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A Mini Review on Electronic Verification for Blood Transfusion

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ABSTRACT

Mistransfusion, in which the wrong blood is transfused to the wrong patient, remains the most common type of error in transfusion practice. Pre-transfusion check at the bedside is the most critical step for the prevention of mistransfusion. An electronic identification system (EIS) is ideally suited to pre-transfusion check requirements. Our experience showed that the bar code-based EIS works well on a hospital-wide basis in the setting of regular allogeneic blood transfusion, pre-operative autologous blood donation and transfusion, pediatric transfusion, and hematopoietic progenitor cell infusion. The purpose of this mini review was to highlight some of concepts for electronic pre-transfusion checking procedures using the EIS.

Keywords: Transfusion safety, Mistransfusion, Electronic identification system (EIS), Bar code, Electronic pre-transfusion check, Bedside

INTRODUCTION

Because the current risks of acquiring viral transmission through blood components are very small [1], the risks of non-infectious complications, including those related to hospital-based steps in transfusion care, have emerged as the most common adverse events [2]. Mistransfusion, in which the wrong blood is transfused to the wrong patient, remains the most common type of error in transfusion practice and typically results from an error made during the pre-transfusion checking procedure just prior to blood administration. ABO-incompatible transfusions attributable to the incorrect identification (ID) of the patient or the blood unit are among the most serious of transfusion hazards [3-5]. Therefore, pre-transfusion check at the bedside is the most critical step for the prevention of mistransfusion. A bar code-based electronic identification system (EIS) is ideally suited to pre-transfusion checking requirements and has recently been reported to significantly improve transfusion practice [6-10]. In this review, I present our own experiences and highlight some of concepts for electronic pre-transfusion checking procedures using the EIS.

ALLOGENEIC BLOOD TRANSFUSION

In Japan, all allogeneic blood components attached labels with the linear bar code (NW7) have been supplied from branches of the Japanese Red Cross Blood Center. Thus, the bar code-based EIS is based on the employment of the linear bar code. A bar code-based EIS is composed of: 1) A wireless hand-held device incorporating a laser bar code scanner, 2) The patient's wristband with bar code and eye-readable ID, 3) A wristband printer, 4) An ID badge for staff with individual bar codes, and 5) A compatibility report form and compatibility label attached to the blood unit on which bar codes informative of the pre-transfusion testing are imprinted [7]. The hand-held device is capable of reading bar codes during the verification procedures, receiving transfusion data via a network, and sending data regarding bedside verification to the host computer in the transfusion service. All patients admitted to the hospital are given wristbands with a bar code and eye-readable ID, including the surname, first name, sex, date of birth, patient ID number, and blood group ABO/RhD. Finally, a bar code-based EIS has been linked with the transfusion management system and hospital information system via a network [7].

The electronic pre-transfusion checking procedures at the bedside except for operating rooms are as follows: the transfusionist sequentially scans bar codes of his/her own ID badge, the patient's wrist band and blood unit using a hand-held device. In operating rooms, where a hand-held device is used for one patient until his/her operation has finished, electronic pre-transfusion checking procedures are

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composed of two parts, i.e., entrance and bedside. In the entrance checking procedure, a nurse scans the bar code of the patient's wristband using a hand-held device when the patient enters the operating room. In the bedside checking procedure, after completing two-person visual and verbal double-check; the transfusionist scans only the bar code of the blood with one scan for each unit just prior to initiating blood administration. If the bar codes of the wristband and blood are identical, the screen of the hand-held device displays 'OK'. Non-matching data result in a warning of 'NG' with an alarm sound [7]. The match happens at the level of software installed in the hand-held device. After completing the electronic pre-transfusion check, the transfusionist immediately initiates blood administration.

PRE-OPERATIVE AUTOLOGOUS BLOOD DONATION AND TRANSFUSION

In Japan, autologous blood transfusion still appears to have a role in eliminating risks related to allogeneic blood transfusion, especially transfusion-associated graft-*versus*-host disease [11]. Furthermore, autologous blood transfusion has been encouraged in the Guidance on the Implementation of Blood Transfusion Therapy, issued by the Ministry of Health, Labor and Welfare in Japan. Pre-operative autologous blood donation (PABD) and transfusion involves collecting and storing the patient's own blood prior to surgery in order to administer it, if necessary, post-operatively. PABD transfusion possesses many of the same complications as that of allogeneic units, such as administrative errors. A bar code-based EIS has been applied to the pre-transfusion checking procedure in the setting of PABD transfusion [12]. Compatibility labels are affixed to PABD units, on which an in-house bar code identifying the product type and number is printed, making it possible to perform electronic pre-transfusion check at the bedside using hand-held devices. With regard to other autologous blood conservation techniques, i.e., perioperative autologous cell salvage (PACS) and acute normovolemic hemodilution (ANH), we have applied a bar code-based EIS to them and found that the bar code-based EIS works well in all types of autologous blood transfusions (manuscript in preparation). Because the error rate of autologous and allogeneic blood transfusions appears to be similar [12], autologous blood transfusion should be approached with the same level of care and consideration as allogeneic blood transfusion.

