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Implementation of electronic identification system for blood transfusion in the setting of hematopoietic progenitor cell infusion at the bedside

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ABSTRACT

Hematopoietic progenitor cell (HPC) infusion at the bedside is a critical step in HPC transplantation. In this study, we implemented a bar code–based electronic identification system (EIS) for blood transfusion in the setting of HPC infusion at the bedside. Between July 2003 and December 2014, a total of 518 HPC products were infused to 190 patients without a single misinfusion in the hospital. An overall compliance rate with the electronic pre-infusion check for HPC infusion at the bedside was 100%. Our observations suggest that an EIS can be successfully applied to the infusion of HPC products at the bedside.

1. Introduction

Intensive chemotherapy followed by hematopoietic progenitor cell (HPC) transplantation has widely been used in the treatment of certain hematological diseases and solid tumors. Among the transplant procedures, the infusion of HPC products at the bedside is a critical step in HPC transplantation. A variety of adverse events with various severities have been reported during HPC infusions, with flushing being the most common, followed by nausea and hypertension [1]. Infusion-related adverse events are either due to the infusion itself or the content of the HPC products, including dimethyl sulfoxide (DMSO) as a cryoprotectant and the granulocyte content [1,2]. Misinfusion, in which the wrong HPC bag is infused to the wrong recipient, may be attributable to human errors, and failing to receive appropriate HPC products after intensive chemotherapy can be fatal for the recipient [3]. However, mislabeled units of umbilical cord blood (UCB) from highly reputable UCB banks have been reported [4]. The prevention of identification check errors, regarding either the recipient or HPC product, is of major importance in HPC transplantation, as in blood transfusion. Thus, the pre-infusion check procedure at the bedside is the most critical step for the prevention of misinfusion in HPC transplantation.

Machine-readable identification technology, especially a bar code–based electronic identification system (EIS), is ideally suited for pre-transfusion check procedures at the bedside and it has been reported to significantly improve transfusion practice [5–8]. Although we had not encountered the incorrect infusion of an HPC product to a recipient in our hospital, we implemented a bar code–based EIS for blood transfusion in the setting of HPC transplantation. Our observations suggest that a bar code–based EIS for blood

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transfusion can be successfully applied to the infusion of HPC products at the bedside.

2. Materials and methods

2.1. HPC products

Allogeneic unrelated bone marrow (BM) HPCs were from The Japan Marrow Donor Program (JMDP, Tokyo, Japan). UCB HPCs were from several UCB banks, e.g., The Japanese Red Cross Kanto-Koshinetsu Cord Blood Bank (Tokyo, Japan), The Japanese Red Cross Kinki Cord Blood Bank (Osaka, Japan). Allogeneic related BM HPCs were harvested in the hospital. Autologous and allogeneic peripheral blood (PB) HPCs were collected under the granulocyte colony-stimulating factor (G-CSF) mobilization regimen in the hospital, employing COBE Spectra® and Spectra Optia® (each Terumo BCT Inc., Co, USA), according to the Guidelines established by both The Japan Society for Hematopoietic Cell Transplantation and The Japan Society of Transfusion Medicine and Cell Therapy [9]. Between July 2003 and December 2014, a total of 635 autologous and allogeneic PB HPC products were collected in the hospital, of which 411 (65%) were infused to 132 patients.

2.2. Bar code–based EIS

A bar code–based EIS for blood transfusion (Nursing Pass, Bio-Rad Laboratories, Tokyo, Japan, previously Olympus Systems, Tokyo, Japan), which links the transfusion management system and hospital information system via a network, was implemented in the hospital in July 2002 [6], and then applied in the setting of HPC transplantation in July 2003. The EIS is based on the employment of the linear bar code (NW7), because it has been used in labels attached to all allogeneic blood components supplied from branches of the Japanese Red Cross Blood Center. In the case of HPC products, in-house bar codes identifying both the patient and product details are attached. This step is critical for the management of HPC products in the transfusion service, because the HPC products from banks are not specified for the recipient in the hospital. The data include the patient's identification number, surname, first name, sex, date of birth, and blood group, as well as the product type and lot number. The system is composed of: (1) a hand-held device including a laser bar code scanner, (2) the patient's wristband with a bar code and eye-readable identification information including the surname, first name, sex, date of birth, identification number, and blood group, (3) a wristband printer (Petit Lapin, Sato, Tokyo, Japan), (4) an identification badge for staff with individual bar codes, (5) a compatibility label imprinted with bar codes, and (6) a compatibility report form imprinted with bar codes. All patients admitted to the hospital are given wristbands. The hand-held device is capable of reading bar codes during the verification procedures, receiving infusion data via a network, and sending data regarding bedside verification to the host computer in the transfusion service.

2.3. Pre-infusion check procedures at the bedside

The electronic pre-infusion check procedures were as follows: (1) At the transfusion service, after completing two-person visual and verbal double-check, the staff member sequentially scans bar codes of his/her own identification badge, the HPC bag (container), and the compatibility report form using a hand-held device, when the HPC component is issued to the patient (Fig. 1A). All HPC products are delivered from the transfusion service after completing the electronic pre-issuing check. (2) At the bedside, after completing two-person visual and verbal double-check, the infusionist sequentially scans bar codes of his/her own identification badge, the patient's wristband, and the HPC bag using a hand-held device (Fig. 1B and 1C). If the bar codes of the wristband and HPC bag are identical, the screen of the hand-held device displays 'OK'. Non-matching data result in a warning of 'NG' with an alarm sound [6]. The match happens at the level of software installed in the hand-held device. After completing the electronic pre-infusion check, the infusionist immediately initiates the infusion of the HPC product at the bedside.

3. Results

Between July 2003 and December 2014, a total of 518 HPC products were infused to 190 patients without a single misinfusion in the hospital, of which 357 (69%) were autologous PB HPCs, 54 (10%) allogeneic PB HPCs, 91 (18%) allogeneic BM HPCs, and 16 (3%) UCB HPCs. An overall compliance rate with the electronic pre-infusion check at the bedside was 100% (Fig. 2). Among specialities, hematology (77%) most frequently required HPC infusion, followed by pediatrics (21%), and urology (2%). Among disorders, malignant lymphoma (36%) most frequently required HPC infusion in the hospital, followed by leukemias (21%), meningioma (17%), multiple myeloma (13%), myelodysplastic syndromes (3%), neuroblastoma (3%), and testicular tumors (2%).

4. Discussion

In this study, we implemented a bar code–based EIS for blood transfusion in the setting of HPC transplantation. Although an EIS for blood transfusion has significantly improved transfusion practice [5–8], the usefulness of an EIS for HPC infusion at the bedside has not, to our knowledge, been reported so far. Limitations of the present study are that it was a single institutional investigation and included a small number of cases of HPC transplantation. However, we showed that a total of 518 HPC products were infused to 190 patients without a single misinfusion and the overall compliance rate with the electronic pre-infusion check at the bedside was 100%. Further studies are needed to establish the usefulness of an EIS in HPC transplantation.

As blood transfusion [6], our infusion policy of HPC products at the bedside was a standard two-person visual and verbal double-check first, followed by an electronic pre-infusion check using a hand-held device. The number of people required to check the identity of the patient and blood unit at the bedside has been controversial in the case