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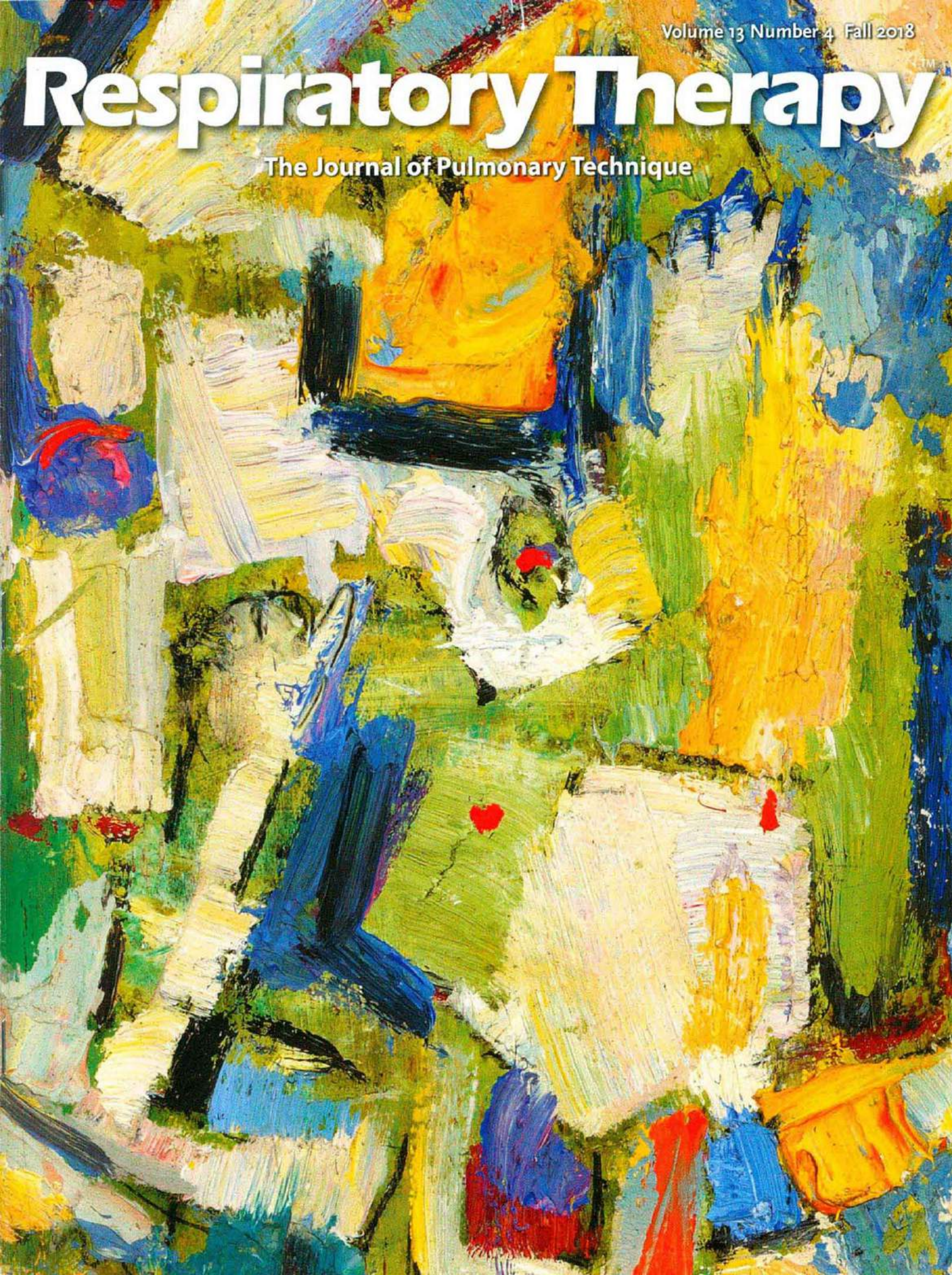

Is BiLevel the 'Holy Grail' of Non-Invasive Ventilatory Support or Overrated Therapy?