PEDIATRIC TRANSFUSION

Pediatric patients seem to be more vulnerable to transfusion-associated complications than adults [13] and have specific requirements regarding the transfusion of blood components, including small-volume transfusions, dispensing blood in plastic syringes, and infusion through small-gauge needles with or without a mechanical infusion pump [14,15]. A bar code-based EIS has been applied to the pre-transfusion checking procedure in the setting of pediatric transfusion [16]. Blood dispensed in syringes has been attached to compatibility labels, on which the bar code of the primary bag of blood is printed, making it possible to perform electronic pre-transfusion check using hand-held devices. The transfusionist sequentially scans bar codes of his/her own ID badge, blood dispensed in a syringe, and wristbands attached to the patient's ankle or nameplate at the bedside in cases of neonates and preterm infants. Transfusion service in a hospital is encouraged to pay attention to the administration of blood components in pediatric patients, as well as adults.

HEMATOPOIETIC PROGENITOR CELL INFUSION AT THE BEDSIDE

Among the transplant procedures, the infusion of hematopoietic progenitor cell (HPC) components at the bedside is a critical step for the success in HPC transplantation and the failing to receive appropriate HPCs for the recipient after intensive chemotherapy can be fatal [17]. However, mislabeled units of umbilical cord blood (UCB) from highly reputable UCB banks have been reported [18]. A bar code-based EIS for blood transfusion has been applied into the setting of HPC transplantation [19]. In the case of HPC components, in-house bar codes identifying both the patient's and component's details are attached. The data include the patient's ID number, surname, first name, sex, date of birth and blood group; and the component's type and lot number. This step is critical for the management of HPC components in the transfusion service. Peripheral blood HPC components collected in the hospital are linked to the patient's information when the components are prepared and managed in the transfusion service. Whereas HPC components from banks are not specified to the patient in the hospital, they have to be correctly managed using, at least, a bar code-based technology in the transfusion service, as blood units. At the bedside, after completing two-person visual and verbal double-check, the infusionist sequentially scans bar codes of his/her own ID badge, the patient's wristband and the HPC bag using a hand-held device. After completing the electronic pre-infusion check, the infusionist immediately initiates HPC infusion at the bedside. Pre-infusion check at the bedside is the most critical step for the prevention of mis-infusion of HPC components to the patient.

NUMBER OF PEOPLE REQUIRED FOR THE ELECTRONIC PRE-TRANSFUSION CHECK AT THE BEDSIDE

When an EIS is implemented in a hospital, the pre-transfusion checking procedure at the bedside may involve one or two healthcare professionals. When one individual carries out the pre-transfusion checking procedure using an EIS, it seems to be plausible. However, if electronic pre-transfusion check at the bedside fails due to human error [20], one-person bedside checking without new technology may present a higher risk of mistransfusion than a standard two-person double-check, although the number of people

required checking the identity of the patient and blood unit at the bedside is controversial [21]. The British Committee for Standards in Hematology (BCSH) Guidelines stated that "the use of a bedside blood tracking system does not replace the role of the well trained and competency assessed clinician who administers blood components" [22].

We have recommended that the electronic pre-transfusion check at the bedside should be basically carried out by 'two-person', of whom one should be the transfusionist and the other should be the second checker [23]. The second checker may not be limited to healthcare professionals, such as the patient. When the patient is conscious, the transfusionist (nurse or doctor), together with the patient, conducts the pre-transfusion check procedures at the bedside using an EIS. When the patient is unconscious or child, two nurses (or a doctor/nurse pair) conduct the pre-transfusion check procedure as well. In this case, another healthcare professional, such as the staff member of the transfusion service who delivered the issued blood component into the clinical area, instead of the patient, may be available for the second checker.

CONCLUSION

Bar code technology is a widely used, reliable and inexpensive machine-readable ID system. Because the Japanese Red Cross Blood Center supplies all allogeneic blood components with attached labels containing linear bar codes, the EIS presently employs linear bar codes in Japan. It has been reported that bar code-related patient misidentifications occur when a linear bar code is used [24]. More advanced systems, such as two-dimensional bar code [25] and radiofrequency ID (RFID) [26] will be introduced in the near future. The economic aspects and availability of products remain issues regarding implementing these technologies. To reduce human error and the risk of mistransfusion, we have to address the issue at the hospital level, employing a system-based approach.

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CONFLICT OF INTEREST

None of the author has any conflicts of interest to declare.

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