Valve Matters

The design and function of the different types of valves used in drug and infusion connector systems can be a source of confusion.

One-way valves

These permit fluid or drugs to flow through them in one direction only. They do not require any back pressure to prevent flow in the 'wrong' direction. The reason for this is that their resting state is in a closed position, they are sometimes called 'normally closed' valves. The valve can be opened to flow in one direction only. The main difference between the two types of one-way valve used in connector systems is the pressure that is required to open (crack) them. Normally closed valves require a high degree of accuracy in their manufacture and their crack pressure and tolerances are often quoted (e.g. 3.5 bar +/- 0.5).

1. Low crack pressure (gravity) valves

These one-way valves, as the name suggests, open with the low driving pressure that a gravity infusion (drip) provides. The force of gravity acting on the infusion fluid when the infusion is placed above the patient's cannula is sufficient to open the valve and allow the fluid to flow. Back pressure, for instance caused by administration of a bolus dose of a drug distal (nearer the patient) to the valve, causes the valve to close thus preventing 'backing up' of the drug in the connector system.

2. High crack pressure (anti-syphon) valves

These one-way valves require a far greater driving pressure to open them. They are suitable for use with pumps (syringe driver or volumetric). The higher crack pressure ensures that free flow or syphonage will not occur simply because the infusion is placed above the height of the patient's cannula. These valves also close if flow in the 'wrong' direction occurs.

Needle-free valves

Needle-free (or needleless) valves are not usually one-way valves. They will allow drugs or fluids to be administered into a connector system but also permit fluid or blood to be aspirated from them in the other direction. Needle-free valves are normally closed and are opened by inserting the tip of a syringe into them. Some such valves also have a screw thread built into their head so that Luer threaded syringes can be screw locked onto them. These valves prevent the risk of needle stick injury to patients and clinicians. They may be damaged by attempts to insert a needle into them and so must be replaced if accidental needle insertion has occurred. Needle-free valves are swabable physical barriers to infection and studies have shown that their use is associated with a lower incidence of vascular catheter infection.

Hidden reservoirs and unwanted bolus dosing

Temporary obstruction (partial or complete) of the delivery system or vein distal to where the drug infusion enters the fluid path can cause 'backing up' of the drug infusion into the fluid giving set. Subsequent relief of the obstruction causes an unseen, unmeasured, and unwanted bolus dose of the infused drug to be given to the patient. Examples include accidental boluses of synthetic oxytocic (e.g. Syntocinon) or vasodilator (e.g. nitrate) causing massive uterine contraction and intrauterine death and profound hypotension and coronary ischaemia respectively.

Learning Point:

Ensure that all gravity lines connected to drug infusion lines are fitted with a gravity (i.e. low crack pressure) back check valve.

Free flow (syphonage)

Uncontrolled free flow of a drug from its reservoir (e.g. syringe) can occur at any time after the delivery line has been primed. Syphonage can occur even when the pump is functioning entirely normally or turned off. All that is required is that the drug reservoir is placed higher than the patient's cannula. Following patient deaths from syphonage, free flow has been called 'the silent killer'.

Learning Point:

Ensure that all pumped drug infusion lines are fitted with anti-syphon (i.e. high crack pressure) valves.

Always isolate the infusion from the patient before removing the syringe from its pump by closing the line clamp.

Needle-free valves

An increasing focus on patient safety and in particular avoidance of hospital associated infections has led to the call for all access ports in intravenous systems to be fitted with needle-free valves. Such valves immediately negate the risk of needlestick injury to both patient and carer. They also reduce the incidence of vascular catheter infection, and external contamination from the administered fluid or drug. Where they are used in place of stop taps with cocks, needle-free valves also negate the risk of complications caused by the incorrect use of stop taps.

Learning Point:

Use needle-free valves in the drug administration set where drugs will be injected intermittently.

Never inject a drug into an administration set using a needle mounted on a syringe.

Replace stop taps with cocks with needle-free valves to reduce complications caused by the use of stop taps.

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