**Potassium Administration and Drug Safety.**

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Potassium is an important inorganic mineral (referred to as an electrolyte) in human physiology. The regulation of potassium levels in the blood and cells is complex, and is frequently deranged in disease. Having too much or too little potassium in the blood can cause serious problems or even death. Minor deviations from normal potassium levels are tolerated well, but major deviations are not.

Because it is important, potassium levels are frequently measured in hospitalized patients. Potassium levels that are too high are treated with a variety of medications, and can be one of the reasons that patients with kidney failure can require hemodialysis.

Low levels of potassium motivate physicians to order potassium replacement. There is very little data about the danger posed by low leves of potassium. Low levels of potassium may be very well tolerated in some patients and settings, but not in others. There is no consensus about when to replace potassium, and it would be difficult to develop guidelines given the lack of data about this subject. Potassium can be replaced intravenously or via the gut. The rapid administration of intravenous potassium, or the administration of too much potassium can cause hyperkalemia, which is very likely to cause death.

There are no other electrolytes that are both as important as potassium, or made abnormal as frequently by disease as potassium. In fact, there are very few medications which are as dangerous to give as potassium.

Therapeutic Index = Toxic dose/therapeutic dose

Digoxin and theophylline are the only two commonly used medications with therapeutic indices as low as potassium. Their use is controversial, and many doubt that they would be approved by the FDA today.

Potassium is frequently replaced/administered in hospitalized patients. As a consequence, doctors are continuously writing orders for its administration, and nurses and pharmacists are constantly handling it and administering it to patients. Blood levels of potassium are frequently measured in hospital patients.

Concentrated potassium solutions are available from pharmaceutical manufacturers, and are diluted with other solutions for administration to patients. Historically, this task has been performed on hospital wards by nurses, but has also been done in hospital pharmacies as well. There are a variety of pre-mixed solutions which are now available from manufacturers which contain potassium.

The following are examples of problems that can occur with potassium handling:

1. Any dose which is given too quickly can be associated with a rapid rise in blood potassium levels. (lethal injection executions)
2. Too much can be given.
3. If potassium is mistaken for some other medication and given too quickly, blood levels of potassium can rise to dangerous levels.

Errors in the dilution of potassium as well as direct, mistaken administration of potassium to patients have both been the subjects of intense news media publicity (particularly #3 above). There is at least one highly respected professional organization, the Institute for Safe Medical Practice(ISMP), which has attempted to disseminate information about these events to both the media as well as practitioners. The ISMP has also campaigned (RNs, MDs, PharmDs, hospitals, govt, FDA) to have concentrated potassium solutions removed from most nursing units and restricted solely to the pharmacy in most hospitals.

Many believe that failure to heed the counsel of the ISMP is an example of disinterest among practitioners of medicine in safety.

Is this truly the case??

Questions and issues which come to mind when considering this problem include:

1. Shifting the mixing of potassium with other solutions to pharmacy from the nursing units changes the location where errors occur. It may also make errors in mixing significantly harder to detect - since the person who makes the error isn't aware of its consequences.

2. The shift also increases the delay incurred for nurses to administer IV solutions. It has also increased the turn-around-time for all other orders from the pharmacy. This 'friction' effect can be substantial.

3. This will not prevent the accidental rapid administration of potassium intravenously. It will prevent 'swaps' which result in the accidental administration of potasium instead of another medicine
(usually furosemide).

4. The potassium problem is easy to recognize because the person who accidently mixes the wrong dose, gives the wrong medication, or administers the rider too quickly is in an ideal situation to recognize what has happened. Reactions more remote in time are much harder to recognize. Except for exceptional clusters of cases (i.e. the neonatal pharmacy case in the ISMP packet), accidents which begin in the pharmacy may be difficult or even impossible to detect.

Remote reactions: fen-fen, encainide, paralytic myopathy

5. 'medication error reporting' is haphazardly done. There are a variety of agencies and organizations which try to collect this information - but no agency has all of the reports, and under-reporting as a consequence of fear of sanctions is a very real problem. For example - the USP list does not seem to contain all of the cases from the ISMP's packet - many of which happened over the same time period.

6. Even if this is a problem - and even if this is the most common problem - it is either very under-reported or very uncommon. The University of Chicago hospital orders approximately 52,000 vials of potassium a year. The pharmacy mixes 80 'riders' a day for adult patients on the floors. Nurses in pediatrics and the ICUs continue to mix their own.

7. Nursing units in many hospitals now stock pre-mixed solutions of potassium (as well as theophylline), which are not as clearly labeled as the concentrated solutions, and which can also be accidentally administered to the wrong patient.

8. Removing concentrated potassium solutions will not prevent the rapid administration of potasssium riders, nor will it prevent rider swaps.

9. Most hospitals cannot tell you how many hyperkalemia cases they have had, and fewer can tell you whether they were associated with potassium administration.