Frequency and importance of blush in lung contusion in patients with blunt trauma: A retrospective observational study

Naoki Tominaga
Nippon Medical School: Nihon Ika Daigaku https://orcid.org/0000-0002-1325-9578
Mineji Hayakawa (mineji@dream.com)
Hokkaido University Hospital: Hokkaido Daigaku Byoin
Shoji Yokobori
Nippon Medical School: Nihon Ika Daigaku

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Frequency and importance of blush in lung contusion in patients with blunt trauma: A retrospective observational study

Naoki Tominaga[1], Mineji Hayakawa[2], Shoji Yokobori[1]

1 Department of Emergency and Critical Care Medicine, Nippon Medical School Hospital

2 Department of Emergency Medicine, Hokkaido University Hospital

Corresponding author

Mineji Hayakawa, MD, PhD

Department of Emergency Medicine, Hokkaido University Hospital, Kita 14, Nishi 5, Kita-ku, Sapporo, 060-8638, Japan.

Email address: mineji@dream.com

Tel: +81-011-706-7377

Fax: +81-011-706-7378

Abstract

Background: The high mortality rate in patients with blunt chest trauma remains a problem. The assessment of blush in hepatic and splenic trauma is important because it indicates the need for emergency hemostatic intervention. However, the frequency and importance of blush in lung contusions are unknown. Therefore, this study aimed to evaluate the frequency of blush in the lung contusion and the relationship between blush and the clinical outcome of patients with blunt chest trauma.

Methods: In this retrospective observational study, we enrolled patients with an injury severity score of 16 or higher and a chest abbreviated injury scale of 3 or higher who were admitted to the emergency department of Hokkaido University Hospital from January 1, 2003, to December 31, 2016. Blush was defined as an active extravasation image of an intravascular contrast agent recognized on contrast-enhanced computed tomography. Date of trauma severity, various treatments, and outcomes were recorded from the electrical medical records of the patients.

Results: During the study period, 83 patients had severe lung contusions and 12 patients had blush. In-hospital mortality of patients with blush was significantly higher than that of patients without blush. Patients with blush required support through mechanical ventilation more frequently and for a longer duration than patients without blush.

Conclusion: Our study revealed that blush in the lung contusions was not rare and was associated with a high risk of mortality in patients with severe blunt chest trauma. We should not hesitate to intervene if a blush of the lung contusion was detected in a patient with blunt chest trauma.

Keywords: Lung contusion, Pulmonary contusion, blunt trauma, chest trauma

Background

For clinicians, reducing preventable death among trauma patients in the emergency department is an important issue. Chest trauma is the third most common cause of death in patients with multiple trauma after abdominal and head trauma [1]. The current study reports that the mortality rate of blunt chest trauma patients among multiple trauma patients is 10%–22% [2,3]. Severe lung contusion often induces severe respiratory failure resulting from intra-lung bleeding [4].

Blush, which has been frequently reported in hepatic and splenic trauma, is defined as an image showing active extravasation of the intravenous contrast agent recognized on computed tomography (CT) [5–7]. Blush was reported to be observed in 6.6–17.1% of patients with severe hepatic and splenic trauma [5–10]. Presence of blush in hepatic and splenic trauma indicates current progressive bleeding and implies the need for emergency hemostatic interventions such as transcatheter arterial embolization and abdominal surgery [5–10]. Therefore, in some current management algorithms for hepatic and splenic trauma, blush has an important role in evaluating the necessity of emergency hemostatic interventions [5–10].

Although the blush in lung contusion is sometimes observed in patients with severe blunt trauma in our clinical setting, its frequency and importance are unclear. Therefore, the present study was conducted to evaluate the frequency and relationships of blush in lung contusions with clinical outcomes in blunt trauma patients.

Methods

Approval for this study was obtained from the Institutional Review Board of the

Ethics Committee at Hokkaido University Hospital. The ethical boards waived the need for informed consent owing to the retrospective design.

Patients

We retrospectively enrolled blunt injured patients with injury severity score (ISS) ≥16 and chest abbreviated injury scale (AIS) ≥3, who were transported to the emergency department of Hokkaido University Hospital between January 1, 2003, and December 31, 2016. We excluded patients who had not undergone contrast-enhanced computed tomography (CECT) on admission to our emergency department. Furthermore, patients whose maximum diameter of lung contusion was less than 5 cm on CT were excluded. Data on the patient's age, sex, mechanism of injury, vital signs, respiratory sequential organ failure assessment (SOFA) score, ISS, AIS of each body part, in-hospital mortality, ventilator free-days, specific treatments, such as mechanical ventilator support, thoracic drainage, isolated lung ventilation, extracorporeal membrane oxygenation support, and thoracic surgery, were obtained from individual electrical medical records.

Definition

Blush was defined as an active extravasation image of intravenous contrast recognized by CECT, similar to previous reports [5–7]. A typical Blush is shown in Figure 1. Severe lung contusion was defined as ≥ 5cm of maximum diameter in CT.

Statistical analysis

Statistical analysis was conducted using JMP 12.0.1 for Windows (SAS Institute

Inc., Tokyo, Japan). Statistical significance was assessed at the 0.05 level unless otherwise noted. Data were summarized using medians and interquartile ranges (25th-75th percentile) or counts and percentages, where appropriate. Univariate comparisons were compared using chi-square tests for categorical variables and Wilcoxon rank-sum tests for continuous variables.

