Technical methods

A plastic bag system which facilitates the preparation and pooling of blood components

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One of the many developments within the Blood Transfusion Service has been the introduction of blood component therapy whereby several individual components of a donation are prepared in order to provide low volume, high concentration fractions. This approach has resulted in new, specific, and effective products and at the same time enabled the Service to make the best use of its scarce raw material. The single most important technical advance responsible for this development has been the replacement of rigid glass bottles by collapsible plastic bags. However, in order to obtain fresh plasma, cryoprecipitate, platelets, and red cells from a donation, it has been assumed that the donor blood must be withdrawn into triple or quadruple bag systems. This approach is both time-consuming and expensive and may be responsible, at least in part, for the slow introduction of plastic bags into the Blood Transfusion Service throughout the United Kingdom.

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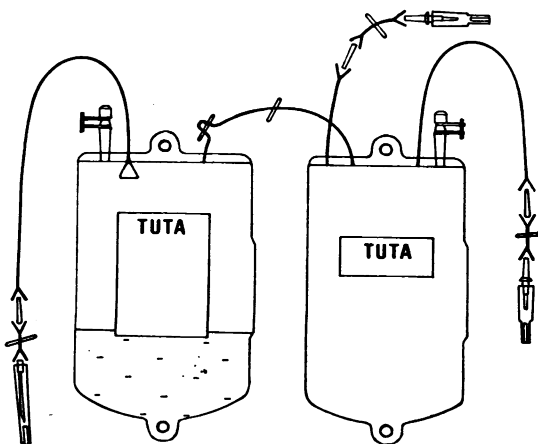

Fig 1 *Diagrammatic representation of the modified double bag showing two outlet lines on transfer-pack.*

The following communication describes a simplified and less expensive system, based on the double-bag, which enables all primary components to be prepared with ease, and greatly facilitates rapid pooling of all concentrates prior to their clinical use. The system has been in operation for three years in this Centre and has proved to be both safe and acceptable to laboratory and clinical personnel.

Modified Double Bag and Pooling Manifolds

The double bags used were supplied and modified for us by Tuta Ltd, Surbiton, Surrey (code number 03-301). The significant feature of the design has been the introduction of two outlet lines situated at the top edge of the transfer pack (fig 1). Both outlet lines terminate in male luer fittings which can be plugged, when required, into the female luer fittings of pooling manifolds (fig 2) (supplied by Avon Plastics Ltd, Kings Norton, Birmingham).

Practical Applications

PLATELETS

Those donations from which it is intended to obtain platelet concentrates and fresh plasma, the latter destined either for the Protein Fractionation Centre or for immediate clinical use, are first centrifuged at 450 g for 10 min at 20°C. The platelet rich plasma is transferred to the transfer-pack and the transfer line is sealed and cut at both extremities. The transfer-pack, containing platelet rich plasma, is then centrifuged at 1900 g for 30 min at 20°C and the platelet poor plasma is pooled through the longer outlet line and plugged into a primary pooling manifold (code number S75 E2 Blood Component Manifold). If the plasma is bound for the Protein Fractionation Centre then 2 units are transferred simultaneously under pressure, using plasma extractors, into a 5 litre bag (supplied by Luxam Hospital Supplies Co, Barnoldswick, UK). This is repeated until a sufficient volume of plasma is transferred. However, if clinical units of fresh frozen plasma are required then 2 units are pooled simultaneously through a primary manifold into a 500 ml transfer-pack fitted with a transfer line terminating in a female luer fitting (supplied by Tuta Ltd, code number 16-040).

On completion of pooling the used outlet line is heat sealed and cut close to the transfer-pack. The remaining short outlet line is retained and used to plug into a secondary manifold (supplied by Avon

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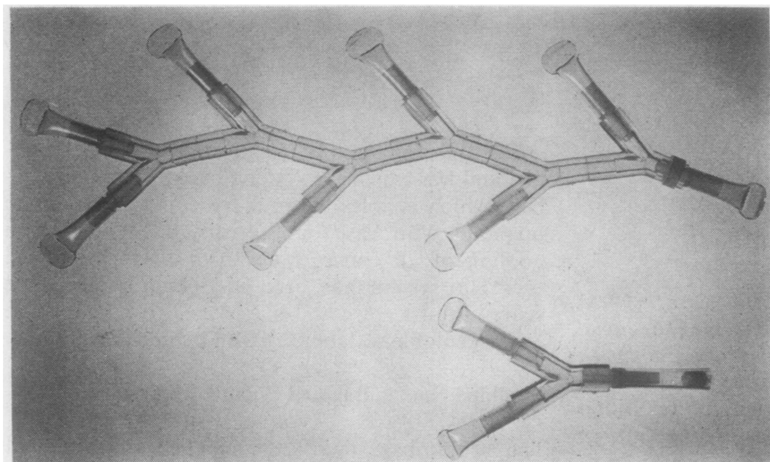

