Critical Care Medicine Section

# Deep Dish is the BEST Pizza — Most of the Time

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We all have preferences and tendencies in various aspects of our lives and work. After living (and eating) in Chicago for five years, I can attest that it is a fact that Chicago deep dish pizza is the best kind of pizza. New York style is unfilling, unsatisfying, and always an unnecessary menu item. Or is it? If I'm in New York, I don't order deep dish because the deep dish is not as good there as in Chicago: not enough cheese, soggy crust — you get the idea. My preference is deep dish, but that doesn't mean it's the best choice in every setting. Sometimes the geography dictates the best choice despite your typical preference.

So, too, ventilator management in the ED, I will argue, demands AC/VC, not AC/PC, or PS or a host of other settings (See Box 1 to buy a vowel for those letters). Not that I don't use the others in my ICU practice — and have a great personal preference generally for PRVC — but when I'm in New York, I eat New York style pizza...

Box 1. **Common Ventilator Abbreviations**

| | |
|---|---|
| AC | Assist Control |
| VC | Volume Control |
| PC | Pressure Control |
| SIMV | Synchronized Intermittent Mechanical Ventilation |
| PS | Pressure Support |
| PRVC | Pressure Regulated Volume Control (same as "autoflow") |

**1. Rate: Initial vent settings in the ED must include a set minimum rate. Recommendation: Assist Control. Avoid: SIMV and PS**

The patient was just intubated and was paralyzed. Depending on emergency backup rates programmed into pressure support is a dangerous practice. Do not depend on fancy ventilator computers.

Some places use SIMV, which has a rate but then supports breaths above the set minimum rate, and I would argue that it is superfluous settings that muddy the interpretation of how the patient is handling the vent. The supported breaths above the minimum set rate (when the patient is no longer paralyzed) do not constrain tidal volumes or pressures. If you recently intubated a patient in the ED, by definition he or she is ill, and if it is a primary cardiopulmonary illness, he or she is going to get worse, not better. SIMV was initially conceived as a weaning setting, not a resuscitation setting.

**2. Delivery: Controlling tidal volume is more important than controlling pressure. Recommendation: Volume Control. Avoid: Pressure Control**

Trials have repeatedly shown lung protective ventilation to be just that: lung protective. There is also some evidence to suggest that all medically ill patients, even if they do not have ARDS, should be on lung protective ventilation starting in the ED.{Fan:2017ca, Fuller:2017jd, Fuller:2013ic}

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Although pressure control does indeed solve the pressure problem (trying to prevent barotrauma), pressure control also prevents you from regulating ventilation. First, extraordinarily hypoxemic or hypoxic patients will require a certain tidal volume to receive sufficient oxygen. Although tidal volume is part of ventilation, patients can be so sick that the volume impacts them. Second, the inability to control ventilation can lead to increased CO2. Permissive hypercapnia is encouraged for ARDS unless there are extenuating circumstances such as intracranial hemorrhage, pressure control does not allow a reliably measurable way of resolving a pH that is too low (usually 7.2).{Laffey:2004jb}

Some advanced vent aficionados are likely to counter that tidal volume is less important than driving pressure, a stance for which there is growing evidence. Even if that is true, pressure control prevents physicians from knowing the plateau pressure so they cannot even calculate a driving pressure, much less aim for a particular target. Once again, volume control affords more controlled ventilation and protection.

**3. Diagnostics: Fancy algorithms interfere with the emergency physician's ability to use the ventilator settings and alarms to diagnose problems. Recommendation: old fashioned Volume Control. Avoid: PRVC, autoflow, any fancy manufacturer additions**

A big part of the ventilator market is proprietary algorithms that make ventilation more comfortable for patients so they require less sedation and can be weaned faster. But this is completely irrelevant in the ED. The

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negative to settings like PRVC (pressure regulated volume control) and autoflow is that they change the pressure and flow, which prevents a real volume guarantee and hides the patient's changing physiology.

For example, if a patient has a developing pneumothorax, you would expect the peak (and plateau) pressure to rise. But if the patient is on PRVC, the ventilator takes steps to minimize the pressure by changing flow, among other things. Thus, rather than see an increase in pressure leading to alarms and early warnings for the physician, there are only silent adjustments under the hood. The pneumothorax won't be diagnosed until clinically visible changes occur.

The ability to constantly measure true airway pressures in AC/VC mode can be live saving since trends can be seen and problems can be noted before they become clinically significant.

Use peak pressure alarms to prompt you to check the plateau pressure (Pplat) and intrinsic PEEP (PEEPi or auto-PEEP) if your vent has the capability. Even if you cannot check Pplat and PEEPi, peak pressure alarms should prompt circuit evaluation and use alternative methods to evaluate the differential for high peak pressures. Important diagnoses to consider with this early warning are pneumothorax, severe alveolar disease such as ARDS, and the patient biting the endotracheal tube, among many others listed in Box 2.

Box 2. **High Yield Differential Diagnosis for High Peak Pressure Alarms on Ventilator. Upper limit of peak pressure is 35 mmH2O. Upper limit of plateau pressure is 30 mmH2O.**

| High Peak Pressure, Normal Plateau Pressure | High Peak Pressure, High Plateau Pressure |
|---|---|
| Circuit blockage | Mainstem intubation |
| ETT kink | Tension pneumothorax |
| Mucus plug | Breath stacking |
| Bronchospasm | Abdominal compartment syndrome |

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