Steven C LeCroy, MA, CRT, EMTP

The Holy Grail is the subject of numerous myths and legends, which makes it difficult for scholars to distinguish fact from fiction. Legends hold that the Grail had the power to heal all wounds, deliver eternal youth and grant everlasting happiness. If you listen to some clinicians BiLevel CPAP (Continuous Positive Airway Pressure) therapy is akin to the Holy Grail, with maybe the exception of everlasting happiness. For the purposes of this article to avoid the debate on the name, CPAP is defined as continuous positive airway pressure therapy with a single pressure. While BiLevel is continuous positive airway pressure therapy with two levels of pressure. Both therapies have their detractors and proponents. But when we get right down to where the rubber meets the road, what we really want to know: Is BiLevel better than CPAP or vice versa? What pressures should be used? What types of patients would respond better to BiLevel or CPAP? Does either therapy improve outcomes or reduce length stay? For those that are non-clinical, can either therapy save money? The goal of this article is to look behind the curtain and see if the shift to BiLevel makes a difference.

BiLevel is often referred to as BiPAP™ (BiLevel Positive Airway Pressure – Respironics) or VPAP™ (Variable Positive Airway Pressure – Resmed). For this article the terms BiLevel and CPAP will be used based on the definitions provided earlier. With that said, I don't think BiLevel is better than CPAP, it's just different therapy. BiLevel may be more effective for some patients or the preferred treatment for some patients with difficulty breathing, but not better. The idea of better came from the routine practice of many physicians to automatically change therapy from CPAP to BiLevel when a patient arrives to the hospital by EMS or is admitted. Generally, EMS agencies do not have BiLevel capabilities and are using CPAP for all difficulty breathing patients regardless of the underlying cause. During the 2018 National Association of EMS Physicians conference, (NAEMSP), I asked several EMS physicians if they routinely change therapy from CPAP to BiLevel when patients arrive by EMS and the answer was a resounding yes. When I pointed out that current research does not strongly support one over the other, each one said in their experience patients did better on BiLevel. However, when Respiratory Therapists were asked the same question, most felt the doctors were overutilizing BiLevel. How's that for a conundrum? If BiLevel is better why doesn't EMS use BiLevel? If it's not better why do physicians routinely change therapy? The most likely reason EMS does not use BiLevel is the cost. Currently, there are no disposable BiLevel devices and BiLevel ventilators come with a big price tag. A disposable CPAP device can be purchased for less than $50 and can be left with the patient, no delays, no cleaning and simple to use. As far as physicians routinely using BiLevel over CPAP, I believe some anecdotally think it's better, others think that by the time the patient gets to the ER they are tired and need the extra help BiLevel provides and some may not know the difference.

If we follow the thinking that the patient is tiring or having trouble doing the work, then the obvious question would be which therapy is non-invasive ventilation (NIV)? There are plenty of papers that state CPAP is NIV and there are plenty of papers that say it's not. I for one believe it's not. CPAP is for a spontaneously breathing patient who can still do the work, but would benefit if the work was easier. Many of these patients have an oxygenation issue and are best described as hypoxic difficulty breathing patients. BiLevel is generally for spontaneously breathing patients who need some help doing the work best described as a hypercapnic difficulty breathing patients. When BiLevel devices cycle pressure from low (expiratory pressure or EPAP) to high (inspiratory pressure or IPAP), that kick in pressure helps the patient inhale making it a form of NIV. Some BiLevel devices also offer a backup rate often described as a spontaneous and time BiLevel mode providing a breath if the patient becomes apneic, this capability is not seen with most CPAP devices. So, instead of pigeonholing a patient under difficulty breathing why not assess which patients are hypoxic or hypercapnic or both. The best solution, especially prehospital or when there is a shortage of BiLevel ventilators might be a disposable device that offers both BiLevel and CPAP.

