Hong Kong Association of Blood Transfusion and Haematology

10th Anniversary Commemorative Album
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Working Team

From left to right:

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Contents

3
Preface

4
Review of Contribution of Hong Kong to Literature on Transfusion Medicine

Articles by Past and Present Chairpersons

Dr. Susan Leong
Hong Kong Red Cross Blood Transfusion Service Blood Programme
Blood: Free and Safe

Dr. C. S. Feng
Hospital Transfusion Practices

Dr. Gregory Cheng
Innovations in Blood Transfusion Practice

Dr. Edmond Ma
Hong Kong Association of Blood Transfusion and Haematology: History and Milestones

Dr. Raymond Chu
How safe is Blood Transfusion in Hong Kong?

Dr. C. K. Lee
New Developments in Blood Transfusion
gives me great pleasure to provide the Preface for this 10th Anniversary Commemorative Album of the Hong Kong Association of Blood Transfusion and Haematology (HKABTH).

The establishment of the HKABTH ten years ago was a symbol of the drive, foresight and energy of a band of like-minded doctors and transfusion specialists who recognized the future importance of their area of interest and study. The science and its practical applications have developed and progressed dramatically over the last ten years, and often in directions that may not have been readily foreseen. Nevertheless, the very presence of the HKABTH has provided a healthy and lively forum for considered debate and discussion and a fertile ground for developing ideas and adding to the wide range of research on our subject.

It is perhaps significant that this anniversary also coincides with the 50th Anniversary of the establishment of a formal Blood Collection Service in Hong Kong started by the Hong Kong Red Cross. Both anniversaries serve to demonstrate just how seriously the subjects of blood transfusion and haematology have been taken in Hong Kong, in terms of both practice and theory, and how, from virtually nothing, Hong Kong has become a regional leader and example of best practice in such a short period of time.

This Commemorative Album contains a comprehensive bibliography of the research material that has emanated from Hong Kong on the subject of transfusion medicine. It is an impressive list and, we must hope, one that will be joined by many more learned papers and contributions in the years to come.

We are also most grateful to our six esteemed colleagues, past and present HKABTH chairpersons, who have contributed their own thoughts in a series of papers that both look back over a momentous period of development in transfusion and haematology, but also look forward to future directions for development and highlight some of the significant issues relating to our subject.

This Commemorative Album is a fitting tribute to an important institution and a commendable effort to its production team. I offer my warmest congratulations to all who have made the past ten years of such success for the HKABTH.
The field of transfusion medicine has advanced significantly over the past 50 years. New scientific findings and innovative ideas are disseminated throughout the medical community largely by way of publication in peer-reviewed journals. Transfusion workers in Hong Kong have been actively contributing to this advancement, as evidenced by the many articles that appear in international journals. Listed below are research papers and review articles published by local authors in the medical literature. A brief abstract accompanies each article that serves to introduce to readers the main ideas and findings presented by the authors. Interested readers are strongly recommended to peruse the original articles for complete information. We apologize to authors of articles omitted here due to incomplete literature search.

* Paper published by author(s) in an institution in Hong Kong
# Paper by local author(s) and with study subjects from Hong Kong

1. Feng CS, Tsang SS

   A survey of fresh frozen plasma use in a teaching hospital in Hong Kong*
   Pathology 1989;21:85-7

   A survey on the appropriate use of FFP was conducted in Prince of Wales Hospital in Hong Kong, based on the consensus statement of the United State National Institute of Health (NIH). Among the 746 units of FFP used in a 30 days period, only 8.7% could be considered inappropriate.

2. Fok TF, So LY, Leung KW, Wong W, Feng CS, Tsang SS

   Use of peripheral vessels for exchange transfusion*
   Arch Dis Child 1990;65:676-8

   The study demonstrates the practicability and safety of using peripheral access for exchange transfusion in infants. The problem of excessive catheter-induced haemolysis was not seen.

3. Poole J, King MJ, Mak KH, Liew YW, Leong S, Chua KM

   The Mill phenotype among Chinese donors in Hong Kong: immunochemical and serological studies#
   Transfus Med 1991;1:169-75

   Immunochemical and serological studies among Chinese donors in Hong Kong illustrated (1) the advantage of using immunoblotting to identify the Mi subclass of large numbers of red cell samples when specific typing serum was not available. (2) the detection of homozygous Mill cells which was not previously possible by conventional serological techniques (3) the dominant inheritance of the Mill gene.
4. Feng CS, Wan CP, Lau J, Lam TK, Fok TF.

**Incidence of ABO haemolytic disease of the newborn in a group of Hong Kong babies with severe neonatal jaundice**
*J Paediatr Child Health* 1990;26:155-7

This study conveys two pieces of important information. First, the amount of maternal ABO antibodies bound on neonatal red cells does not correlate with the degree of hyperbilirubinaemia. Second, ABO haemolytic disease of the newborn occurs predominantly in the settings of group O mother and group A or B newborns.

5. Feng CS, Ng AK

**An analysis of donor blood wastage due to outdating in a large teaching hospital**
*Pathology* 1991;23:195-7

The authors reported their analysis of the pattern and rate of donor blood outdating in Prince of Wales Hospital from 1986 to 1990. They found that the rate of blood outdating was significantly reduced after implementation of the Type and Screen crossmatch protocol.

6. Lin CK, Chu R, Li KB, Leong S

**A study of hepatitis C virus antibodies and serum alanine amino transferase in blood donors in Hong Kong Chinese**

The relationship between serum ALT and anti-HCV tests was studied and concluded that: (1) there is a direct relationship between serum ALT level and anti-HCV positively by EA; (2) there is a direct correlation between serum ALT level and anti-HCV ELISA ratio, and (3) both Abbott and Ortho anti-HCV kits perform similarly in the identification of positive serum samples.

7. Mak KH, Voak D, Chu RW, Leong S, Chua KM

**Bv: a distinct category of B sub-group among Chinese blood donors in Hong Kong**

The authors presented a detailed study of this special blood subgroup, with emphasis on the laboratory techniques for its differentiation from other B subgroups.
8. Mak KH, Yan KF, Cheng SS, Yuen MY

*Rh phenotypes of Chinese blood donors in Hong Kong, with special reference to weak D antigens*
Transfusion 1993;33:348-51

The authors reported the Rh phenotypes of Chinese blood donors in Hong Kong with special reference to the weak D antigens. Of 0.27 percent apparently D negative, 0.19 percent were "true D negative" and 0.079 Del phenotypes as defined by the reactivity of eluate obtained by an adsorption and elution procedure using anti-D. 56.77 percent of the "apparent D negative" and 80.24 percent of the "true D negative" were c cdee phenotype.


*Sequence variability in the 5' non-coding region of hepatitis C virus identification of a new virus type and restrictions on sequence diversity*
J Gen Virol 1993;74:661-8

Using molecular techniques the authors discovered a new type of hepatitis C virus (type 4) which was not usually found in the Far East. They also showed that the sequence variability in the genome among different types was less than expected due to covariability. This phenomenon resulted in preservation of an important secondary loop structure in all different types.

10. Lau YL, Chow CB, Lee AC, Ng KW, Lim WL, Chan CF, Lam SY, Li CK

*Hepatitis C virus antibody in multiply transfused Chinese with thalassaemia major*
Bone Marrow Transplant 1993;12 Suppl 1: 26-8

The authors detected a percentage (34%) of hepatitis C virus carriage in this group of patients. They also showed that seropositivity was associated with age and the number of units transfused.

11. Mak KH, Banks J, Lubenko A, Chua KM, Torres de Jardine AL, Yan KF

*A survey of the incidence of Miltenberger antibodies among Hong Kong Chinese blood donors*
Transfusion 1994;34:238-41

The authors reported that the incidence of Miltenberger antibodies among Hong Kong Chinese blood donors was 0.057% and most of them were naturally occurring.


*A prospective study of symptomatic bacteremia following platelet transfusion and of its management*
Transfusion 1994;34:950-4

This is one of the few prospective studies on the topic and is often quoted. The authors found that significant febrile reactions (>2 degree Celcius rise) occurring within 24 hours of platelet transfusion were highly likely to be indicative of bacteraemia. They also proposed routine retention of the transfused platelet bags for 24 hours to facilitate microbiological investigations if needed.

The first example of anti-Gy⁺ detected in Hong Kong*

The authors reported the first example of potent anti-Gy⁺ in a Hong Kong Chinese old male patient when his blood was found incompatible with all units of blood tested by a saline indirect antiglobulin test. The patient was transfused with 10 units of Gy(a⁺) blood without any adverse effect.

14. Mellor J, Holmes EC, Jarvis LM, Yap PL, Simmonds P. The International HCV Collaborative Study Group (Dr. CK Lin is a member of the study group)

Investigation of the pattern of hepatitis C virus sequence diversity in different geographical regions: implications for virus classification#
*J Gen Virol 1995;76:2493-507

This extensive and detailed study shows that the genetic information in a small part of the hepatitis C virus genome (NS-5) provided adequate information for classification of most genotypes, subtypes and isolates. New types of this virus were detected from the specimens collected from different areas in the Eastern Hemisphere. Study on the phylogenetic relationship of these strains gave hints for the mechanism of transmission of this virus.


Use of NS-4 peptides to identify type-specific antibody to hepatitis C virus genotypes 1, 2, 3, 4, 5 and 6#
*J Gen Virol 1995;76:1737-48

The authors used the 5' end of the NS-4 peptides of hepatitis C virus (HCV) to identify the type-specific antibody to six major genotypes (1 to 6). They found that 87% samples from blood donors and patients infected with chronic HCV genotypes 1 to 6 showed detectable type-specific antibody to NS-4 peptides that in almost all cases (>97%) corresponded to the genotype detected by a PCR method. These results show that there are major antigenic differences between genotypes of HCV, and explain why detection of infection with different variants of HCV by a serological test is possible.

16. Lin CK, Wong KF, Mak KH, Yuen CM, Lee AW

Hemolytic transfusion reaction due to Rh antibodies detectable only by manual polybrene and polyethylene glycol technique*

The authors reported two cases of severe hemolytic transfusion reaction attributable to Rh antibodies, which were readily detectable by manual polybrene technique, manual polybrene indirect antiglobulin test and polyethylene glycol indirect antiglobulin test, but not detectable by conventional methods such as saline indirect antiglobulin test, low ionic strength saline solution technique, or two-stage enzyme indirect antiglobulin test.
DNA polymorphism at the ABO locus in the Chinese population of Hong Kong

**Hum Hered 1995;45:266-71**

DNA polymorphism at the ABO locus was investigated using denaturing gradient gel electrophoresis of polymerase-chain-reaction-amplified DNA products from 315 healthy individuals of the Chinese population of Hong Kong. Five different alleles were identified. The genotyping method identifies many more alleles in the ABO locus and thus makes it a more useful genetic marker in linkage analysis, paternity testing and individualization in forensic work.


Survey of major genotypes and subtypes of hepatitis C virus using RFLP of sequences amplified from the 5’ non-coding region

**J Gen Virol 1995;76:1197-204**

This paper describes a molecular method for genotyping hepatitis C virus. The prevalence of the various genotypes in the world was studied using this technique in an international collaboration (15 countries/regions including Hong Kong). Important geographical differences in genotype distribution was found, which provides important information for further epidemiological studies.

19. **Lin CK, Mak KH, Yuen CMY, Chan NK, Liu HW, Cheng G.**

A case of hydrops fetalis, probably due to antibodies directed against antigenic determinants of GPMur (Miltenberger Class III) cells

**Immunohaematology 1996; 12:115-118.**

The authors reported a case of hydrops fetalis due to maternal anti-Mi. The maternal anti-Mi was a mixture of IgG1 and potent IgG3 and fixed complement. It gave strongly positive results in the monocyte monolayer assay and chemiluminescence test.

20. **Prescott LE, Simmonds P, Lai CL, Chan NK, Pike I, Yap PL, Lin CK**

Detection and clinical features of hepatitis C virus type 6 infections in blood donors from Hong Kong


This study employs serological as well as genotyping techniques to determine the genotype distribution of hepatitis C virus in 212 viraemic blood donors from Hong Kong. The most frequent genotypes were 1b and 6a, at percentages of 58.8 and 27.0 respectively. Previous blood transfusion, intravenous drug abuse and tattooing were identified as the major risk factors for infection. A history of drug abuse was found in 66% of donors infected with the 6a genotype.

