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Original article

## Transfusion-associated circulatory overload: A survey among Dutch intensive care fellows

*Surcharge circulatoire post-transfusionnelle : un sondage entre les internes réanimation néerlandais*

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### Abstract

**Objectives.** – Transfusion-associated circulatory overload (TACO) is a severe pulmonary transfusion reaction and leading cause of transfusion-related morbidity and mortality in Europe. TACO is of particular importance in critically ill patients, since they often receive blood transfusions and have multiple risk factors for TACO. This study investigates transfusion practices in patients at risk of developing TACO, and furthermore knowledge concerning risk factors, diagnoses and treatment strategies among Dutch intensive care unit (ICU) fellows.

**Material and methods.** – An unannounced paper-based survey was conducted among Dutch ICU fellows during an educational conference. The survey consisted of 16 multiple and open choice questions.

**Results.** – Of all 65 Dutch ICU fellows 56.8% completed the survey; of respondents 88.9% identified the correct constellation of symptoms for TACO. In total, 29.7% of the respondents are aware they are obligated to report TACO cases to the blood bank. Major risk factors for TACO that respondents identified were reduced left ventricular function, infusion volume and infusion rate. In a non-emergency setting, 45.9% of fellows start red blood cell transfusion with 2 units or more. Transfusion rates exceeded national guidelines in 15.4% of fictitious cases. TACO is treated with furosemide by 94.5% of the fellows, however goals of the therapy varied greatly.

**Conclusion.** – Dutch ICU fellows are knowledgeable of TACO symptoms, risk factors and treatment, however knowledge on reporting and transfusion practice in the setting of at risk patients for TACO should be improved.

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**Keywords:** TACO; Transfusion; Infusion rate; Survey; ICU

### Résumé

**Objectifs.** – La surcharge circulatoire associée à une transfusion (TACO) est une réaction transfusionnelle pulmonaire grave et la principale cause de morbidité et de mortalité liée à la transfusion en Europe. TACO affecte tout particulièrement les patients gravement malades qui ont souvent besoin de transfusions et présentent de multiples facteurs de risque pour cette pathologie. Cette étude analyse les pratiques transfusionnelles chez les patients à risque, les facteurs de risque, les diagnostics et les stratégies de traitement possibles par de jeunes praticiens dans les unités de soins intensifs néerlandais.

**Matériel et méthodes.** – Une enquête sans caractère officiel et sur support papier a été menée auprès de patients néerlandais de l'USI lors d'une séance éducative. L'enquête comprenait 16 questions ouvertes ou à choix multiples.

**Résultats.** – Sur les 65 jeunes praticiens néerlandais de l'ICU, 56,8 % ont répondu à l'enquête ; 88,9 % d'entre eux ont identifié les symptômes pour TACO et 29,7 % savent qu'ils doivent signaler les cas de TACO à la banque du sang. Les principaux facteurs de risque de TACO identifiés par les personnes interrogées étaient la réduction de la fonction ventriculaire gauche, le volume transfusé ainsi que le débit de perfusion. Lorsqu'il n'y a pas d'urgence, 45,9 % des patients commencent une transfusion de globules rouges avec 2 unités ou plus. Les taux de transfusion dépassaient les directives nationales dans 15,4 % des cas fictifs. Le TACO est traité avec du furosémide pour 94,5 % des patients mais les objectifs thérapeutiques ont été largement variables.

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*Conclusions.* – Les jeunes praticiens néerlandais de soins intensifs connaissent les symptômes, les facteurs de risque et le traitement du TACO. Cependant, il faudrait les former davantage à l'importance de la déclaration de cette pathologie et aux pratiques de transfusion pour les patients à risque de TACO.

