

Post-infusion phlebitis is a common complication of intravenous therapy. Pat Francombe found that intravenous filters help reduce its incidence

INTRAVENOUS FILTERS AND PHLEBITIS

NURSES' involvement in the administration of intravenous therapy has increased dramatically in recent years. It is therefore important to realise the factors associated with the development of phlebitis and effective measures which can be taken to control the problem.

Post-infusion phlebitis (reddening, often accompanied by pain, proximal to the venepuncture site) is the most common complication of intravenous therapy, affecting up to 70% of all infusions¹ (Fig 1). The increase in the use of intravenous therapy for fluid replacement, nutritional requirements and drug therapy has increased the use of invasive techniques. Intravenous catheters and infusions expose the patient to possible bacterial and fungal contamination and, in addition, to particulate matter.

A recent survey of several hospitals² revealed that nurses in general believe that the most significant factors contributing to the development of phlebitis are (in approximate order) bacterial contamination at the venepuncture site or catheter tip, the use of chemically irritating drugs, the duration of intravenous therapy, catheter management (that is, site preparation, catheter placement, avoidance of catheter movement) and particulate contamination of drugs and solutions.

In fact, the most significant factors causing phlebitis are particulate matter, drug pH and osmolarity, duration of therapy and location of cannula. There is no significant association between phlebitis and bacterial presence. However, patients with phlebitis seem to be at a greater risk of developing septicaemia³. Particulate contaminants may be derived from incompletely reconstituted drugs, rubber stoppers, glass from vials, plastics from the cannula, syringes, taps and intravenous

lines.

Common strategies cited for dealing with phlebitis were resiting of the cannula and careful aseptic technique.

In our unit we became aware of an increase in the incidence of phlebitis. Although there may have been several reasons for this trend, it is probably significant that we had started to use multi-drug therapy and increasingly used syringe pumps to deliver more concentrated doses of drug for more controlled patient management.

We attempted to limit phlebitis by improving techniques for cannulation, and by keeping the cannula patent by regular flushing. Neither of these techniques was successful.

A review of the clinical literature indicated that there was a poor correlation between the presence of bacterial contamination of the catheter (the most frequently cited cause of phlebitis) and development of vein irritation at the cannulation site^{3,4}; conversely, a series of articles^{5, 6, 7, 8, 9, 10} appeared in print which strongly suggested that particles present in intravenous solutions and drugs were a major cause of post-infusion phlebitis.

Particles, although minute, may cause considerable harm. They travel through the venous system, ending in the capillary bed of the lung. Particles larger than the capillary diameter (7-12µm) will become lodged in the lung, leading to cellular damage or tissue death. Particles that have bypassed the lungs enter the arterial system; several clinical investigations have suggested pathological consequences of this process¹¹. Therefore, the removal of particulate matter before it enters the lung field seems prudent.

Particles present in intravenous drugs solutions can be divided into those present as an inevitable result of the manufacturing process (intrinsic

contamination) and those present as a result of opening or puncturing the container, drug reconstitution (where applicable) and drug interactions (extrinsic contamination). As previously stated, particles are also found in syringes and administration sets.

Although the permissible number of particles present in large volume parenterals (LVPs, that is, containers with a volume of solution of 100ml or greater) are regulated by the *British Pharmacopoeia* (1980), no British standard currently exists for small volume parenterals (SVPs, that is, drugs in vials and ampoules with a container volume of 100ml or less) other than the statement: 'injectable preparations which are solutions, when examined under suitable conditions of visibility, must be clear and practically free from particles'.

Significant quantities of particles are present in SVPs, especially in reconstituted drugs¹². Up to 70% of particles present in an intravenous administration system are contributed by addition of drugs to the line. Overall, a typical critical care patient may receive intravenously of the order of two million particles greater than 2 microns in size per day of therapy¹³. Removal of these particles, using end-line intravenous solution filters fitted proximally to the catheter, seemed a logical approach.