21. **Yip SP, Choy WL, Chan CW, Choi CH**

The absence of a B allele in acquired B blood group phenotype confirmed by a DNA based genotyping method

**J Clin Pathol 1996;49:180-1**

The authors confirmed the absence of a B allele in a group A patient with acquired B blood group phenotype by DNA based genotyping methods.
22. Lin CK, Mak KH, Szeto SC, Poon KH, Yuen CM, Chan NK, Liu HW, Ng CP

First case of haemolytic disease of the newborn due to anti-Mur in Hong Kong*
Clin Lab Haematol 1996;18:19-22

This report demonstrates the importance of detecting anti-Mi antibody in the local population. Inclusion of a GP.Mur-positive screening cell at pre-transfusion testing is now a routine practice in many hospital blood banks in Hong Kong.

23. Mak KH, Lubenko A, Greenwell P, Voak D, Yan KF, Poole J

Serologic characteristics of H-deficient phenotypes among Chinese in Hong Kong*
Transfusion 1996;36:994-9

A study on the H-deficient status of Hong Kong people from 1984 to 1993 found that the Hong Kong Chinese represent a homogeneous group and the incidence of the H-deficient phenotype was 1 in 15,620.


From maximum surgical blood ordering schedule to unlimited computer crossmatching: evolution of blood transfusion for surgical patients at a tertiary hospital in Hong Kong*
Transfus Med 1996;6:121-4

The authors reported the advantages of a computer crossmatching system that could permit efficient use of blood stocks, reduce blood wastage due to outdated and overcome the shortcomings of the maximum surgical blood ordering schedule (MSBOS).


Hypertransfusion for spinal cord compression secondary to extramedullary hematopoiesis*

The authors reported that transfusion therapy obviated the need for surgery or radiotherapy in a patient with spinal cord compression secondary to extramedullary hematopoiesis.


A novel system for providing compatible blood to patients during surgery: "self-service" electronic blood banking by nursing staff*
Transfusion 1996;6:347-50

This is a notable example of process re-engineering which resulted in significant reduction in staff workload, turn around time for additional blood units, and improvement in inventory control. Specific blood units were not assigned to surgical patients who had been screened negative for atypical antibodies. Nursing staff chose from the operation room blood stock compatible blood units for these patients according to a pre-printed list that was unique to every patient. Abbreviated crossmatch was omitted. The feasibility of such a system paved the way to subsequent computer crossmatch and operation theatre blood transaction systems.

Provision of an out-of-hours blood banking service at a satellite hospital without blood bank staff*

The authors introduced a system for provision of a safe transfusion service at small hospitals without the requirement of blood banking staff after regular working hours.

28. Cheng G, Wong HF, Chan A, Chui CH

The effects of a self-educating blood component request form and enforcement of transfusion guidelines on FFP and platelet usage*

A blood component request form used in Queen Mary’s Hospital in Hong Kong was designed with the FFP and platelet transfusion guidelines printed on it to facilitate physician education. The form was well accepted and inappropriate transfusion was found to have significantly reduced.


Complete coding sequence of hepatitis C virus genotype 6a #
Biochem Biophys Res Commun 1997; 234:393-6

The authors determined for the first time the full length coding sequence of hepatitis C virus genotype 6a. This particular genotype of HCV is only found in South East Asia. The carrier of this isolate was a blood donor from Hong Kong.

30. Cheng G

Experiences with "self service" electronic blood banking*
Vox Sang 1998;74 Suppl 2:427-9

The development of electronic crossmatching enables the setting up of self service blood banking systems in operation theatres and satellite hospitals. The self service blood bank saves manpower, improves crossmatch/transfusion(C/T) ratio and makes the maximum surgical blood ordering schedule (MSBOS) redundant. A novel self service system that does not require expensive computer hardware and networking was also described.

31. Wong KF, Lee AW, Hui HL, Chang FK, Mak CS, Kwan AM

Operating theater blood transaction system. A "virtual" blood transfusion service that brings the blood bank to the operating table*
Am J Clin Pathol 1999;112:481-4

The authors described an operating theater blood transaction system (OTBTS) that was a novel computer software system incorporating electronic crossmatching and the concept of a "self-service" blood banking system in the operating theater. Through this system the efficiency and safety of intraoperative transfusion was enhanced and workforce resources was saved.
32. Liu HW, Yuen KY, Cheng TS, Lee KB, Chua EK, Ho PL, Lin CK

Reduction of platelet transfusion-associated sepsis by short-term bacterial culture*
Vox Sang 1999;77:1-5

The authors evaluated the effectiveness and applicability of bacterial culture on platelets and concluded that short-duration bacterial culture by an automated system was effective and suitable for routine screening in a regional transfusion center.

33. Chow EYD

The impact of the type and screen test on hospital transfusion practice*
HKMJ 1999;5:275-9

This paper reports the experience in implementing the type and screen pretransfusion policy in the author's hospital. Advantages including reduction in crossmatch:transfusion ratio, flexibility in inventory control and shortening of turn-around-time were confirmed. This policy has been adopted by all major hospitals in Hong Kong.

34. Tsang KS, Li CK, Wong AP, Leung Y, Lau TT, Li K, Shing MM, Chik KW, Yuen PM

Processing of major ABO-incompatible bone marrow for transplantation by using dextran sedimentation*
Transfusion 1999;39:1212-9

The authors developed a new method of red cell depletion for haemopoietic stem cell harvests, and successfully prevented post-transplant haemolysis in eight major ABO-incompatible bone marrow transplants.

35. Chu RW

Leukocytes in blood transfusion: adverse effects and their prevention*
HKMJ 1999;5:280-4

The author summarized the unwanted side effects due to white cell contamination of blood components. While reckoning that leucodepletion could eliminate many of these adverse effects, the author questioned the cost-effectiveness of universal leucodepletion. A more restricted use of leucodepleted blood for at-risk patients is favoured.

36. Yip SP

Single-tube multiplex PCR-SSCP analysis distinguishes 7 common ABO alleles and readily identifies new alleles*
Blood 2000;95:1487-92

The author devised a simple and fast molecular approach to determine ABO genotypes. The method was shown to correlate well with serological phenotypes and it also allowed detection of new alleles. One can predict that as we gather more information on the polymorphism of the ABO locus, there may come a day when our “type and screen” becomes “genotype and screen”.

37. So CC, Wong KF, Yu PH, Kwan AM, Lee AW

Alloimmunization in Chinese with warm autoimmune haemolytic anaemia - incidence and characteristics*

The authors reported the incidence and characteristics of alloimmunization in Chinese patients with warm autoimmune haemolytic anaemia. The rate of alloimmunization in Chinese patients was about 11.3% lower than that of alloimmunization in Western population.
38. Lau FY, Wong R, Chui CH, Ng E, Cheng G

*Improvement in transfusion safety using a specially designed transfusion wristband*
Transfus Med 2000;10:121-4

The paper reported the use of a specially designed transfusion wristband in a hospital in Hong Kong. The wristband system detected incidents of drawing blood from a wrong patient or labeling wrongly a right patient's sample. Among 2189 patient's samples, the wristband system detected and avoided two potential mismatched transfusion which otherwise would not have been detected because neither patients had previous ABO grouping results.

39. Tsang KS, Li K, Huang DP, Wong AP, Leung Y, Lau TT, Chang AM, Li CK, Fok TF, Yuen PM

*Dextran sedimentation in a semi-closed system for the clinical banking of umbilical cord blood*
Transfusion 2001;41:344-52

Volume reduction of stem cell harvests is an important issue faced by all blood bankers involved in stem cell transplant. The authors set out to evaluate dextran sedimentation as a volume reduction method, and compared it with two other techniques, namely ficoll-hypaque centrifugation and hydroxylethyl starch fractionation. RBCs, nucleated cells, MNCs, CD34+ cells, CFUs and long-term culture-initiating cells (LTC-ICs), viability, and sterility were evaluated in each method. Dextran sedimentation gave satisfactory results which were comparable to the other two methods.

40. Chan PK, Chik KW, Li CK, Tang NL, Ming MS, Cheung JL, Ng KC, Yuen PM, Cheng AF

*Prevalence and genotype distribution of TT virus in various specimen types from thalassaemic patients*
J Viral Hepat 2001;8:304-9

This study indicates that carriage of transfusion-transmitted virus (TTV) is very common in repeatedly transfused patients (50/50 subjects studied). Using molecular detection techniques, the virus was isolated in various body fluids including plasma, saliva and urine. Infection with multiple genotypes in a single patient was not uncommon. However, the clinical significance of TTV infection is uncertain.

41. Lo YM

*Fetal DNA in maternal plasma: application to non-invasive blood group genotyping of the fetus*
Transfus Clin Biol 2001;8:306-10

The author is one of the pioneers in the field of non-invasive prenatal diagnosis. Using sensitive molecular methods, cell-free foetal DNA in maternal plasma can be analysed for various genetic markers including blood groups. This information is very important in the management of pregnancies at risk of haemolytic disease of the foetus/newborn.
42. Cheng CK, Wong ML, Lee AW

**PEG adsorption of autoantibodies and detection of alloantibodies in warm autoimmune hemolytic anemia***
*Transfusion* 2001;41:13-7

The authors reported that the PEG adsorption method was an effective, sensitive, and efficient method of enhancing auto-antibody adsorption and alloantibody detection. It could reduce the time for alloantibody detection in patients with warm autoimmune hemolytic anemia (WAIHA).

43. Lau FY, Cheng G

**To err is human nature. Can transfusion errors due to human factors ever be eliminated?***
*Clin Chim Acta* 2001;313:59-67

This article presents two methods to tackle transfusion errors. The first is a simple wristband-portable barcode scanner system which aims to avoid clerical errors during patient identification and blood administration. It differs from the current barcode scanner system used in some local hospitals in its low cost. The other method tested is highly innovative. The authors suggested red cell phenotyping the whole population and giving full phenotype-matched blood for all transfusions using an electronic matching system. This will have profound implications on transfusion practice as well as blood bank staffing structure.

44. Lau FY, Wong R, Chan NP, Chui CH, Ng E, Ng MH, Cheng G

**Provision of phenotype-matched blood units: no need for pre-transfusion antibody screening***
*Haematologica* 2001;86:742-8

In this article, the authors showed a feasible and cost-effective smart card system to transfuse patients with phenotype-matched blood without pre-transfusion antibody screening.

45. Zhong S, Yeo W, Lin CK, Lin XR, Tang MW, Johnson PJ

**Quantitative and genotypic analysis of TT virus infection in Chinese blood donors***
*Transfusion* 2001;41:1001-7

The authors used quantitative competitive PCR and sequencing to determine the prevalence and genotypes of TT virus (a member of a newly described family of human viruses related to the Circoviridae viruses) in Chinese blood donors. The prevalence of TT virus in Chinese blood donors was high (53.3%) and increased steadily with age. The major genotypes of TT virus detected were G1, G2, and G3. In addition, a new TTV genotype, tentatively designated as G17, and a new subtype, G2f, were also identified.
46. Yip SP

Sequence variation at the human ABO locus*

In this article the author reviewed the current knowledge on the genetic makeup of the human ABO gene. Extensive sequence heterogeneity in both the coding and non-coding regions was described. A mechanism of intragenic recombination in generating this polymorphism was emphasized. Various molecular techniques available for detection of these genetic changes were also detailed.

47. Whitney BM, Chan AT, Rickinson AB, Lee SP, Lin CK, Johnson PJ

Frequency of Epstein-Barr virus-specific cytotoxic T lymphocytes in the blood of Southern Chinese blood donors and nasopharyngeal carcinoma patients*

Nasopharyngeal carcinoma is prevalent in this locality. It has been shown to be associated with Epstein-Barr virus infection. Using a specific assay for T-cell immunity, the authors showed that pre-existing anti-EBV immunity was common among patients with nasopharyngeal carcinoma and healthy blood donors. However, the response was weaker in patients when compared with normal controls. These findings suggest that cellular immunotherapy may have a role in the management of these patients.

48. Lee CK, Ho PL, Chan NK, Mak A, Hong J, Lin CK

Impact of donor arm skin disinfection on the bacterial contamination rate of platelet concentrates*
Vox Sanguinis 2002; 83:204

The authors showed that skin disinfection by povidone-iodine and isopropyl alcohol was more effective than that by cetrimide/chorhexidine and isopropyl alcohol in reducing venepuncture-associated contamination of platelet concentrates by skin flora.