Fig 2 *Primary (small) and secondary (large) pooling manifolds.*

Fig 3 *Pooling of platelet concentrates (or cryoprecipitate) by gravity through a secondary (large) manifold prior to ward issue.*

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Medicals Ltd, code number D88 E7 Type Blood Component Manifold) for rapid, gravity aided pooling of platelet concentrates, after a specific patient request has been made (fig 3).

If the Blood Bank is short of whole blood then the transfer line between packs is not heat sealed and cut but temporarily occluded using the clip provided on the transfer line. After the second centrifugation (of both red cells and platelet rich plasma) the platelet poor plasma is transferred back to the red cells, and the transfer line is sealed and cut at both extremities.

This procedure readily makes available either whole blood (minus platelets) and platelets, or concentrated red cells, platelets, and fresh plasma.

CRYOPRECIPITATE

Those donations from which it is intended to obtain cryoprecipitate and cryoprecipitate supernatant for fractionation are centrifuged at 1900 **g** for 60 min at 4°C. The platelet poor plasma is forced into the attached transfer-pack, and the transfer line is sealed and cut at both extremities. The transfer-pack is then snap frozen in an ethanol/dry ice mixture (−60°C) for 10 min, thawed at 4°C for up to 12 h, and then centrifuged at 1900 **g** for 30 min. The supernatant is pooled under pressure into a 5 litre bag through the longer outlet line which is then sealed and cut close to the transfer-pack. The short outlet line is retained and used for rapid simultaneous pooling (by gravity) of thawed cryoprecipitates when requested for patient care, using the larger (secondary) pooling manifold (fig 3).

If factor VIII deficient whole blood is required then the primary and secondary packs are not separated but clipped off temporarily; the platelet poor plasma is snap frozen in the normal manner but the concentrated red cells are placed outside the ethanol/dry ice mixture. After the cryoprecipitate has thawed both packs are centrifuged at 1900 **g** for 30 min and the cryoprecipitate supernatant is transferred back to the red cells. The transfer lines are then sealed and cut at the extremities.

The procedure readily makes available whole blood (minus factor VIII) and cryoprecipitate, or red cell concentrates, cryoprecipitate, and cryoprecipitate supernatant.

Studies were undertaken to ascertain whether, during the primary pooling procedure which is performed under pressure, it is possible for back-flow to occur and thus result in cross-contamination of the red cell concentrates. Forty-eight outdated whole blood units in single pigtail bags were selected randomly. To 24 separate donations was added and mixed 1 ml (5 μCi) of ^{125}I iodinated human albumin. All donations (24 iodinated and 24 non-iodinated) were centrifuged at 1500 rev/min for 30 min at 20°C and left overnight at 4°C. The plasma from 24 pairs, consisting of one radiolabelled pack and one non-labelled, was separated and pooled under pressure in the routine way, using a primary Y-shaped manifold draining into a 5 litre bag. The upper layer of the residual plasma in the non-radiolabelled bag was sampled and counted. It was calculated that 1μl of radiolabelled plasma passing into the non-labelled bag would increase the count by 50. In no case did this occur.

Comments

One of the important reasons for the introduction of a multiple continuous bag system in the preparation of the various components of blood donations was the desire to maintain a 'closed system' in order to minimize bacterial contamination. The system described above is not 'closed' and it might also be considered that the presence of two extra outlet lines would further enhance this potential hazard. However, all pooling procedures are performed using aseptic procedures in continuous filtered air flow chambers, and detailed studies on platelet concentrates prepared as above and stored at room temperature for more than 48 hours showed no more evidence of a heightened bacterial contamination than those obtained using the conventional closed system (Cunningham and Cash, 1973). These findings confirmed those of Buchholtz *et al* (1971). We believe, therefore, that the technique, as applied, does not appear to increase the hazard of bacterial contamination. Although we are satisfied that no back-flow, and thus cross-contamination, occurs, it is obviously essential to ensure that the outflow line distal to the Y-manifold running into the pooling bag is always open before the application of positive pressure on to individual donations. It is concluded that these design modifications, which also permit the use of single 'pig-tail' packs with the pooling manifolds, provide a system which is easily operated, enhances productivity, gives a great deal of flexibility, and makes available clinically effective concentrates at reduced cost.

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References

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