With the introduction of end-line filtration in the IV delivery system a remarkable result was observed (Fig 2). We investigated some 56 patients before the introduction of filtration, and 101 patients afterwards. The relationship of phlebitis/no phlebitis in these two groups is shown in Fig. 3. None of our other standard procedures or intravenous practices changed significantly during this period.

Although we do not see the use of intravenous solution filters as a panacea for the problems of phlebitis, they do

Fig 1. Phlebitis



Fig 2. A patient receiving intravenous therapy



Fig 3. C



seem to be receiving other intravenous therapy. Bacteria administration accidents is reported in the literature.

These important immunological problems are prone to well have

Fig 1. Phlebitis following intravenous drug administration (by permission of Dr S. Mehtar, North Middlesex Hospital)

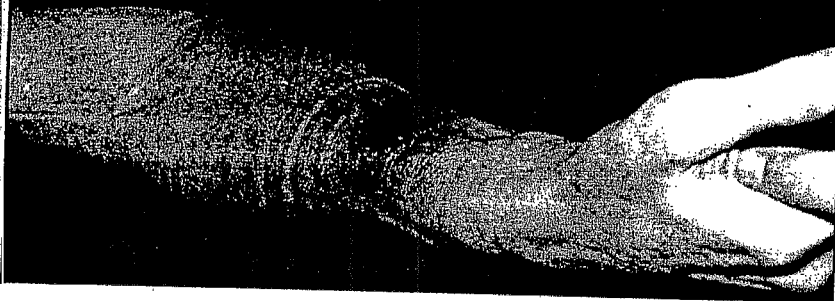


Fig 2. Application of an end-line intravenous filter (set saver, ELD 96 LYS Pall Biomedical, Portsmouth, UK)

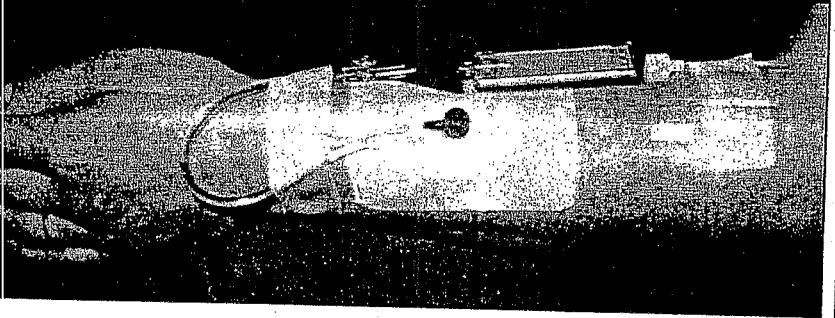
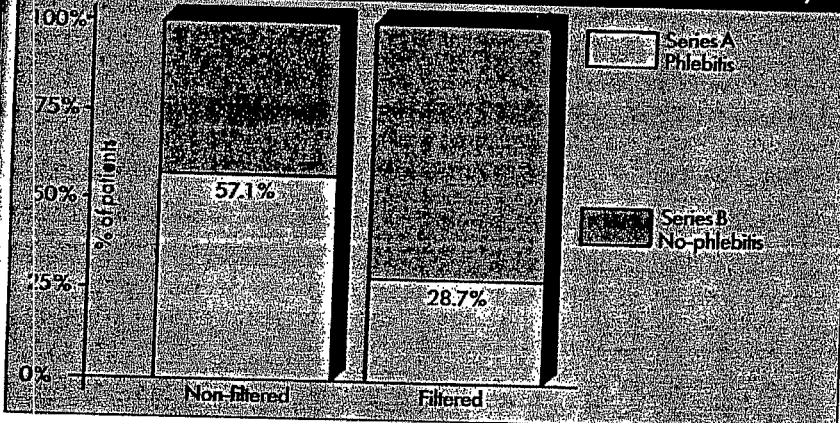


Fig 3. Occurrence of phlebitis (Non-filtered and filtered infusions)



seem to be of value to those patients receiving drugs intravenously.

Other advantages of these devices include protection of the patient from bacteria present in the intravenous administration system as a result of accidental touch contamination (which is reported to occur in about 3% of all infusions¹⁴), and their ability to vent air.