49. Yip SP, Chee KY, Chan PY, Chow EYD, Wong HF

Molecular genetic analysis of para-Bombay phenotypes in Chinese: a novel non-functional FUT1 allele is identified*
Vox Sanguinis 2002; 83:258-262

The authors studied five Chinese individuals serologically typed as para-Bombay by molecular techniques. They identified a novel non-functional FUT1 allele (522 C>A, or Phe174Leu) in a para-Bombay individual and on a se357, 385 haplotype background.
List of local authors for the above research papers and review articles

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17
List of local authors for the above research papers and review articles

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History

In 1952, the Hong Kong Red Cross initiated a blood collection service to provide Hong Kong Government hospitals with whole blood. It collected 400 units that year. The Government in turn provided the Red Cross with an annual grant.

In 1974, the Hong Kong Government allocated the task of operating Hong Kong’s blood programme to the Hong Kong Red Cross, and 10 years later, an integrated Blood Transfusion Service (BTS) was established. The programme is based on a voluntary non-remunerated blood donation system.

In 1991, the BTS came under the management of the Hospital Authority (HA), which is responsible for the adequate funding of BTS operations.

Function

The BTS main function is to identify the blood transfusion requirements of the territory (population approximately 6.2 million; 24,000 hospital beds) and to provide blood & blood components which have been tested for safety against transfusion transmitted infections and for product quality.

Donor Resources

Donor recruitment is the most important front-line activity. The motivation, recruitment, selection and retention of voluntary non-remunerated blood donors is the on-going labour intensive activity. Operating procedures for the ethical and medical selection and care of blood donors are carried out according to international recommended criteria and standards.

It has been recognised that public education and public relations work are vital to the success of donor recruitment and retention. Throughout the years, the Hong Kong mass media have been supportive, and have continued to give coverage to all events of interest concerning blood programmes. A donor award ceremony is held each year to give public recognition and thanks to multiple times donors and winners of the schools’ blood donation programme.
Blood Collection

The Blood Collection Division operates 8 fixed premises at district levels. Mobile teams make daily appointed visits to education institutions, offices, factories and clubs. Air-conditioned buses accommodate donor beds serve to promote the overall public image and to provide convenience to the donors. 188,121 units of whole blood were collected in 1996/97. The apheresis programme is an important adjunct to the blood collection programme and is processing well. An autologous blood transfusion programme is being introduced.

Laboratory Services

Testing

Laboratory screening of each unit of donating blood includes the following: ABO & Rh blood grouping typing and irregular blood group antibodies. Transfusion transmitted infections such as syphilis, HBsAg, HIV 1+2, HCV & HTLV I, are routinely screened and tested before issue to hospitals for transfusion.

Blood Component Processing

About 95% of whole blood collected are processed into blood components. The ranges prepared includes pre-storage filtered red cells, buffy coat removed red cell packs, platelet concentrates, fresh frozen plasma for clinical uses and cryoprecipitates.

Plasma Fractionation Products

A total of 23,000 liters of plasma collected were contracted annually for fractionation into stable products for therapeutic purpose. From this sources all HA Hospitals supplied with Albumin solution, IVIG, Factor VIII, and Factor IX concentrates.

cryopreservation

Fully typed blood and cryopreservation of red cells enable rare phenotypes to be made available for emergencies.

Serology Reference Service

The majority of cases involve the investigation of transfusion reactions, the identification or resolution of antibodies to high frequency antigens and complex multiple antibodies. The BTS has recently provided Hospital Blood Banks with supplementary screening of red cells for “Mi” antigens.

Training and Education

Training programmes in transfusion medicine and blood banking are conducted regularly for its staff and other laboratory staff. Trainees include doctors, nurses and laboratory technicians. A series of lectures and workshops on transfusion medicine are organised for all hospital staff.
Hospital Transfusion Committees

Their formation in all hospitals where blood is transfused has fostered good relationship and improved transfusion practice in all blood banks.

Integrated Computer Information System (MARCH 1997)

This fully computerised data management system for donor registration and records, blood inventory, laboratory results and accounting functions enhances the overall operational efficiency as well as improving the quality of service.

Quality Management System

Recent technological changes have greatly raised the priority and awareness of quality issues. The service has always been concerned to ensure that the quality of blood components and products which they issue meets the needs of patients. Quality managers have put a lot of effort into encouraging the updating and development of SOPs and to ensure that they are being followed. The ISO-9000 is being implemented and Continuous Quality Improvement (CQI) programme is being enforced.

Blood : Free and Safe

- If one were to walk into any hospital blood bank in Hong Kong in the early sixties, open any blood refrigerator at the beginning of the day, one would most likely see empty shelves. The officers-in-charge of the blood banks had to face the daily unpleasant task of trying to meet urgent requests for blood, and to allocate the few available units as fairly as possible. Transfusion Medicine not only did not exist in those early days, it had not even been contemplated. The morale of the blood bank staff was low.

- Walk into any blood bank today. The staff would be proud to show the variety of quality blood and blood components, all fully tested and available all year round.

Historical Background:

Neither the first use of blood transfusion nor the first collection of blood has been officially recorded in Hong Kong’s medical history. In 1952, the Hong Kong Red Cross Society agreed to provide a service for the Government by collecting blood from volunteers, the rest were collected from the British Land forces, U.S. fleet, expatriates, and local Chinese. During that year, the collection team managed to get 400 bottles of whole blood, of which only 2 bottles were donated by two Chinese gentlemen. The Government in turn provided the Red Cross with an annual grant.

Blood donor recruitment from the general public at that time was rudimentary, motivation activities and strategy non-existent. The general policy was to allow relatives and friends of patients urgently requiring blood to make appeals over the radio. The whole approach though well meaning, created more problems that it solved.

- Non-Government subvented hospitals had been originally excluded from the supply by Red Cross. Such hospitals had to resort to family/friend replacement donorship, or to the open market system, which depended solely on paid professional donors. Commercial
blood banks flourished. The costs to the end users fluctuated widely and at times grew prohibitive as a result of the manipulations of the middle men practising trade in blood.

Problems grew when the Red Cross voluntary non-remunerated blood donors underwent treatment in private hospitals. They were made to pay the going market price for blood. They objected to the inequitable situation and bitter accusations were hurled at organisations connected with blood procurement. This state of practice, existing alongside the traditional Chinese ‘anti-blood giving’ syndrome, seriously threatened the growth of the blood collection programme. A solution had to be found.

**Dr. Gerald Choa**, **Director of Medical and Health Department**, headed the first Blood Banking Advisory Committee and representatives from Red Cross, British Medical Association, Chinese Medical Association, British Land Forces, Government Information Service and voluntary donor were invited to attend. It was agreed that the Red Cross with the approval of the Government should undertake the supervision and operation of the territory’s blood collection programme. It was decided that the Red Cross’s task was to extend the free supply of blood to all hospitals with blood banks facilities. Testing and grouping, storage and inventory control, allocation and distribution of blood remained in the hand of the Institute of Pathology in Sai Ying Pun. The activities of the Red Cross were confined to donor recruitment and blood collection until 1984. When the first and only integrated Hong Kong Red Cross Blood Transfusion Service was established.

The entry of the Red Cross in donor recruitment and blood collection field had the desired stabilizing effect.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Units Collected</th>
<th>% of total population</th>
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<tbody>
<tr>
<td>1952</td>
<td>435</td>
<td>(0.5%) Not available</td>
</tr>
<tr>
<td>1960</td>
<td>6,943</td>
<td>(5.8%) Not available</td>
</tr>
<tr>
<td>1970</td>
<td>27,923</td>
<td>(37.5%) 0.2%</td>
</tr>
<tr>
<td>1985</td>
<td>102,461</td>
<td>(95.0%) 2.5%</td>
</tr>
<tr>
<td>1990</td>
<td>136,233</td>
<td>(96.1%) 3.2%</td>
</tr>
<tr>
<td>1995</td>
<td>178,842</td>
<td>(97.9%) 4.5%</td>
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</table>

**Motivation of voluntary non-remunerated blood donation.**

It was realised quite early in the programme that education of the Chinese in voluntary blood donation might not be achieved overnight and that a long term education policy had to be implemented to overcome the underlying Chinese superstitions and beliefs about parting with one’s own blood. In tandem with the education of the general public at large, emphasis was brought to bear on the education of the young. However, much resistance was shown by parents and relatives at that time to the idea of their young giving blood. They protested that the collection team was robbing the cradle.

In order to attract young donors, cooperation was sought from educationalists and community leaders. When such pillars of the Society were approached, often on an individual basis, the collection team received their full and generous support. Gradually over many years, past prejudices were painlessly circumvented and the practice of regular voluntary donations by the young is now considered natural and uplifting.
Age Groups of Blood Donors

<table>
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<tr>
<th>Age Group</th>
<th>1985</th>
<th>1995</th>
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<tr>
<td>16 to 17 years</td>
<td>11%</td>
<td>12.6%</td>
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<tr>
<td>18 to 30 years</td>
<td>73.0%</td>
<td>58.8%</td>
</tr>
<tr>
<td>31 to 45 years</td>
<td>14.4%</td>
<td>25.4%</td>
</tr>
<tr>
<td>Over 45 years</td>
<td>1.6%</td>
<td>3.2%</td>
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<tr>
<td>Male / Female</td>
<td>68.7%</td>
<td>58.2%</td>
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<tr>
<td>Total registered donation</td>
<td>&gt;890,000</td>
<td></td>
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</table>

Blood collection service:

On looking back, the Blood Bank Working Party, Medical and Health Department which met in April 1972 formulated several policies which achieved far-reaching results. Pressing issues were discussed at length and unanimously agreed at this meeting that:

a) Blood should be supplied free of charge.

b) Priority should be accorded to the immediate relatives of regular donors whenever emergency cases requiring blood came up.

c) Staff should be employed for organising blood drives and for attending blood donors. This service had been undertaken by non-paid volunteers who were mostly wives of expatriates working in Hong Kong.

Centralisation and Integration

In 1974, upon the submission of the Stratton’s Report (Professor Fred Stratton, Director of the British National Blood Transfusion Service) an ad hoc Red Cross Branch Committee, chaired by Dr. T.C. Cheng was formed to study the Report and to make recommendations to the Government on how to implement a Blood Transfusion Service in Hong Kong. As a result an Independent Blood Transfusion Service Management Board was formed. Composition of the Board was made up of the following members: Chairman of Red Cross Branch (Dr. T.C. Cheng) and Director of Red Cross Branch (Mrs. Li Fook-kow), Director of Medical and Health Department (Dr. Gerald Choa), Professor of Medicine, University of Hong Kong (Professor D. Todd), Professor of Pathology, University of Hong Kong or representation of Hong Kong Haematology Society (Dr. S.C. Tso) was elected to represent the Hong Kong Society of Haematology and others to manage the Hong Kong Red Cross Blood Transfusion Service. Following the establishment of the Board, action was taken to recruit a Medical Director in 1978 to plan for the proposed Blood Transfusion Service and to carry out immediate improvements on the

Component Processing

<table>
<thead>
<tr>
<th>Year</th>
<th>Total units processed</th>
<th>Range of components</th>
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<tbody>
<tr>
<td>1970</td>
<td>0.4% of total blood collection (27,920)</td>
<td>Plasma, red cells</td>
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<td>1980</td>
<td>4% of total blood collection (102,460)</td>
<td>Platelet concentrate, platelet rich plasma, buffy coat &amp; red cells</td>
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<tr>
<td>1984</td>
<td>12% of total blood collection (138,650)</td>
<td>Platelet concentrate, platelet rich plasma, cryoprecipitates, buffy coat &amp; red cells</td>
</tr>
<tr>
<td>1994</td>
<td>80% of total blood collection (172,150)</td>
<td>Red cell products, FFP, cryoprecipitates, leucocyte depleted cells, buffy coat, single donor platelets, paediatric packs</td>
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</tbody>
</table>
existing Service, namely, the introduction of tests for HBsAg (Hepatitis B Surface Antigen) on every blood donation, quality control of the Collection Service and the motivation and recruitment of non-remunerated donors.