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*Mots clés* : TACO ; Transfusion ; Débit de perfusion ; Enquête ; ICU

## 1. Introduction

Transfusion-associated circulatory overload (TACO) is a severe pulmonary complication of blood transfusion and is the leading cause of major transfusion-related morbidity and mortality in France, the UK and the Netherlands, and the second leading cause in the United States [1–4]. TACO is defined by the International Society of Blood Transfusion as the onset of any four of the following symptoms occurring within six hours after transfusion: acute respiratory distress, tachycardia, increased blood pressure, acute or worsening pulmonary edema (on imaging) and/or evidence of positive fluid balance [5]. Evidence supporting the diagnosis includes cardiac ultrasound, history of heart failure and increased pulmonary capillary wedge pressure or central venous pressure.

The incidence of TACO varies from 1–8% of all patients after a blood transfusion [6–8], and incidence in national hemovigilance reports has been rising likely due to increased recognition and reporting of cases [9–11]. TACO is especially relevant in the ICU patients since they are vulnerable; they have limited reserve (respiratory) capacity, 40% receive one or more transfusions during ICU admission [12] and frequently have multiple risk factors for decreased fluid tolerance including heart and renal failure.

Within ICU patients, adequate recognition and treatment of TACO is important since this complication results in increased length of hospital stay, severe morbidity and 10% mortality [13]. While studies regarding transfusion practices and triggers are numerous, little is known of how practices differ for patients at elevated risk of volume overload. Furthermore, presence of comorbidities, such as renal failure or cardiac failure, is likely to influence treatment of critically ill patients with volume overload.

We aimed to investigate how transfusion practices differ for critically ill patients at a high-risk of volume overload. Using a survey, we investigated how ICU fellows approach transfusion in volume-incompliant patients at risk for TACO, as ICU fellows likely reflect ICU standards across the country. We further investigated knowledge on risk factors, diagnosis, treatment and reporting strategies for TACO.

## 2. Material and methods

### 2.1. Survey

A survey (Supplementary, Appendix A) was conducted among Dutch ICU fellows during an educational conference.

Prior to the seminar, fellows were encouraged to read a background article by Li et al. [7]. The survey was unannounced and performed prior to the seminar.

The paper-based survey consisted of 16 multiple-choice and open questions in three parts. The first section inventoried basic respondent demographics: sex, age, work experience, specialty and current work setting—secondary or tertiary hospital. The second part of the survey consisted of general questions with regards to transfusion practices, focusing on transfusion volume and infusion rate of blood products using clinical vignettes. The final section consisted of questions specifically regarding TACO. Clinicians were asked about the definition of TACO, list major risk factors, describe therapeutic management – based on vignettes with and without TACO risk factors; and were questioned on reporting practices. We defined TACO according to the International Society of Blood Transfusion 2011 criteria [5].

### 2.2. Data management and statistical analysis

All surveys were filled in anonymously. Data was extracted and processed by two independent researchers using R Statistics 3.3.2 using RStudio interface version 1.0.136 (RStudio Team, Boston MA, USA). The responses of categorical questions are expressed as a percentage of the total number of responses for that question. Responses concerning continuous data are expressed as median with interquartile range. Graphs were created using ggplot2 version 2.2.0. No statistical analysis was performed due to the descriptive nature of the study.

## 3. Results

Of all 65 Dutch ICU fellows, 39 attended the seminar and 37 completed the survey (56.9%). More than half of respondents ( $n = 19$ ) had a background in anesthesiology, the remaining specialties comprised internal medicine, neurology, cardiology and pulmonology. The majority of respondents (89.2%) worked in an academic hospital and had at least 1 year of experience in critical care medicine, 48.7% had at least 2 years of experience. Table 1 summarizes the demographic characteristics of the respondents.

### 3.1. Transfusion practices: volume and rate

#### 3.1.1. Transfusion volume and rate

The respondents were given a fictitious case: a 70-year-old ICU patient, post-cardiac surgery, weighing 80 kg with a hemoglobin of 4.0 mmol/L (6.5 g/dL). Fellows were asked how

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