These last two aspects are particularly important in immunosuppressed and immunocompromised patients, who are prone to infections, and who may well have central lines for monitoring or

feeding; through these lines could well prove of air and bacteria through these lines could well prove fatal¹⁵. The presence of a filter will not significantly alter the accuracy of central venous pressure measurement¹⁶.

Some intravenous line filters are guaranteed for a 24-hour period, but recently manufacturers have developed filters with a longer lifespan. These filters can be left *in situ* for up to 96 hours. Their use can influence the frequency of changing administration sets (usually changed every 24 hours) and this would be a cost-effective means

of justifying the use of the intravenous filter.

There are many articles documenting the potential danger from particulate matter infusion and bacterial contamination during intravenous therapy. Our study has highlighted the clinical efficacy of intravenous fluid filtration in reducing the incidence of phlebitis; this is just one aspect of the advantages of filter use when patient safety is of prime importance. **NT**

REFERENCES

- Ryan, P.B., Rapp, R., Deluca, P. et al. In-line final filtration: a method of minimising contamination in intravenous therapy. *Bulletin of the Parenteral Drug Association* 1972; 27, 1-14.
- G. D. Lowe, Pall Biomedical Limited (Personal communication).
- Maki, D.G. Infection control in intravenous therapy. *Annals of Internal Medicine* 1973; 79, 867-887.
- Cowan, M.E. Bacterial contamination of side-ports of 'Venflon' intravenous cannulae. *Journal of Hospital Infection* 1982; 373-79.
- Rebagay, T., Rapp, R., Bivins, B., Deluca, P. Residues in antibiotic preparations 1: scanning electron microscopic studies of surface topography. *American Journal of Hospital Pharmacy* 1976; 33, 433-443.
- Dorris, G.C., Bivins, B., Rapp, R. et al. Inflammatory potential for foreign particulates in parenteral drugs. *Anesthesia and Analgesia* 1977; 56, 422-428.
- Rusho, W.J., Bair, J.N. Effect of filtration on complications of postoperative intravenous therapy. *American Journal of Hospital Pharmacy* 1979; 36, 1355-1356.
- Bivins, B., Rapp, R., DeLuca, P. et al. Final inline filtration: a means of decreasing the incidence of infusion phlebitis. *Surgery* 1979; 85, 388-394.
- Alcut, D.A., Lort, D., McCollum, C.N. Final inline filtration for intravenous infusions: a prospective hospital study. *British Journal of Surgery* 1983; 70, 111-223.
- Falchuk, K.H., Peterson, L., McNeil, B.J. Micro-particulate induced phlebitis. *New England Journal of Medicine* 1985; 312, 78-82.
- Leong, A.S-Y. Particulate contamination in intravenous therapy and extracorporeal systems. *The Medical Journal of Australia* 1982; 2, 309-310.
- Backhouse, C.M., Ball, P.R., Booth, S. et al. Particulate contaminants of intravenous medications on infusions. *Journal of Pharmacy and Pharmacology* 1987; 39, 241-245.
- Mehrkens, H.H., Klaus, E., Schmitz, J.E. Möglichkeiten materieller Verunreinigungen durch Zusatzinjektionen. *Klinische Anästhesiologie und Intensivtherapie* 1977; B and 14.
- Denyer, S.P. In-use contamination in intravenous therapy — the scale of the problem. In: D'arcy, P.F. (ed) *Infusions and Infections? The hazards of in-use contamination in intravenous therapy*. Oxford: The Medical Publishing Foundation, 1982, 1-15.
- Coppa, G.F., Thomas, M.D., Gouge, H. et al. Air embolism: a lethal but preventable complication of subclavian vein catheterisation. *Journal of Parenteral and Enteral Nutrition* 1980; 5, 166-168.
- Gibbs, E.P., Lowe, G.D. Central venous pressure measurement with end-line bacterial filtration. *Anaesthesia* 1981; 36, 829.

Pat Francombe, RGN, is sister (coronary care), Singleton Hospital, Swansea