- In 1984, the new custom built Blood Transfusion Service Centre in King’s Park Rise was completed and was formally opened for operation in November of that year by the late Sir Edward Youde, Governor of Hong Kong. It costs HKD31.5 million and was built to handle up to 180,000 units of blood.

- In 1991, the Hong Kong Red Cross Blood Transfusion Service came under the management of the Hospital Authority. The composition of member of its Government Committee is now made up of representation from Red Cross and the Hospital Authority. Dr. S.C. Tso is the longest serving member, and has been invaluable to the service since 1974.

### Organisation

The Hospital Authority Governing Committee is authorised to formulate and implement major policies involving blood transfusion. The Director - Hospital Chief Executive (1978 - 1995) is responsible to the Committee for strategic and budgetary planning and the day to day operation of the Blood Transfusion Service.

### Progress

The service of the Blood Transfusion Service had come a long way since the seventies. The advantages and the risks, both to the donors, the recipients and the staff handling the blood were much more clearly defined. Three fundamental events, viz., plastic pack containers, HIV, and protein fractionation, opened the way for many of the major advances of the following years. In 1972, plastic packs replaced glass bottles, allowing much greater flexibility in the handling and processing of blood.

### Plasma fractionated products

In the days before 1980, out-dated blood were either poured down the drains on the Blood Banks or taken to be used as plant-fertilisers. Since then, all expired blood were required to return to the Blood transfusion Service for salvage and fractionation into stable blood products. In 1980, 260 liters were contracted out to Commonwealth Serum Laboratories (CSL), Australia in return for 154 Bottles of SPPS which were then distributed to Government hospitals for clinical use.

In 1995/96, 23,000 liters of fresh frozen plasma were sent to CSL in return for Albumin, IVIG, high purity Factor VIII and Factor IX.

### Automation

**Donor Records.** Data entry by manual method was replaced by computerization of donor records in 1977 which provides fast and accurate information and retrieval of up-to-date donor data. Full confidentiality of donor record is maintained throughout.

**Laboratory Data.** The automation of tests in 1984 and computerization of laboratory data provide rapid interpretation of results and linkage of these results with individual donations. Routine blood grouping and typing was carried out by the Groupamatic MG80 with in-built codabar labelling systems. A much improved Olympus PK7100 was installed in 1992.

### Transfusion Transmitted Infections

To prevent transfusion transmitted infections, various strategies have been implemented,
including pre-donation screening procedures, viz., health history interviews;
donor deferral procedures and donor counselling. Donors with potential infectious
diseases are dissuaded from donation. Routine laboratory mass screening and
confirmation tests were carried out for every unit of blood donated.

AIDS - In 1983, implementation of advisories for 'at risk' persons to refrain from donating
blood. Implementation of HIV-1 antibody testing and the notification to Government
of the number of confirmed positive test results was initiated in August 1985.
Counselling of Positive donors is done on a one-to-one basis with full confidentiality,
before referral to the Government AIDS clinic or own private physician for special follow-up
service.

Transfusion Transmitted Infections

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<th>Lab. Testing</th>
<th>Commenced</th>
<th>Confirmed + rate (%) as at 1994</th>
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<tr>
<td>Syphilis</td>
<td>Before 1978</td>
<td>0.027</td>
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<tr>
<td>HBsAg</td>
<td>Before 1984</td>
<td>2.18 (9% 1st time)</td>
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<tr>
<td>HIV 1</td>
<td>8/1985</td>
<td>0.002</td>
</tr>
<tr>
<td>HIV 1+2</td>
<td>9/1990</td>
<td>0.002</td>
</tr>
<tr>
<td>HCV</td>
<td>7/1991</td>
<td>0.14</td>
</tr>
<tr>
<td>CMV</td>
<td>3/1992</td>
<td>80.4</td>
</tr>
<tr>
<td>HTLV1</td>
<td>12/1993</td>
<td>0.003</td>
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</table>

A look back programme was introduced in 1985 to trace implicated blood units and
those donors who have donated blood and who have subsequently developed
transfusion transmitted diseases.

Quality Assurance Programmes

Since 1984 the Service has carried out routine in-house quality control programmes
to ensure the safety of blood and blood component and the quality of testing
reagents used and the accuracy of laboratory testing. It also participates in several
external proficiency programmes, such as those conducted by the Centre for Disease
Control, Atlanta, USA; the UK National External Quality Assessment Scheme for
Microbiology, Colindale; and the Australian Red Cross Society, Sydney.

Clinical Interface of Blood Transfusion Service

Transfusion Medicine is part of the specialty of Haematology and the hospital consultant
haematologist is responsible for the running of its blood bank. Ideally, haematology
laboratories serving large hospitals should have at least two haematologists, one of
whom to have a special interest in Transfusion Medicine. There was no qualified
consultant haematologists in Government Service in the seventies, and the
Government blood banks were managed by histopathologists and medical laboratory
scientists and technicians.

Training in Transfusion Medicine: Training of medical officers, technicians, nurses in
serology and blood banking was implemented in 1985 on a need basis. The training
programme is now an on-going process, providing new comers and existing staff with
a comprehensive programme in medical, technical, nursing and management fields.

Blood Group Serology

Studies in local blood group polymorphism and their frequency were conducted in
1985. Free consultant service for all hospitals in Hong Kong has been provided by the
Reference Laboratory since the establishment of the Blood Transfusion Service in
1984. The number of referrals is currently about 30 cases per month.
Serological investigation led ably by the Chief Medical Technologist (now a senior serologist) and his technical team has led to the discovery of previously unrecognised antigens and antibodies among the local Chinese. The ABO, Lewis, Rhesus phenotypes of the Chinese were studied in detail. Interesting cases were encountered, including Miltenberger antibodies, H-deficient phenotypes, I-negative phenotype, anti-Gy\(^a\) (Gregory), anti-D\(\text{p}\) and anti-Xg\(^a\).

In order to enhance the rare red cell panels, the BTS in 1990 joined the well-known and respected SCARF organized by (Serum, Cell And Rare Fluids) by John J. Moulds, Houston, U.S.A. Contributions made by the BTS included red cell phenotypes Mill (GP\(\text{Mur}\)), Di\(^a\) (Diego), CCDEE, CAD+, Miltenberger antibodies in exchange for about 60 rare blood samples per year obtained all over the world.

**Fully-typed Donor Registry**

A fully-typed panel was introduced in 1985. This panel has been expanded from a few donors to 35,000 by 1994 and has provided vital service for patients with rare phenotypes and/or with problem of multiple atypical allo-antibodies.

**Cryopreservation.** In 1986 Red cells of rare phenotypes were collected and preserved for emergency use. The service has accumulated a total of 210 units of fully tested para-Bombays, Jk(a-b-) ‘0’ negative blood, Fy(a-) blood, etc.

**The Tissue Typing Laboratory** was set up in 1986 to provide adequate frozen lymphocyte panels for investigation of transfusion problems. A panel of fully HLA typed regular donors is maintained to provide single donor platelet concentrates.

**Conclusion**

Over the last 25 years, enormous progress has been made in Transfusion Medicine. A firm foundation has been laid to form a powerful base of voluntary non-remunerated blood donors. The last decade has shown increased emphasis on quality assurance and new improved technical procedures. It is now difficult to realise how primitive Transfusion Medicine was not so long ago. The growing sophistication of this discipline even surpasses those of us who had worked full time in this field. Often, one does not realise that one is part of history as the service is developing; but looking back the major advances can be clearly seen.
An old Bloodbanker once said: “When it comes to finding compatible blood for safe transfusion, there hasn’t been much progress since 1900.” That was, of course, the year Landsteiner discovered the ABO blood group system.

“The older I get the wiser that bloodbanker seems.”

If you review reports of patients who died of red cell incompatibility after blood transfusion, you will almost never find anyone who succumbed to any blood group mismatch outside of the ABO system. I still remember a case report in JAMA many years ago. It detailed how a woman died after having been transfused two units of blood positive for the antigens JKa and E, and was later found to carry the antibodies for both antigens. What struck me then was how tenuous the relationship was between her death and the alleged haemolysis. The woman was over seventy years old and had terminal carcinoma of colon, heart disease, diabetes, and septicemia. The transfusion was required because of massive blood loss after palliative surgery. The delayed haemolytic transfusion reaction might have pushed her over the edge, but hardly a major factor in causing her death.

We must not confuse co-existence of findings with cause and effect. It’s not unusual to find anaemia, haemolysis, and a positive Coombs’ test simultaneously in the same patient, especially after transfusion and surgery. Anaemia and haemolysis together can be commonly found because of tissue trauma and blood loss before, during, or after surgery. Anyone transfused with enough blood will also have evidence of haemolysis because of free haemoglobin in the transfused plasma. Finding an unexpected antibody and a positive Coombs’ in transfused blood may only be incidental findings, not the cause of haemolysis. To prove that the antibody the cause of haemolysis would require time-consuming and expensive studies, such as using radioisotope technique to determine donor red cells survival. Such studies were almost never done in case reports describing haemolysis caused by a particular blood group system.

Up to 10% of inpatients can be found to have a positive direct Coombs’, yet few of them are ever being investigated for haemolysis. This can mean that having a positive Coombs’ is not necessarily associated with haemolysis, or that it is usually so minor a problem that it escapes attention.

The ‘60s and ‘70s saw a big boom in finding new blood groups. It became a case of ‘jumping on the bandwagon’. Finding a yet-to-be described blood group was a big deal then, putting the serologist in the limelight, adding pages to new editions of standard blood bank textbooks. If having enough cells and serum stored, the serologist would get endless referrals and become the sage of...
that blood group. By the early ’80s, the number of blood groups ballooned to over 250, and it took a major catastrophe—Aids—to redirect bloodbankers' focus to a more important issue, i.e. transfusion-transmitted infections.

In terms of medical science, the discovery of a new blood group serves only two purposes: 1) paternity testing, and 2) finding compatible blood. The advent of genetic fingerprinting renders the former obsolete, and priorities in transfusion safety render the latter frivolous.

Another hot topic in the ’70s was the Type & Screen method for pre-transfusion testing, which elicited unwarranted and overblown debate about its safety. The Sloan-Kettering Memorial Hospital in New York apparently started the practice as early as the ’50s with no fanfare and no mishaps whatsoever, until the safety issue of Type & Screen was raised. In my opinion, patient safety is equitable in both conventional crossmatch and the Type & Screen. The loss of the ability to detect rare blood group antibodies by crossmatching is compensated by the provision of double antigen dosage for many common and significant blood group systems in commercial screening cells when the Type & Screen is used instead. The serious calculations used by some blood bankers to assess risks involved in switching to the Type & Screen appear comical in retrospect, because patient safety is not even the issue. The issue is inventory management and control. Thanks to the Type & Screen, blood wastage in major hospitals all over Hong Kong has been dramatically reduced. Anyone still holding copies of Hong Kong Red Cross Blood Transfusion Service’s annual reports of yesteryears will find that Queen Mary Hospital used to have blood wastage rates in the 10-20% range for years.

Efforts to further improve the safety of the pre-transfusion testing by trying to detect additional rare antibodies in minor blood group systems are ridiculously cost-ineffective, if not a total waste of money and time. Adding another screening cell in pre-transfusion testing involves thousands of additional tests at a cost of tens of thousands of dollars per year, and the return is the possible prevention of rare cases of mild post-transfusion haemolysis easily compensated, or so mild it would go unnoticed.

Maybe it’s time we should concentrate on preventing ABO-mismatch transfusions, the occurrence of which poses a real and present danger. For example, more attention and manpower should be spent on eradicating the clerical errors involved in patient identification.

The Aids epidemic rejuvenated two other practices of hospital transfusion: autologous transfusion, and directed donations from family and friends.

The HKRC BTS, like all other blood services/blood banks in developed countries, provides the safest possible blood. The easy availability of safe blood becomes a disincentive for using autologous blood, or blood from directed donors. To encourage more autologous donors, keep the process simple. Do it in the same hospital where the surgical operation is scheduled. Ask few but relevant questions, and do the minimal number of laboratory tests. Patient identification is most important. At Prince of Wales Hospital, we attach a laminated copy of the patient’s I.D. card onto the autologous unit of blood to facilitate patient identification in the operating room. It helps to have a photo I.D. when the patient is
unconscious. For patients wary of privacy, such I.D. copies can be waived or returned post-transfusion. It has been said before, and I say it again here: when it come to transfusion, nobody’s blood is better than your own.

