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perk



Posted 20 April 2006 05:32 AM

Just want to get a general feel for what technicians & nurses think about the safety issues involved when a venous access becomes dislodged or seperated from the access while the patient is on the machine. With all the bells and whistles the machine has for problems that might arrise, why has this not been addressed by the vendors? Blood flows increase to 500 + and no safety device in inline.Thanks, Perk

This message has been edited. Last edited by: [perk](#), 11 May 2006 10:39 AM

Posts: **1** | Location: **Charleston,WV USA** | Registered: **10 October 2003**



ScottH



Posted 20 April 2006 11:30 AM

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Undetected Venous Line Needle Dislogement during Hemodialysis was published by ECRI in Health Devices, Nov 1998;27(11):404-6. I have read alerts regarding this issue from at least Gambro(Cobe) and B.Braun Medical and I don't doubt every other manufacturer has written something as well over the years.

That said, this has been a growing problem along with the trend of increasing blood flow rates and is not a machine dependant hazard, it can occur with any manufacturers machine.

Because the hazard is not neccessarily a simple one to fully appreciate, it's worth reviewing what pressures are where in the extracorporeal circuit. Blood comes from the patient via the arterial needle or port and is measured for pressure pre-blood pump (Arterial). Depending on the machine, there may be another pressure read post-pump before the blood enters the dialyzer. The next blood pressure measurement (Venous) is read after the blood exits the dialyzer but before it enters the venous needle or port and is returned to the patient.

In a static system (blood pump off), the pressures (both arterial and venous) would be nearly 100% a reflection of the patient's vital pressures. During dialysis however, we have a dynamic system through the extracorporeal circuit that contribute multiple factors as a percentage of the total meter pressure, dramatically effecting the

composition of both the arterial and venous pressures. These factors include:

Blood pump speed, Size of the needle lumen, Surface drag of the blood tubing material, Compliance of the tubing material, Blood viscosity and Temperature.

Remembering that with the blood pump off, there is little or no effects attributed to the A/V meter pressures other than the patient's blood pressure, with increasing blood pump flow rates (Q_b) the patient's pressure contribution is quickly overwhelmed by these latter factors (particularly the needle lumen size). If the pressures contributed were to be graphed out, one would see not linear positive sloping lines but a set of positive curves and S-shapes, except for the patient's pressure contribution which would be negatively correlated to the sum of all the other factors.

Back in the years when Q_b 's were 150 to 250 ml/min, it would not be abnormal to have the patient's contribution to be 30 - 40% of the meter pressures. In such a situation, should a venous needle come out, the venous meter pressure might drop as much as 40%. With today's Q_b 's hitting twice this, the patient's pressure contribution could be as low as 05%. Just the tubing compliance paired with the pressure oscillations of a peristaltic pump (all blood pumps are currently of this type) can contribute as much as this. That means, unless you want continuous venous pressure alarms while at this Q_b , the alarm window would need to be wider (in this case) than the pressure drop from the venous needle disconnecting. Unfortunately, this means that the alarm will probably not trip should this occur.

From an engineering standpoint, this is a difficult problem because of the number of factors that contribute to the meter pressures and that most of them are quite variable under widely different circumstances. To date, no manufacturer has been able to overcome these obstacles. The strong consensus of opinion is that clinical operators must be continuously vigilant in monitoring the extracorporeal circuit and that needles are secure and in place at all times, particularly in the case of any blood handling alarm.

Some food for thought... Even if the blood pump was set to a rate where a venous pressure alarm would occur should the needle come out, if the operator resets the blood pump (unaware the needle is out) the new alarm limits will be activated around the new lower pressure and obediently pump the blood from the patient without the patient's pressure contribution to set off another alarm and stop the catastrophe.

This last scenario is the one that keeps me up at night.

Please forgive the long post.

Scott Hansen
NKC Technical Services

Posts: 3 | Location: **Seattle** | Registered: **19 October 2005**



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