What's a beneficial starting pressure? I don't believe there is a universal answer when it comes to using CPAP or BiLevel for difficulty breathing. When utilizing CPAP I think the best approach is to start low and work your way up, subsequently there can be negative effects of increased airway pressure, such as a drop in blood pressure or an increase in the work of

Steven LeCroy spent more than 30 years with St. Petersburg Fire & Rescue and retired as a Captain Paramedic. In addition, he has been an adjunct instructor at St. Petersburg College since 1984 and is certified as a Respiratory Therapist since 1978. He has been retained as an EMS Expert in over 100 legal cases. Steven has been a national speaker and has published articles in both EMS World and JEMS magazines. He is also the author of the "Equipment Technology for Noninvasive Ventilation in the Pre-hospital Setting" chapter in the textbook, *Noninvasive Mechanical Ventilation: Theory, Equipment, and Clinical Applications* published by Springer International Publishing Switzerland. Currently he is the Clinical Manager for Mercury Medical.

breathing. Using the lowest pressure that improves the patient's respiratory status should be the goal. In the pre-hospital setting research indicates the maximum pressure should be 10 cmH_2O. In the hospital higher pressures can be used due to a more controlled setting. With BiLevel the same thinking applies, the lowest pressure that improves the patient's respiratory status. Good initial BiLevel starting pressures would be 10 cmH_2O for the inspiratory pressure (IPAP) and 5 cmH_2O for the expiratory pressure (EPAP). These numbers can always be adjusted based on patient assessment. Nevertheless, the difference between the IPAP and the EPAP pressures often referred to as pressure support should always be at least 5 cmH_2O. Some of the advanced BiLevel devices offer automatic settings that adjust pressure levels according to patient need.

CPAP in general has been shown to reduce intubations, admissions to critical care units, and, consequently, a reduction in length of stay. Most of the studies that report outcomes from CPAP therapy do not differentiate between BiLevel and CPAP. Anecdotal evidence would indicate that BiLevel improves outcomes when compared to CPAP. Apart from the 1997 study by Mehta (1997 Critical Care Medicine) that stated, "The higher rate of myocardial infarctions associated with the use of bilevel positive airway pressure highlights the need for further studies". All other studies concluded the number of myocardial infarctions was similar in CPAP and Bilevel therapy groups. The difficulty would be to get a study approved by an institutional review board (IRB) when physicians believe one therapy is better than the other.

So, back to the basic question. Does BiLevel therapy produce a better outcome than CPAP therapy? The popular opinion appears to be yes, but what we don't see is the supporting documentation. Most everyone agrees that positive pressure therapy works. What everyone doesn't agree on is which form of therapy works best. I know one pulmonologist that believes all patients with difficulty breathing should be CPAP candidates. What he doesn't say is which type. I've never been a fan of always and never when it comes to medicine. A better sequence of questions would be: Should the appropriate therapy be determined based on patient assessment? Is the patient hypoxic or hypercapnic or both? Do we understand the pathophysiology of different medical conditions that may benefit from not only positive pressure, but pressure delivered in different ways? The jury is still out on BiLevel making a difference, but with advances in technology and further studies, we may soon have our answer.

References

- Behringer, T. and Collins, S. (2015). Non-invasive Ventilation: A Gimmick or Does It Really Affect Outcomes?. Current Emergency and Hospital Medicine Reports, 3(2), pp.62-65.
- Craven, R., Singletary, N., Bosken, L., Sewell, E., Payne, M. and Lipsey, R. (2000). Use of Bilevel Positive Airway Pressure in Out-of-hospital Patients. Academic Emergency Medicine, 7(9), pp.1065-1068.
- Hess, D. (2013). Noninvasive Ventilation for Acute Respiratory Failure. Respiratory Care, 58(6), pp.950-972.
- Ho, K. M., & Wong, K. (2006, March 27). A comparison of continuous and bi-level positive airway pressure non-invasive ventilation in patients with acute cardiogenic pulmonary oedema: A meta-analysis. Retrieved July 5, 2018, from https://ccforum.biomedcentral.com/articles/10.1186/cc4861
- Mehta S, Jay GD, Woolard RH, et al: Randomized, prospective trial of bilevel versus continuous positive airway pressure in acute pulmonary edema. Crit Care Med 1997; 25: 620–628
- Panacek, E. and Kirk, D. (2002). Role of Noninvasive Ventilation in the Management of Acutely Decompensated Heart Failure. Reviews In Cardiovascular Medicine, [online] 3(4), pp. S35 - S40. Available at: https://ucdavis.pure.elsevier.com/en/publications/role-of-noninvasive-ventilation-in-the-management-of-acutely-deco [Accessed 5 Jul. 2018].x

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