The bloodbanking community generally frowns upon directed donations, but in my opinion, no one should ever be denied the opportunity to donate blood for their families and friends. In public hospitals, patients and their relatives can be more easily persuaded not to go through with the cumbersome process involved and to use Red Cross blood instead. But in private hospitals, they can be more insistent in their demands. The deterrent factors are the costs involved in doing the panel of pre-transfusion tests including all the standard infection markers, and the 24-48 hours delay required to clear the blood before use, making more urgent transfusions impossible.

We are all familiar with the reasons for discouraging directed donations, but let us not lose sight of the fact that some of the so-called altruistic donors showing up at blood centres around the world may have a hidden agenda. For example, male homosexuals know they can get free HIV testing by donating blood. They do it regularly after exposure to high-risk sexual activities, and they tell their friends to do the same. That’s why the window period of HIV and other infectious agents is still the scourge of safe blood supply. Who are we to deny relatives and friends the opportunity to donate blood for a patient who is worried about receiving blood from strangers?

In conclusion, in finding safe and compatible blood for hospital patients, the wise old bloodbanker’s wise words must not be ignored. A low-tech and good common sense approach is still the best way.
Reduction of blood wastage, improvement of blood transfusion safety, cost and manpower savings are the major tasks facing the blood bank nowadays. Many innovative developments have occurred in Hong Kong in the past decades.

Self-service blood banking system in the operating theatre

In the traditional practice, the surgeon or anesthetist will order and reserve a specified number of blood units for the patient undergoing surgery. The amount reserved varies according to the type of operation, and ranges from two to as many as forty units. However, in actual practice, many surgical patients are transfused only a fraction of the reserved amount or even not requiring blood transfusion at all. A large number of blood units are therefore, held in reserve and unavailable for usage by other patients. This also results in wastage of technical staff time and efforts. On the other hand, if the patient has extensive bleeding and requires massive blood transfusion, the operating room staff may have to make repeated visits to the blood bank to collect the additional blood units. The trip from the operating room to the blood bank and back could take up to 30 minutes or longer. This may result in delays in transfusion. The blood bank staff will also have to disrupt their routine work to meet this emergency demand, thereby causing considerable stress.

In 1995, a self-service blood banking system was implemented at the Queen Mary Hospital. The blood bank stocks about 100 blood units in the operating room refrigerators at the beginning of each week. The stock is based on the average weekly operating room transfusion. Specific blood units are no longer assigned to surgical patients with negative antibody screen. The patient will be provided with a computer generated cross-matched list of the serial numbers of all group-identical blood units currently in the blood bank inventory. In other words, the patient is electronically cross-matched with as many as 100-200 ABO group identical blood units. Should a patient require transfusion during surgery, the operating room nurses simply go to the refrigerator, remove any group-identical unit, and check the serial number of the selected unit against the serial numbers on the computer generated list. If the serial number is on the list, then the unit is suitable for transfusion and the blood bank will accept responsibility for compatibility.

This system has proven to be safe and efficient. As many units as required could be provided promptly. The blood bank technologists do not need to disrupt routine work to issue urgent units, thereby improving workflow. Anesthetists and surgeons no longer need to wait for the arrival of these urgent units, while their patients are bleeding. Nurses no longer need to collect specific units preoperatively or to return untransfused units. Clerical work such as...
Improvement of blood transfusion safety

Fatal haemolytic transfusion reaction due to ABO incompatibility occurs mainly as a result of clerical errors and is a major problem worldwide. Up to one-third of British hospitals reported one or more incidents in which a patient had given the wrong unit of blood. In the United States, the risk of transfusion error was estimated as 1 per 12,000 units of blood transfused. In Hong Kong, there were highly publicized cases of transfusion of wrong blood units into patients. Most blood transfusion errors result from failure to correctly identify the patient prior to blood sampling and mislabeling of the specimen. Each hospital has standard operating procedures for proper patient’s identification and administration of blood to prevent mishaps. However, faced with an increasing workload and fatigue, house staff may attempt to take shortcuts and omit important steps in patient’s identification. Over the years, many different approaches had been used to battle against human errors. However, none was convincingly and uniformly effective. Some hospitals require a second specimen drawn at a later time to confirm the ABO blood group, otherwise new patients will only be issued group O blood. This will create an extra 40-50% workload for the blood bank and house staff. Patients have to undergo venipunctures at least two times. Some house staff may draw a blood sample into two separate bottles at the same time and send one later on, thus circumventing the system. Other hospitals require two individuals to identify the patients before blood sampling and counterchecking the labeled specimens. This will strain the already limited manpower. There is also concern that junior staff may be coerced by their superiors into countersigning a specimen that they have not checked.
In Hong Kong, we developed an innovative system to tackle this problem using a specially designed transfusion wristband (8). The wristband has the following special features: (a) once attached, it cannot be removed except by cutting. (b) It has an attached transfusion label. (c) A unique transfusion code is printed on each transfusion label and the corresponding wristband simultaneously by computer technology. The manufacturing procedures ensure each transfusion wristband and its associated transfusion label bear the same unique transfusion code number. (d) A transfusion label removed from the wristband after attachment to the patient has a characteristic tear-mark distinguishing it from one removed prior to the attachment.

This will enable the blood bank to know whether the house officers follow the crucial first step, namely attachment of the wristband prior to blood sampling. Since the wristband once attached, cannot be removed from patient except by cutting, therefore if blood sample is drawn from the “wrong” patient, the wristband together with the unique transfusion code number will stay with the “wrong” patient. Blood unit crossmatched with this blood sample will bear the unique transfusion code on the wristband. When the nurses transfuse these blood units to the intended patient, the patient will either not carry a transfusion wristband at all or carry one with a different transfusion code number. This human error can therefore be detected. Unless the house officer attaches the wristband to the patient, a specimen label with a unique tear-mark cannot be generated. Without such a label, the specimen will not be accepted by the blood bank. This enforces the crucial first step, namely attachment of the wristband prior to sampling labeling. Since the specimen bottle and wristband are tied together, and the tear-mark label can only be generated from the patient’s wristband, this facilitates putting the transfusion label on the specimen at the patient’s bedside. As long as the house officers put on the wristband first and the transfusion label on the specimen at the bedside, even blood sample drawn from wrong patient can be detected at the blood transfusion stage. The procedures were well accepted by both clinical and blood bank staff. Little additional workload was involved. The blood bank staff had no difficulty in distinguishing a label with the characteristic tear-mark from one without. In the past, the blood bank would reject a blood specimen missing minor information such as patient’s age, sex, ward unit etc. The house officer would be required to provide the missing information or even draw a new sample. This created quite a lot of friction between blood bank and ward staff. It also caused delay in the processing of the blood sample. With the new system, blood bank staff was comfortable in performing compatibility testing on blood samples labeled only with the transfusion code, patient’s identity number and name. The cost of the wristband is only HK$2.50 each and can be implemented readily.

The Pamela Youde Hospital developed a unique patient identification system to reduce sampling error. Prior to blood sampling, the house officer uses a portable barcode scanner-printer to scan a unique barcode - hospital number on the patient’s wristband. The blood bank will only accept a specimen bearing this unique label. The blood unit will bear this unique hospital number for counterchecking against the wristband number prior to transfusion. This system enforces the important step of checking the patient’s wristband for identification before blood sampling.
However, the system is quite expensive. It costs about HK$18,000 for each scanner-printer and in a major hospital about 50-100 scanners are required. The newer scanner-printer may be cheaper at HK$2000 each.

The Smart ID card-phenotype blood system

The Hong Kong government is planning to issue a new electronic smart identity card for every citizen. The card will contain the individual’s barcode identity number and fingerprints. If the new card contains the person’s detailed red cell phenotypes, then the phenotypes of all admitted patients and donor red cell units will be readily available. It may be possible to issue phenotype-matched blood to patients without the need for any pre-transfusion antibody screening. Upon admission to hospital, the admitting office will enter the HK identity number of the patient into the computer. A wristband bearing the patient’s ID number and barcode phenotype will be generated and attached to the patient. When transfusion is required, the blood bank staff will simply enter the patient ID into the blood bank computer, which in turn select the most appropriate phenotype-matched blood. At the bed side, the nurse will use a portable barcode scanner to counter-check the red cell phenotype and patient’s personal ID number on the blood unit against those on the patient’s wristband and patient’s smart ID card. If all data match, the portable scanner will generate a go ahead signal.

The smart card-phenotype blood system has several potential advantages over the current antibody screening method:

a) The time from request for type and screening, drawing of blood samples by ward staff, delivery of the blood sample to the blood bank, processing of the sample by blood bank staff, to completion of the antibody screening tests, averages at least one and half hour, and often longer. With the smart card-phenotype system there is no such delays.

b) For patients with positive antibody screening tests, there is even further delay. It may be days before suitable blood units are available. With the smart card system, phenotype-matched blood will be readily available without delay.
c) If the patient has been transfused 72 hours earlier, the antibody screening test must be repeated if further blood transfusion is required. There is no need for such repeat test with the smart card system.

d) Currently when the Red Cross stock for certain blood group (e.g. group O) is low, the Red Cross will make a public appeal for volunteer donation. Many first-time volunteers will come to donate blood, but many of them will be of a different blood type (A, B etc.), thereby wasting considerable resources. The first four digits of the smart card represent a specific phenotype, for example, 1011 stands for O, The Red Cross can then specifically appeal for citizens with smart card number beginning with 1011 to donate if such phenotype blood is required and therefore more efficient.

e) Mismatched blood transfusion due to clerical error, for example blood sample drawn from the wrong patient, and labeled as another person’s specimen remains a common problem worldwide. The smart card system may significantly reduce such error.

A preliminary study was carried out at the Prince of Wales Hospital in 2001 and the results showed that the above system was feasible and cost effective.

By our cost analysis, the reagent cost of performing red cell phenotype serologically (HK$ 100 each) for the 7 million citizens is HK$700 millions. A full time technician is able to perform 150-200 red cell phenotypes daily. 200 technicians working full-time for one year would be able to complete the task. Total salaries would be approximately HK$60 millions. With a birth rate and immigrant rate of 50,000 and 60,000 per annum respectively, the annual reagent cost for red cell phenotyping was HK$11 millions. Three technicians (total salaries HK$ 600-750,000 per annum) can handle the phenotyping for newborns and new immigrant.

Patients with rare phenotypes, visitors or illegal immigrants without phenotype information may still require antibody screening. This should constitute less than two percent of the present workload. Each major hospital in the cluster may need only one or two blood bank staff and many small hospitals in the cluster may not need to staff the blood bank at all. The number of blood bank staff at each hospital could therefore be significantly reduced by 50-90% (up to 5 blood bank staff per hospital at annual salary of HK$ 250,000-$400,000 each). For the forty government hospitals, the annual savings in salaries and reagent cost would be HK$110 millions. The above cost analysis is based on performing red cell phenotypes serologically using semi-automated methods. The genes encoding all major blood group antigens have been identified and cloned. It is therefore possible to accurately determine red cell genotype/phenotype by molecular techniques using saliva or hair sample with full automation. The cost benefit may be even greater.
Introduction

Our Association was formerly known as the Hong Kong Blood Transfusion Society Limited at its inception, and was incorporated as a company with limited liability on 26th March 1992. In order to broaden our field of interest to other aspects of haematology, the name was changed to the Hong Kong Association of Blood Transfusion and Haematology (HKABTH) on 25th January 1996. We are therefore celebrating our 10th anniversary this year.

Goals and Objectives

The primary objectives for which the association is established are:

1. To promote and maintain interest in a high level of ethical and professional standards, and to contribute to the advancement of knowledge in the field of blood transfusion, haematology and related disciplines.
2. To provide a forum for presentation and discussion in these fields and to facilitate interchange of ideas and information among members.
3. To establish and foster connections with related bodies and other bodies outside Hong Kong.

