Inpatient Prostacyclin Administration Errors: An Opportunity to Improve Patient Safety

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Intravenous epoprostenol (Flolan®; GlaxoSmithKline, and Veletri®; Actelion) and treprostinil (Remodulin; United Therapeutics) are continuous intravenous medications used in the most advanced cases of PAH. Dose changes are made in minute increments and sudden increases or decreases in the dose can be life-threatening.

When patients require hospital admission, prostacyclin administration and programming of their home infusion pump becomes the responsibility of the pharmacy and nursing staff. This can be challenging as many nurses have had limited exposure to both the medications and the ambulatory infusion pumps. We conducted a national survey to determine the type and frequency of prostacyclin administration errors in the hospital setting and to explore hospital policies regarding prostacyclin infusions. Ninety-seven PAH treating centers participated in the survey.

Policy questions explored what type of pump was used in the hospital when patients are admitted and whether or not back-up prostacyclin was kept on the nursing unit. More than half (59%) of the respondents kept patients on their own ambulatory infusion pumps; 12% transitioned patients to hospital CADD pumps; and the remaining 28% transitioned patients to regular hospital infusion pumps. Back-up epoprostenol cassettes were stored on nursing units at 65% of the respondent's hospitals, whereas only 28% kept back-up treprostinil on the unit ($p<0.05$).

The survey also explored number and type of prostacyclin errors which have occurred at each center. Serious or potentially serious errors were reported by 65 (68%) of the 95 respondents who completed the survey section on errors. Some of the errors resulted in minimal or no symptoms, but 28 (29%) reported errors that led to a serious adverse event, including 9 deaths. The most commonly reported error, described by 31 respondents, involved flushing the dedicated prostacyclin line. Other errors reported by multiple respondents included use of the wrong medication dose due to calculation or concentration error ($N = 29$); use of a prostacyclin cassette or bag that was intended for a different patient ($N = 25$); incorrect rate programmed into the infusion pump ($N=24$); and pump inadvertently stopped for a period of time ($N = 24$). There were also 15 miscellaneous errors written in by respondents. Overall error rates were similar regardless of whether home infusion pumps or hospital pumps were used for prostacyclin administration ($p>0.05$).

Our findings suggest that prostacyclin infusion errors are not uncommon, and carry considerable safety risk. We believe the errors occur for several reasons: the identical appearance of treprostinil and epoprostenol cassettes; the multitude of available concentrations; the lack of familiarity of some nursing staff with the infusion pumps; the complex weight-based dosing; and the lack of standardized guidelines. Further, the narrow therapeutic dosing range, combined with patients who often have tenuous hemodynamics, means that even modest dosing errors can, and do, lead to serious or fatal outcomes.

After interviewing several centers that had experienced serious errors and made process changes, we developed some basic recommendations. The similarities in certain policy improvements across multiple experienced centers add strength to these recommendations, but evidence-based support is lacking. The present investigators believe that the most important policies involve limiting the number of epoprostenol and treprostinil back-up cassettes stored on the nursing units at any given time in order to limit the opportunity for a mix-up. Also, requiring a second RN signature, as is commonly done with blood products, seems to be a prudent and important safety measure.

The findings in this survey suggest that hospitals should consider standardized prostacyclin administration policies, including ongoing training of staff to decrease the likelihood of a serious event or death. Special consideration will be required for home miniaturized pumps as well. Currently our group in conjunction with the PH Resource Network and Scientific Leadership Council are working on a more comprehensive safety consensus statement. For now, to review more policy safety suggestions, please refer to the full manuscript: Kingman M, Tankersley M, Lombardi S, Spence S, Torres F, & Chin K. *Prostacyclin administration errors in pulmonary arterial hypertension patients admitted to hospitals in the United States: a national survey. J Heart Lung Transplant. 2010;29:841-846.*

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