lepinsky, and Sangheeta Mehta. "Analgesic, Sedative, Anxiolytic, and Neuromuscular Blocker Use in Canadian Intensive Care Units: A Prospective, Multicenter, Observational Study." *Canadian Journal of Anesthesiology* 61, no. 7 (July 2014): 619-30. <https://doi.org/10.1007/s12630-014-0174-1>

Buxton, Jane A., Tim Gauthier, Ma-Lei Woo Kinshella, and Jesse Godwin. "A 52-Year-Old Man with Fentanyl-Induced Muscle Rigidity." *CMAJ*. *Canadian Medical Association Journal* 190, no. 17 (April 30, 2018): E539-41. <https://doi.org/10.1503/cmaj.171468>

Camporeale, Luigi, Davide Chiumello, Mattia Busana, Luciano Gattoni, and John J. Marini. "Pathophysiology of COVID-19-Associated Acute Respiratory Distress Syndrome." *The Lancet Respiratory Medicine* 0, no. 0 (November 13, 2020). [https://doi.org/10.1016/S2213-2600\(20\)30551-1](https://doi.org/10.1016/S2213-2600(20)30551-1)

Coruh, Başak, Mark R. Tonelli, and David R. Park. "Fentanyl-Induced Chest Wall Rigidity." *Chest* 143, no. 4 (April 2013): 1145-46. <https://doi.org/10.1378/chest.12-2131>

Davis, Miller P., and Bertrand Bellem. "Reasons to Avoid Fentanyl." *Annals of Palliative Medicine* 9, no. 2 (March 2020): 61124-624. <https://doi.org/10.1155/2020/61124>

Freund, F. G., W. E. Martin, K. C. Wong, and T. F. Hornbren. "Abdominal-Muscle Rigidity Induced by Morphine and Nitrous Oxide." *Anesthesiology* 58, no. 4 (April 1973): 358-62. [https://doi.org/10.1016/S0018-2825\(19\)80051-1](https://doi.org/10.1016/S0018-2825(19)80051-1)

Gattoni, Luciano, Silvia Coppola, Massimo Cressoni, Mattia Busana, Sandra Rossi, and Davide Chiumello. "COVID-19 Does Not Lead to a 'Typical' Acute Respiratory Distress Syndrome." *American Journal of Respiratory and Critical Care Medicine* 201, no. 10 (May 15, 2020): 1299-1300. <https://doi.org/10.1164/rccm.202003-0819LE>

Grasselli, Giacomo, Tommaso Tonetti, Alessandro Protti, Thomas Langer, Massimo Girardis, Giacomo Bellani, John Laffey, et al. "Pathophysiology of COVID-19-Associated Acute Respiratory Distress Syndrome: A Multicenter Prospective Observational Study." *The Lancet Respiratory Medicine* 8, no. 12 (December 1, 2020): 1201-8. [https://doi.org/10.1016/S2213-2600\(20\)30370-2](https://doi.org/10.1016/S2213-2600(20)30370-2)

Kireli, F. L., R. A. Koons, and J. S. Denison. "Fentanyl in Anesthesia: A Report of 500 Cases." *Anesthesiology* 49, no. 4 (August 1970): 523-32.

Haudebout, Anne-Fleur, François Pieter, Samuel Tuffet, Nicolas de Prost, Keyvan Razazi, Armand Mekontso Dessap, and Guillaume Carleaux. "Respiratory Mechanics of COVID-19- versus Non-COVID-19-Associated Acute Respiratory Distress Syndrome." *American Journal of Respiratory and Critical Care Medicine* 202, no. 2 (June 1, 2020): 287-90. <https://doi.org/10.1164/rccm.202004-1226LE>

Jacobi, Judith, Giles L. Fraser, Douglas B. Cousins, Richard R. Riker, Doris Fontaine, Eric T. Whitford, Donald B. Chaffin, et al. "Clinical Practice Guidelines for the Sustained Use of Sedatives and Analgesics in the Critically Ill Adult." *Critical Care Medicine* 30, no. 1 (January 2002): 119-41. <https://doi.org/10.1097/00003246-200201000-00020>

Lucero, David, Shobha Mandal, and Apurva Karli. "Lung Compliance in a Case Series of Four COVID-19 Patients at a Rural Institution." *Cureus* 12, no. 7. Accessed December 18, 2020. <https://doi.org/10.7759/cureus.9472>

Payen, Jean-François, Gérard Chagnac, Jean Mantz, Christiane Hercule, Igor Auriant, Jean-Luc Leguilou, Michèle Binhas, et al. "Current Practices in Sedation and Analgesia for Mechanically Ventilated Critically Ill Patients: A Prospective Multicenter Patient-Based Study." *Anesthesiology* 106, no. 4 (April 1, 2007): 687-95. <https://doi.org/10.1097/01.ANE.0000264747.08017.d8>

Roos, Jeffrey P., Nevil Bajaj, Field A. Davis, and Natalie Kerdinakis. "Opioids and Chest Wall Rigidity During Mechanical Ventilation." *Annals of Internal Medicine* 168, no. 9 (May 1, 2018): 678. <https://doi.org/10.7326/L17-0612>

Sokoloff, M. D., J. L. Hoyt, and S. D. Geigis. "Studies in Muscle Rigidity, Nitrous Oxide, and Narcotic Analgesic Agents." *Anesthesiology* 51, no. 1 (February 1972): 16-20.

Torralba, Randy, Amy J. Eshleman, Tracy L. Swanson, Jennifer L. Schmalzer, William E. Schmalzer, Shelley H. Bloom, Katherine M. Wolfman, John P. Reed, and Aaron Janowsky. "Fentanyl but Not Morphine Interacts with Non-Opioid Recombinant Human Neurotransmitter Receptors and Transporters." *Journal of Pharmacology and Experimental Therapeutics*, January 1, 2020. <https://doi.org/10.1124/jpet.120.265561>

Torralba, Randy, and Aaron Janowsky. "Nonadrenergic Mechanisms in Fentanyl-Mediated Rapid Death Explain Failure of Naloxone in the Opioid Crisis." *Journal of Pharmacology and Experimental Therapeutics* 371, no. 2 (November 1, 2019): 453-75. <https://doi.org/10.1124/jpet.119.294569>

Yasuda, Hirotoshi, Tetsuro Kamo, Masamitsu Sanui, Eishi Nango, Takayuki Abe, Toru Takebayashi, Alan Kawara Lefor, and Satoshi Hashimoto. "Optimal Plateau Pressure for Patients with Acute Respiratory Distress Syndrome: A Protocol for a Systematic Review and Meta-Analysis with Meta-Regression." *BMJ Open* 7, no. 5 (May 29, 2017). <https://doi.org/10.1136/bmjopen-2016-011591>

Yasuda, L. T., Hirono, T., Yusa, and M. Satoh. "Tracheal Constriction by Morphine and by Fentanyl in Man." *Anesthesiology* 49, no. 2 (August 1978): 117-19. <https://doi.org/10.1097/0000542-197808000-00012>