Original Subscribers

The original subscribers of the association are (in alphabetical order with the position they held at that time):

<table>
<thead>
<tr>
<th>Subscriber</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Au Ka-Leung</td>
<td>Consultant Haematologist, PMH</td>
</tr>
<tr>
<td>Mr. Chan Chung-Kin Danny</td>
<td>Senior Medical Technologist, QMH</td>
</tr>
<tr>
<td>Dr. Chan Li-Chong</td>
<td>Senior Lecturer, HKU</td>
</tr>
<tr>
<td>Mr. Chan Yan-Shee</td>
<td>Senior Medical Technologist, SYP</td>
</tr>
<tr>
<td>Mr. Cheung Tat-Tang</td>
<td>Senior Medical Technologist, PMH</td>
</tr>
<tr>
<td>Dr. Feng Chi-Shun</td>
<td>Consultant Pathologist, Department of Health</td>
</tr>
<tr>
<td>Mr. Lee Shun-Keung</td>
<td>Chief Medical Technologist, PWH</td>
</tr>
<tr>
<td>Dr. Leong Susan</td>
<td>Executive Director, HKRCBTS</td>
</tr>
<tr>
<td>Mr. Leung Ping-Yiu Paul</td>
<td>Senior Medical Technologist, PWH</td>
</tr>
<tr>
<td>Mr. Mak King-Hang</td>
<td>Laboratory Supervisor, HKRCBTS</td>
</tr>
<tr>
<td>Mr. Ng Che-Ping</td>
<td>Senior Medical Technologist, TMH</td>
</tr>
<tr>
<td>Mr. Ng Wai-Hung Joseph</td>
<td>Senior Medical Technologist, QEH</td>
</tr>
<tr>
<td>Dr. Andrew Pollock</td>
<td>Senior Clinical Pathologist, QMH</td>
</tr>
<tr>
<td>Dr. Wong Kit-Fai</td>
<td>Senior Medical Officer, QEH</td>
</tr>
<tr>
<td>Mr. Yeung Wai-Ho</td>
<td>Senior Medical Technologist, KH</td>
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</table>
### Office bearers

In the past ten years, the following councils have served our association:

<table>
<thead>
<tr>
<th>Year</th>
<th>Council Chairman</th>
<th>Council Members</th>
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</thead>
<tbody>
<tr>
<td>1992 - 1993</td>
<td>Dr. Susan Leong</td>
<td>Dr. Andrew Pollock (Secretary) &lt;br&gt;Mr. T. T. Cheung (Treasurer) &lt;br&gt;Mr. Y. S. Chan &lt;br&gt;Dr. C. S. Feng &lt;br&gt;Mr. K. H. Mak &lt;br&gt;Dr. K. F. Wong</td>
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<tr>
<td>1993 - 1994</td>
<td>Dr. C. S. Feng</td>
<td>Dr. C. K. Lin (Secretary) &lt;br&gt;Mr. T. T. Cheung (Treasurer) &lt;br&gt;Dr. K. L. Au &lt;br&gt;Dr. Gregory Cheng &lt;br&gt;Mr. K. H. Mak &lt;br&gt;Ms. Amy Y. S. Ng</td>
</tr>
<tr>
<td>1994 - 1995</td>
<td>Dr. Gregory Cheng</td>
<td>Ms. Amy S. Y. Ng (Secretary) &lt;br&gt;Mr. Paul P.Y. Leung (Treasurer) &lt;br&gt;Mr. T. T. Cheung &lt;br&gt;Dr. H. W. Liu &lt;br&gt;Dr. K. F. Wong &lt;br&gt;Dr. Wilson T. C. Yeun</td>
</tr>
<tr>
<td>1995 - 1996</td>
<td>Dr. H. W. Liu</td>
<td>Ms. Ala Lee (Secretary) &lt;br&gt;Mr. Paul Leung (Treasurer) &lt;br&gt;Dr. Gregory Cheng &lt;br&gt;Dr. Eudora Chow &lt;br&gt;Ms. Lisa Siu &lt;br&gt;Dr. Wilson Yeung</td>
</tr>
<tr>
<td>1996 - 1997</td>
<td>Dr. H. W. Liu</td>
<td>Mr. Tony Yan (Secretary) &lt;br&gt;Ms. Elizabeth Chua (Treasurer) &lt;br&gt;Dr. Gregory Cheng &lt;br&gt;Dr. Edmond S. K. Ma &lt;br&gt;Dr. W. C. Tsoi &lt;br&gt;Dr. K. F. Wong</td>
</tr>
<tr>
<td>1997 - 1998</td>
<td>Dr. Edmond S. K. Ma</td>
<td>Mr. Tony Yan (Secretary) &lt;br&gt;Mr. Paul Leung (Treasurer) &lt;br&gt;Dr. Gregory Cheng &lt;br&gt;Dr. Eudora Chow &lt;br&gt;Dr. Clarence Lam &lt;br&gt;Dr. W. C. Tsoi</td>
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### Membership

Currently membership number extends to over 129 comprising pathologists, physicians, medical technologists and specialist nurses in the discipline of blood transfusion medicine and haematology.

The association is open to everyone working in the field of blood transfusion and haematology. There is one class of membership: Individual members, i.e. persons with registered medical, scientific, technical or nursing qualification who have demonstrated a continuous interest in the field of blood transfusion, haematology or related discipline.

Individual members are entitled to vote and be elected officers of the association or council members. They are also eligible for sponsorship to attend courses, conferences or workshops.

### Scientific Sessions

In order to fulfill the objective of knowledge dissemination and idea exchange, the HKABTH organizes regular scientific lectures on various topics in blood transfusion medicine and haematology. They were initially held at the conference room of the Hong Kong Red Cross Blood Transfusion Service and later a better venue was identified at the Ground Floor of the Pathology Block (M-Block) of Queen Elizabeth Hospital. These are usually evening-lectures and, despite the not inconsiderable daytime work commitments of our members, are often well attended and warmly received.
When opportunity arises, the lecture is delivered by an overseas speaker passing by Hong Kong, for example Dr. Geoff Daniels (MRC Blood Group Unit, UK) spoke on 'The molecular basis of some unusual phenotypes in the ABO, H and MNS blood group system in 1994, Ms. Helen Starr of Therapeutic Goods Administration, Australia, who spoke on 'Regulatory Issues in Blood Transfusion back in 1999'. More recently, at a mini-symposium organized in 2000, Dr. Ambrose Ng (American Red Cross Blood Services) spoke on 'Blood Therapy - Where Should You Bet Your Money?', Dr. Yenshen Hsueh (American Red Cross Blood Services) spoke on 'Infectious Diseases Transmitted by Transfusion' and Dr. Ping Law (UCSD) spoke on 'Processing Laboratory in Support of Blood & Marrow Transplantation'. The Annual General Meeting (AGM) and Scientific Symposium is a major event for the association. In the past few years, we are fortunate enough to be able to invite prominent overseas speakers to address the meeting. Some of the recent AGM lectures are as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Speaker</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1992</td>
<td>Dr. Philip R. G. Henon</td>
<td>Single Donor Platelets</td>
</tr>
<tr>
<td></td>
<td>Director Institute of Research on Haematology and Transfusion Mulhouse, France</td>
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<tr>
<td>1993</td>
<td>Dr. C. Marcela Contreras</td>
<td>Clinically Significant and Insignificant Antibodies</td>
</tr>
<tr>
<td></td>
<td>Chief Executive &amp; Medical Director North London Blood Transfusion Center UK</td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>Dr. Paul V Holland</td>
<td>Emerging Strategies in Blood Banking</td>
</tr>
<tr>
<td></td>
<td>Chief Executive &amp; Medical Director Sacramento Blood Centre California, USA</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>Dr. M.P. Busch</td>
<td>Time Course of Detection of Viral and Serologic Markers Preceding Human Immunodeficiency Virus Type 1 Seroconversion</td>
</tr>
<tr>
<td></td>
<td>Associate Professor of Laboratory Medicine University of California USA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dr. Helen H. Lee Reader in Medical Biotechnology University of Cambridge UK</td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>Dr. Louis D. Wadsworth</td>
<td>Neonatal Transfusion: A Clinical and Laboratory Perspective</td>
</tr>
<tr>
<td></td>
<td>Program Director Department of Haematopathology British Columbia’s Children’s Hospital Vancouver, BC, Canada</td>
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</tr>
<tr>
<td>Year</td>
<td>Presenter/Author</td>
<td>Title/Topic</td>
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<tr>
<td>1997</td>
<td>Dr. H. W. Liu</td>
<td>Risk Management in Transfusion - Hong Kong Experience</td>
</tr>
<tr>
<td></td>
<td>Consultant</td>
<td>Hong Kong Red Cross Blood Transfusion Service Hong Kong</td>
</tr>
<tr>
<td>1998</td>
<td>Professor Man-Chiu Poon</td>
<td>Low Molecular Weight Heparins: Role in Thrombotic Disorders and New Indications</td>
</tr>
<tr>
<td></td>
<td>Professor and Head</td>
<td>Division of Hematology and Hematologic Malignancies Department of Medicine University of Calgary, Canada</td>
</tr>
<tr>
<td>1999</td>
<td>Dr. Peter Christey</td>
<td>Nucleic Acid Testing in Transfusion Medicine</td>
</tr>
<tr>
<td></td>
<td>Senior Director</td>
<td>Blood Testing Division Chiron Corporation, USA</td>
</tr>
<tr>
<td>2000</td>
<td>Professor Samuel J Machin</td>
<td>Thrombotic thrombocytopenic purpura: Advances in Diagnosis and Management</td>
</tr>
<tr>
<td></td>
<td>Professor of Haematology</td>
<td>Department of Haematology University College Hospital London UK</td>
</tr>
<tr>
<td>2001</td>
<td>Professor George Garratty</td>
<td>Relationship of Blood Group to Disease - Do Blood Groups Have a Biological Role</td>
</tr>
<tr>
<td></td>
<td>Scientific Director</td>
<td>American Red Cross Blood Services and Clinical Professor of Pathology University of California, Los Angeles USA</td>
</tr>
</tbody>
</table>

Since 2001, the HKABTH has jointly organized an Annual Scientific Meeting with the Hong Kong Society of Haematology. The program consists of invited talks delivered by preeminent local and overseas experts in the field of transfusion and haematology, together with presentation of oral abstracts as well as posters by members of both societies. For two consecutive years this event has attracted over 100 participants and enjoys much positive feedback from members.

Workshops

The HKABTH is active in organizing workshops for continuous education and enhancement of professional standards in the practice of transfusion medicine and haematology.

These workshops are organized in the form of a lecture that is opened to all followed by a practical entertaining a defined number of participants so that skill is acquired or sharpened through a hands-on approach.


Lectures

a. Homologous transfusion: risks and alternatives
b. Current concepts and practices in pre-transfusion testing
c. Practical aspects of blood administration
d. Handling transfusion reactions
e. Platelet refractoriness
f. Transfusion support to transplant recipients

3. Workshop on instrument calibration (2001)

 Lectures and practical

a. Requirement of Equipment Calibration for ISO9000 certification
b. Basic Concept of Uncertainty
c. Calibration of thermometer and temperature controlled enclosure
d. Calibration of analytical balance
e. Calibration of autopipette
f. Calibration of timer

g. Calibration of centrifuge

 Web page

(http://www.fmshk.com.hk/hkabth/)

The HKABTH has operated a web page since 1997, featuring its background and objectives, council members and their contacts, announcements and activities. A discussion forum for members is also created for expression of opinion and free communication. More recently, education materials are posted onto the web page for viewing and are updated on a regular basis.

Newsletter and guidelines

The HKABTH has edited and issued a newsletter for circulation to members and workers in the health care sector since 1995. Articles usually touch on issues that are topical and of local interest. Those more recent issues (published in 1999 and 2000) can be viewed at our web page. As a means to cut down the cost of printing and to obviate the need for circulation, the newsletter has been superseded by the use of education materials posted on the web page since 2001.

Our association has published two guidelines on the practice of autologous transfusion. These guidelines can be viewed at our web page.

113x747

Practical

a. Antibody detection techniques
b. Type and screen procedure
c. Clinical significant and insignificant antibodies
d. Recognition and resolution of serological problems
e. Laboratory evaluation of suspected haemolytic transfusion reaction
f. Demonstration: HLA typing and platelet cross-match
g. Recognizing cell grouping problems
h. Recognizing serum grouping problems
i. Resolution of ABO discrepancies
j. Investigation of a positive direct antiglobulin test
k. Typing DAT positive cells
l. Warm autoimmune haemolytic anaemia and cold haemagglutination disease
m. Application of antibody elution and adsorption techniques

2. Workshop on blood film and bone marrow examination (1997 - 1998)

Lectures and practical

a. Laboratory investigation of a acute leukaemia
b. The myelodysplastic syndrome and myeloproliferative disorders
c. A guide to the chronic lymphoproliferative disorders
d. Red cell and platelet morphology
e. Laboratory diagnosis of malaria and other blood parasites
1. Preoperative Autologous Blood Deposit for Defined Use, and
2. Acute Normovolaemic Haemodilution

A summary of major events in the history of the association

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
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<tbody>
<tr>
<td>1992</td>
<td>Inauguration of the Hong Kong Blood Transfusion Society Limited</td>
</tr>
<tr>
<td>1995</td>
<td>Publication of a regular Newsletter Workshop on Transfusion Medicine</td>
</tr>
<tr>
<td>1996</td>
<td>Renamed as the Hong Kong Association of Blood Transfusion and Haematology</td>
</tr>
<tr>
<td>1997</td>
<td>Operation of a Web Page Workshop on Blood Film and Bone Marrow Examination</td>
</tr>
<tr>
<td>2001</td>
<td>Workshop on Instrument Calibration</td>
</tr>
<tr>
<td>2001</td>
<td>Newsletter superseded by web-based Education Material Joint Annual Scientific Meeting with the Hong Kong Society of Haematology</td>
</tr>
<tr>
<td>2002</td>
<td>Tenth Anniversary</td>
</tr>
</tbody>
</table>

Conclusion

Throughout the past ten years, the HKABTH has admirably fulfilled its objectives by the hard work and contribution of office bearers and the enthusiastic participation of its members.

For our association to go from strength to strength, the continual support, contribution and participation of fellow members is vitally important.
Introduction

Blood transfusion safety starts from the blood donor's vein and end up in blood recipient's vein, which involves many steps and parties with each contributing to the overall transfusion safety. It relies not just on the supply of safe blood, but also depends very much on the clinical blood transfusion practice.

Blood supply in Hong Kong

Safe blood requires a quality-assured, adequate supply of well-screened blood collected from low risk donors. In Hong Kong, all blood and blood components are supplied by the Hong Kong Red Cross Blood Transfusion Service (BTS). The BTS collects blood from voluntary, non-remunerated donors under strict donor screening criteria in accordance with internationally accepted practices. The annual collection over the recent years is around 190,000 to 200,000 units, which is adequate, as it is seldom for hospitals in Hong Kong to have problem in getting enough supply of blood and blood components. The BTS has a well-developed quality assurance program and has obtained ISO 9002 Certification, which ensures the quality of the blood and services they provide.

Safety of blood supply

Safe blood is blood that does not contain infectious agents or chemicals that might cause harm, danger or disease to the recipient. Currently the BTS tests every unit of blood for the presence of hepatitis B surface antigen (HBsAg), antibodies against hepatitis C (anti-HCV), antibodies against HIV 1 and 2 (anti-HIV 1, 2 including type 'O'), antibodies against human T-lymphotrophic virus I (anti-HTLV I) and antibodies against T. pallidum (syphilis). A certain proportion of the blood is screened for CMV antibody in order to supply CMV seronegative blood and blood components to those patients who have a higher risk of acquiring CMV infection.

However, even with proper screening with highly sensitive kits, there are still some residual risks in infectious disease transmission. The main reason is due to blood donation during the 'window period'. The term "window period" refers to the time gap from a person's exposure to the infectious agent to the time the current laboratory test is able to detect the infectious marker.

The actual residual risk of infectious disease transmission is unknown as there have been no local studies to look at the incidence of post-transfusion viral transmission. Some idea can be gained by estimating the residual infectious risks of blood transfusion based on the seroconversion rate in blood donors:

<table>
<thead>
<tr>
<th>Infection</th>
<th>Estimated risk per million blood donation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV</td>
<td>0.77</td>
</tr>
<tr>
<td>HCV</td>
<td>11.34</td>
</tr>
<tr>
<td>HBV</td>
<td>187.11</td>
</tr>
</tbody>
</table>
To put these figures in perspective, the following table compares the risk of window period donation with other western countries (figures in number per million donations).

<table>
<thead>
<tr>
<th>Disease</th>
<th>Hong Kong</th>
<th>Australia</th>
<th>United States</th>
<th>France</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBV</td>
<td>187.11</td>
<td>6.45</td>
<td>15.83</td>
<td>8.45</td>
</tr>
<tr>
<td>HCV</td>
<td>11.34</td>
<td>4.27</td>
<td>9.71</td>
<td>4.48</td>
</tr>
<tr>
<td>HIV</td>
<td>0.77</td>
<td>0.79</td>
<td>2.03</td>
<td>1.75</td>
</tr>
</tbody>
</table>

Source:
(1) Figures supplied by the BTS based on the seroconversion rate in blood donors from Jan 2000 to Dec 2001
(2) Whyte GS, Savoia HF: The risk of transmitting HCV, HBC or HIV by blood transfusion in Victoria. MJA 1997; 166: 584-586

In Hong Kong, NAT testing for HIV and HCV on all donated blood will be done by around mid 2002. As the diagnostic window period is shortened by NAT testing, the residual risk of transmitting such agents through blood transfusion would be lowered further as shown in the table below.

<table>
<thead>
<tr>
<th>Risk of window period donation (per million blood donation)</th>
<th>HIV</th>
<th>HCV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before NAT testing</td>
<td>0.77</td>
<td>11.34</td>
</tr>
<tr>
<td>After NAT testing</td>
<td>0.4</td>
<td>3</td>
</tr>
</tbody>
</table>

Although the reduction in the HBV window by NAT testing is quite small when compared to HCV, the much higher prevalence of HBV in Hong Kong would make NAT testing for HBV worthwhile when commercial test kits are available in the future.

**Bacterial risk of blood transfusion**

The major risk of infectious disease transmission by platelet is bacterial rather than viral as they are stored at 220C, which favours bacterial growth. In a local study in 1994, the risk estimate of bacteraemia due to platelet transfusion was 1:2000 per unit of platelet concentrate, which is unexpectedly high. Since then, many publications from other countries show similar findings, confirming the fact that the risk of bacterial transmission is much higher than viral transmission for platelet transfusion. As a result of these findings, the BTS has been performing routine bacterial surveillance on all platelet concentrates since January 1998. This program has
been shown to be effective as there have been no reported cases of transfusion related bacterial sepsis after its implementation.

**Other aspects of blood safety**

Blood, other than the risk of transmitting infections, can lead to various adverse blood transfusion reactions. Leukocytes present in blood could cause febrile non-haemolytic transfusion reactions and the lymphocytes can cause graft versus host disease in certain immunocompromised patients. The BTS has been providing irradiated blood and blood components for indicated patients and has been supplying leucodepleted blood for some patients, mainly patients with Cooley’s anaemia.

The HA(BTS) Expert Panel on Blood and Blood Products Safety was set up in 1997 to advise the BTS and HA on matters related to blood transfusion safety. However there is no national policy or regulatory bodies on blood transfusion in Hong Kong.

**Safety aspects in clinical transfusion practice**

Although the blood supply is relatively safe in Hong Kong, especially when compared to the previous times, blood still poses significant risk to its recipient, especially when it is used or handled inappropriately. Therefore, safe clinical transfusion practice is another important facet of the overall blood transfusion safety.

Over 90% of blood collected by the BTS is used by hospitals within the Hospital Authority (HA). Although different HA hospitals may have minor variations in their blood transfusion practice, there are still a lot of similarities within HA hospitals in such aspect.

In all HA hospitals with significant blood transfusion activities, each has their Hospital Transfusion Committee (HTC), which defines the transfusion policies, monitor, audit and review transfusion practices, with the aim of continually improving clinical blood transfusion practices within their hospital. Many have prepared their blood transfusion handbooks, which give out guidelines on clinical transfusion practice and transfusion related procedures. In the recent years, HA has set up the Central Transfusion Committee in order to coordinate clinical transfusion practice in different HA hospitals so as to unify the standard of practice and to avoid duplicated efforts by the various HTC.

In the last decade, the blood collection figures have not changed significantly and yet the number of inpatients and surgeries have increased dramatically. However, there is seldom shortage of blood in Hong Kong mainly because of the change in blood transfusion practice over the years. As more and more people are aware of the risk of blood transfusion, less homologous blood is being used and the practice of autologous transfusion has become more popular. Pre-operative blood deposits, normovolaemic haemodilution with saving of autologous blood immediately before operation and intra-operative blood salvage are practiced quite commonly in some hospitals. Erythropoietin is now commonly used in certain patients with anaemia, especially in patients with chronic renal failure, which decreases blood requirements. Ways to decrease blood loss during surgery, e.g., use of fibrin glue, various haemostatic
techniques, haemostatic agents such as tranexamic acid etc. are more commonly used, leading to less blood being transfused to patients during surgery.

**Blood transfusion errors**

Transfusion error is the most important cause that leads to fatalities and serious morbidities following transfusion. The majority are clerical errors resulted from failure to correctly identify the patient prior to blood sampling, mislabeling of the specimen and transfusion of the wrong blood units. Errors within blood banks are less common but have led to serious transfusion errors in Hong Kong in the recent years. All these would need to be tackled in order to ensure blood transfusion safety. Most hospitals require two nurses to countercheck the blood units and patient's identity before blood transfusion and only one person for the blood sampling procedure for pre-transfusion testing. Some HA hospitals even require a second person to witness and to counter-check the blood sampling procedure, as this is the main area that leads to transfusion error. However, it is debatable whether this so called ‘buddy system’ could reduce human errors significantly. Major system changes may need to be implemented, as it is unreasonable to expect human error to occur with a frequency of less than one in ten thousand.

Some HA hospitals have tried novel ways in patient and blood sample identification in the recent years. In Pamela Youde Nethersole Eastern Hospitals, a Unique Patient Identification (UPI) system together with the use of barcode scanners have helped in minimizing transfusion errors. Since May 1999, all inpatients have a UPI number and barcode on their wristband, which is a modified hospital number (HN). This UPI barcode is not present on other places, including patient's gum labels. Before blood sampling for compatibility testing, a barcode scanner / printer unit is used to scan the UPI barcode on patient's wristband and the HN barcode on patient's gum label on the blood request form. If the two matches, the instrument would print out a confirmation label with HN barcode, HN number, date and time of checking and the label is stuck on the sample tube. Blood units assigned to a certain patient will have a label on that unit, which bears the patient’s HN barcode as well as patient’s demographic data. Before blood administration, nurses have to scan the patient’s wristband UPI barcode and the HN barcode on the label of the blood unit. If they match, a confirmation label is generated and is put on the patient’s blood request form as documentation of the checking. From May 1999 to December 2001, with over 38,000 pre-transfusion blood sampling and transfusion of over 29,000 units of blood, no transfusion errors was noted. Review of the time period before the implementation of the UPI system from April 1995 to April 1999 shows 13 transfusion errors - 2 with blood sample taken from the wrong patient, 10 with wrong label on blood sample or request form and 1 with right sample but label on form and sample were from another patient. A specially designed transfusion wristband has been tried in Prince of Wales Hospital and results showed...
that it is effective in minimizing transfusion errors.

Many blood banks in HA hospitals have the laboratory information system (LIS) and some have practiced electronic crossmatch, which helps in reducing errors from occurring within blood banks.

**Hemovigilance system**

The term is used in France as a system of surveillance of adverse transfusion reactions. Since the early 1990s there has been an international push to develop surveillance systems to monitor blood safety. It is accomplished in different ways in different countries. The most comprehensive is the hemovigilance system in France. The legislation that deals with blood transfusion safety includes the requirement for all actors including health care personnel to report any unexpected or undesirable effects associated with transfusions. In UK there is a program consisting of the voluntary reporting of serious hazards of transfusion (SHOT). In Canada, the manufacturer (blood service organization) is required to report deaths or serious adverse transfusion reactions to the regulator. Although there is no requirement for hospitals to report adverse transfusion reactions, there are initiatives to encourage and standardize the reporting of adverse transfusion reactions in some parts of Canada.

One would learn to avoid more transfusion mishaps from happening by doing surveillance of “near misses” or transfusion incidents. In 2000, the NHS in England has set up a new, national system for logging all failures, mistakes, and “near misses” in health care.

HA hospitals have a more or less similar system in reporting blood transfusion reactions and transfusion incidents centrally to the head office. When more figures are collected and analysed, the experience gained could be shared amongst all hospitals in order to improve on existing transfusion practices.

**Conclusion**

Hong Kong is amongst the safest place in the world with regard to blood transfusion. This relies very much on the continuous effort of all those people involved in the supply, processing and use of blood, as there is no end point to the pursuit of perfection in terms of blood transfusion safety. There are already things on the horizon that are very promising in reducing the risk of transfusion further in the coming years. The most promising one is pathogen inactivation, which may eliminate the risk of viral and bacterial transmission through blood transfusion. As more and more infectious agents are being discovered that may be potentially transmissible through blood transfusion and that some of them may not have readily available commercial kits for testing, pathogen inactivation is likely to play an important role in ensuring blood transfusion safety in the near future.
Introduction

To begin with, it must be stressed that blood transfusion should be treated as a kind of replacement fluid that exerts biological effects. As our knowledge accumulates, we know that this biological product has to be handled cautiously because of the problems and risk associated with blood transfusion reported to national haemovigilance programs. In this regard, concern in blood safety or in a broader scope safety in the blood transfusion process has been the main focus in modern transfusion medicine. Nowadays, transfusion safety has covered the whole process from the selection and collection of blood from donors, blood component processing, blood sample testing, blood matching, and finally administration and monitoring of the recipients.

In the following, I try to summarize some of the important recent developments in transfusion medicine that will bring along significant and evolutionary changes to clinical practice.

A. Blood Substitutes

The idea of blood substitutes starts off in scientific fiction that human being should find some forms of substitutes for the blood at least during the period of active blood loss to replace the machinery or allow time to repair. Since then in the 70s and 80s, the global shortage of the blood supply and the fear of dreadful infection transmitted by blood transfusion have prompted active research into artificial blood. With little initial progress after years of research, the hope for red cell substitutes finally becomes realistic and they are likely to be marketed very soon as pharmaceutics. Of these the most amazing and well known substitutes fall into red cells.

I. Red Cells

There are a number of technical difficulties in the development of red cell substitutes. In addition to oxygen transport, red cells have been shown to have a number of other functions. These include modulation of oxygen delivery under conditions of low pH and/or high pCO2; encapsulation of haemoglobin to prolong its circulating half life; modulation of nitric oxide concentration; antioxidant activity of red cell enzymes and reduction of methaemoglobin. All these depend on a complex and elegant interplay between the haemoglobin molecule, the red cell enzymes, the internal milieu and the red cell membrane.

Following years of research, there are briefly five types of red cell substitutes (1). crosslinked haemoglobin tetramers, (2). recombinant haemoglobin tetramers, (3). polymerized haemoglobin, (4). encapsulated haemoglobin and (5). fluorocarbons. I quote below a recent meeting report to illustrate what has been done in the market.
Alliance Pharmaceutical Corp. is waiting for the go-ahead from the Food and Drug Administration (FDA) and European regulatory authorities to resume clinical trials of its intravascular oxygen carrier, Oxygent™, a sterile perfluorochemical emulsion that does not contain human or animal blood components. ......

Biopure Corp. is preparing to submit in May 2002 a final report to the FDA on its US Phase III orthopaedic surgery trial of Hemopure(c). Hemopure(c), already approved for use in South Africa, is produced from protein hemoglobin retrieved from managed herds of US beef cattle. ......

Hemosol, Inc., is actively pursuing approval of its products, Hemiline™ for use in Canada, US, the United Kingdom and Europe. Described as a hemoglobin raffimer, Hemolin™ is currently in the last stage of clinical trials.

Northfield Laboratories is in Phase III clinical trials of its oxygen carrier, PolyHeme(c), a “chemically modified hemoglobin derived from human blood.”

At present, it seems that haemoglobin solution (Hemopure(c) and PolyHeme(c)) will be the product to appear in the market. However, there are still some unresolved questions. Since these products are used almost exclusively in acute blood loss for trauma cases or accident/ emergency setting, will they be applicable to patients with chronic anaemia? Besides, their present clinical indications may result in the change in the pattern of blood demand. As such the planning of blood collection in the industry will have to revise when the products are fully available.

II. Platelets

Development of platelet substitutes is obviously next as the demand on platelet concentrates is even more pressing than any other blood components due to the shorter shelf life and the requirement of multiple random donor units for a single dosage in adult. In addition as platelet transfusion is frequently associated with frequent transfusion reactions, artificial products will be ideal replacement. However, the development has faced similar difficulties as red cells.

For example, infusible platelet membranes are derived from processing of freeze-dried platelets that have the advantages of reduced viral load, elimination of bacteria, reduced expression of class I antigens and may be made from both fresh and outdated platelets. However, the clinical haemostatic effect is difficult to reproduce and is no greater than that of outdated platelets.

III. Cytokines

We are all aware that cytokines can be applied to numerous clinical conditions that save thousands of lives since the rapid development and understanding of various cytokines in the haematopoietic pathways and blood cells development in the 70s. Some of these cytokines are now used in standard treatment protocols e.g. the use of granulocyte colony stimulating factor (G-CSF) in mobilization of the stem cells and treatment of drug induced neutropenia, recombinant erythropoietin in the correction of
anaemia in patients with chronic renal anaemia. In fact, the list of indications is ever growing. In the coming future that the development of a single cytokine molecule that bears several functions will be the next important milestone.

In blood transfusion, we have seen the applications of these cytokines to

1. stimulate patients bone marrow recovery in various causes of cytopenia that transfusion required can be markedly decreased. Examples here include use of G-CSF or GM-CSF, MDGF after cancer chemotherapy, use of erythropoietin for patients with myelodysplasia.
2. stimulate patients stem cells such that they can be collected readily by apheresis machine in case of haematopoietic stem cell transplantation.
3. stimulate endogenous red cell production to allow sufficient autologous blood deposit for scheduled surgery.

IV. Universal Blood Donors

Similar to blood substitutes, an alternative approach to improve the availability of blood products is to have donation from universal blood donors. The traditional high demand of group O is one of the examples to prompt the research into this area. However, the approach suffers from the lack of sufficient group O donors but also the presence of other blood groups antigens that may hinder compatibility. In laboratory setting, one has considered the development of chemical or enzymatic modified universal blood group that strips off all the clinical significant antigen on the surface of the red cells. However, this may all result in the loss of functions or stability of red cells as we all know that some red cell antigens have biological functional significance.

B. Improved Safety in Blood Transfusion

There have been numerous discussions of improved viral detection by nucleic acid testing and elimination of bacterial contamination by source reduction and enhanced detection of contaminated microbes and therefore these will not be discussed here. Instead I will like to describe on pathogen inactivation which appears to be the most promising development in the coming years. Despite stringent donor selection and enhanced detection algorithms, there exists the possibility of missing in the windows period and/or emergence of new bugs, therefore, it is a revolutionary approach to kill off all the micro-organisms in the blood products before they are considered safe to use. Basically, pathogen inactivation employs the use of certain chemical which chelates with DNA and/or RNA molecules. Upon activation process e.g. UV A light, blood products will become sterile. Indeed, pathogen inactivation of labile blood products will diminish not only the risks of transfusion-transmitted infections but also
immunomodulatory disturbances which is related to the donor white blood cells.

Potential application of pathogen inactivation of blood products:
1. further reduction of the risk of transfusion-transmitted HIV, HCV and HBV infections though the risk benefit ratio is expected to be very narrow under the present donor screening and infectious disease testing procedures
2. extension into the inactivation of clinically relevant non-enveloped viruses including HAV and parvovirus B19,
3. bacterial decontamination of cellular blood products, particularly of platelet concentrates,
4. removal of residual leucocytes in labile blood products and result in reduction in the risk of transmission of cell-associated viruses and other infectious agents, most importantly CMV and pro-viral HIV
5. reduction of leucocyte-dependent immunomodulatory events, such as alloimmunization to HLA antigens and concomitant refractoriness to platelet transfusion
6. elimination of the need for gamma-irradiation of blood products to prevent transfusion-transmitted GVHD

However, it has been showed that overall cost-effectiveness was poor, and therefore, it is still uncertain whether the procedures under investigation will meet the commonly accepted cost-benefit target. Thus, the question is that is it worthwhile to allocate resources to these procedures, or could their introduction divert sparse funds from other, more cost-effective public health measures?

At present pathogen inactivated blood products that are available in the markets include solvent detergent treated fresh frozen plasma and methylene blue treated fresh frozen plasma. However, there are a number of other in clinical trials. The most promising one is the use of psoralens S59 and UVA in plasma and platelet concentrates. Potential application in the pathogen inactivation in red cells is still in the early stage of clinical trials.

In addition to cost-effectiveness analysis, there are other concerns of the applications.

(i) Is there detrimental influence on the blood products e.g. reduction in their biological activity? A simple answer is yes and observed in the present available blood products.

(ii) The possibility that compounds used for pathogen inactivation could actually undermine the safety of the products by creating new risks cannot be totally negated. Certainly, clinical trials have excluded immediate and mid-term safety risks, but questions about later occurring side-effects could only be answered by widespread and long-term use.

Besides, experience has furthermore shown that implementation of new safety measures did not replace other practices already in use, even if their value has become questionable. It is therefore up to the present moment, there are still a number of unresolved questions on pathogen inactivation.

C. Future of Hospital Blood Banking

Computer system is now indispensable in modern transfusion service. From the regional transfusion center like BTS, its use governs all data processing from donor registration, donor information management, component processing, infectious diseases and blood group testing, labelling, inventory control and blood
products distribution. Whereas at hospital blood banks level, computer system is heavily relied for sample registration, laboratory data requisition, decision making and inventory management.

In Hong Kong, most blood banks under HA have been using ECPath BBS modules developed by the Laboratory Information System Project Team but there are still some using the paper recording systems. At present, the Central Transfusion Committee under HAHO has asked BTS and LIS team to study the feasibility of the internetworking system to enhance information flow and data management. The scope of the system includes blood inventory, service request system and reference serology at BTS, and blood inventory, blood issue and return management, and blood group, antibody results and patient special product requirement management at hospital blood bank level.

Under the present technology, it seems that the project is feasible and is expected to be open platform that in particularly inventory and patients’ laboratory results management can be greatly enhanced. As a result, it is expected both the patients’ care in term of quality and speed can be benefited.

Conclusion

There have been rapid progresses in the development in transfusion medicine. As blood or transfusion safety is of paramount important, these developments and enhancements of various processes are not only focused on blood collection, processing, and testing, but also on the clinical indications and administration. We should keep an open mind in the interpretation and evaluation of their uses and appropriateness. We should continuously monitor the progress and update on our knowledge of development in transfusion medicine.
# The Hong Kong Association of Blood Transfusion and Haematology

c/o Hong Kong Red Cross Blood Transfusion Service, 15 King’s Park Rise, Kowloon, Hong Kong

Tel: (852) 2710 1383  Fax: (852) 2710 1385  http://www.fmshk.com.hk/hkabth/

## Membership Application Form

<table>
<thead>
<tr>
<th>Membership no.:</th>
<th>Membership status:</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>To be filled by applicant:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last Name:</td>
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<tr>
<td>Sex:</td>
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<td>Qualification:</td>
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<td>Specialty:</td>
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<td>Position held:</td>
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</tbody>
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| Office:                   | Department:         |
| Block/Room:               |                      |
| Institute:                |                      |
| Address:                  |                      |

| Tel.:                      | Fax:                  | Pager/Mobile Phone: |
| Email:                     |                      |                     |
| Correspondence Address (if different from above): |

I certify that the above information is correct and I hereby agree that, if elected to membership, I will abide by the rules and by-laws of the Hong Kong Association of Blood Transfusion and Haematology Ltd. and I shall strive to maintain a high standard of Blood Transfusion and Haematology in Hong Kong.

$ Consent for publication of the registered name in the coming HKABTH membership directory:

- [ ] Agreed
- [ ] Not Agreed

Signed: ___________________________ Date: ___________________________

The applicant should complete this form and send it together with the membership subscription fee at HK$150 (please make cheque payable to The Hong Kong Association of Blood Transfusion and Haematology Ltd.) to:

Mr. NK Chan

c/o Laboratory, Hong Kong Red Cross Blood Transfusion Service
15 King’s Park Rise, Kowloon

The Hong Kong Association of Blood Transfusion and Haematology
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