Results

From January 1, 2003, to December 31, 2016, 247 patients with ISS ≥ 16 and chest AIS ≥ 3 were admitted to the emergency department. Of these, 82 patients who had not undergone CECT on admission, 35 without lung contusion injury, and 67 without severe lung contusion injury were excluded. In 83 patients with severe lung contusion injuries, 12 patients with blush in the lung contusions were detected (Figure 2). The patients with blush in the lung contusions were 10% of patients with lung contusion and 15% of patients with severe lung contusion.

Compared to the patients without blush, the patients with blush did not show any difference in age, sex, or cause of injury. Although there was no significant difference in individual AIS between the two groups, ISS in the patients with blush was higher than that in the patients without blush (Table 1).

Table 2 shows clinical outcomes in the patients with and without blush. In the patients with blush, in-hospital mortality rate was significantly higher than that in the patients without blush. Furthermore, frequency of mechanical ventilator supports in the patients with blush were higher than that in the patients without blush. Ventilator free-days in the patients with blush were shorter than those in the patients without blush.

As for the specific treatment, isolated lung ventilation supports were frequent in blush patients. In addition, major cause of death was severe bleeding including pulmonary bleeding-induced respiratory failure in both groups.

Discussion

Although the present study was a single-institutional retrospective observational study, patients with blush in the lung contusion were more frequently observed than those in our estimation. Furthermore, the blush in lung contusions was associated with the necessity of various interventions and a high mortality rate.

Treatment strategies have been established for blush in the hepatic and splenic trauma, and the mortality rate of patients with blush in the hepatic and splenic trauma has been reported as 0–8.4% [5,7–9]. However, to our knowledge, no investigation into the importance of blush in lung contusion has never been reported previously. In the present study, blush in lung contusion was more frequently observed than that in hepatic and splenic trauma [5,7–9]. Furthermore, blush in lung contusions was clearly associated with poor patient outcomes. However, because the importance of blush in lung contusion had not been recognized by attending physicians in our institution before the present study, the management strategy had not been established. Similar to the blush in hepatic and splenic trauma, blush in lung contusion will be a good indicator of management strategy in patients with chest trauma.

Blush in the lung contusion indicates ongoing hemorrhage similar to blush in the hepatic and splenic injury. However, the effects of ongoing hemorrhages are much different between lung contusion and hepatic/splenic injury, because the hemorrhages in

lung contusions are frequently also intra-airway hemorrhages. Intra-airway hemorrhage from lung contusions will exacerbate respiratory condition, even if small amounts of hemorrhage are present [11,12]. Therefore, when blush in the lung contusion is detected, we will have to intervene more aggressively the hemorrhage in the lung contusion.

Therapeutic interventions for hemorrhage in the lung contusion are considered as two sides: protection of the contralateral lung from pulmonary hemorrhage and hemostatic intervention [12]. Simple protection of contralateral lung from intra-airway hemorrhage is isolated lung ventilation. When blush in the lung contusion is detected, we may have to isolate the contralateral lung before exacerbation of respiratory condition by intra-airway hemorrhage from lung injury. Although lung resection and lobectomy are definitive hemostatic procedures for lung injury, their invasion is too high. Therefore, trans-arterial embolization is frequently selected for pulmonary hemorrhage, similar to hepatic and splenic injuries [12,13]. However, the lung is inflowed by two vessel systems, the tracheal and pulmonary artery systems. Furthermore, blood flow in the pulmonary artery is more than that in the tracheal artery in the lung. Therefore, control of blood flow in the pulmonary artery, for example balloon occlusion, will be necessary to stop the pulmonary hemorrhage [14,15].

There are inherent limitations in any retrospective evaluation. Additionally, the numbers in this series may be considered small, hence precluding broad generalization. However, to the best of our knowledge, this is the first report about blush in lung contusion and its characteristics. More extensive research is needed to confirm our results.

Conclusions

Our study revealed that blush in lung contusions was not rare and was associated with the necessity of various interventions and high mortality rates. When blush in the lung contusion is detected in patients with blunt chest trauma, we should not hesitate to protect the contralateral lung from pulmonary hemorrhage and hemostatic intervention.

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Figure legends

Fig. 1 Typical blush in lung contusion.

Arrows indicate extravasation of contrast media in the lung contusion, which are defined as blush.

Fig. 2 Flowchart of the study selection process.

The Blush group included patients who were detected brush in the severe lung contusion (≥ 5cm of maximum diameter) on contrast-enhanced CT on arrival at the ER. No blush group included patients who had severe lung contusions, but blush was not detected.

ISS, injury severity score; AIS, abbreviated injury scale; CT, computed tomography; ER, emergency room

Ethics approval and consent to participate

The retrospective protocol of this study was approved by our institutional review board, and the requirement for informed consent was waived.

Consent for publication

Not applicable

Availability of data and materials

All relevant data are presented in the published manuscript.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

NT collected and interpreted the data and drafted the manuscript. MH conceived the study, analyzed and interpreted the data, and drafted the manuscript. SY read the manuscript and revised it for important intellectual content. All authors read and approved the final manuscript.

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Figures

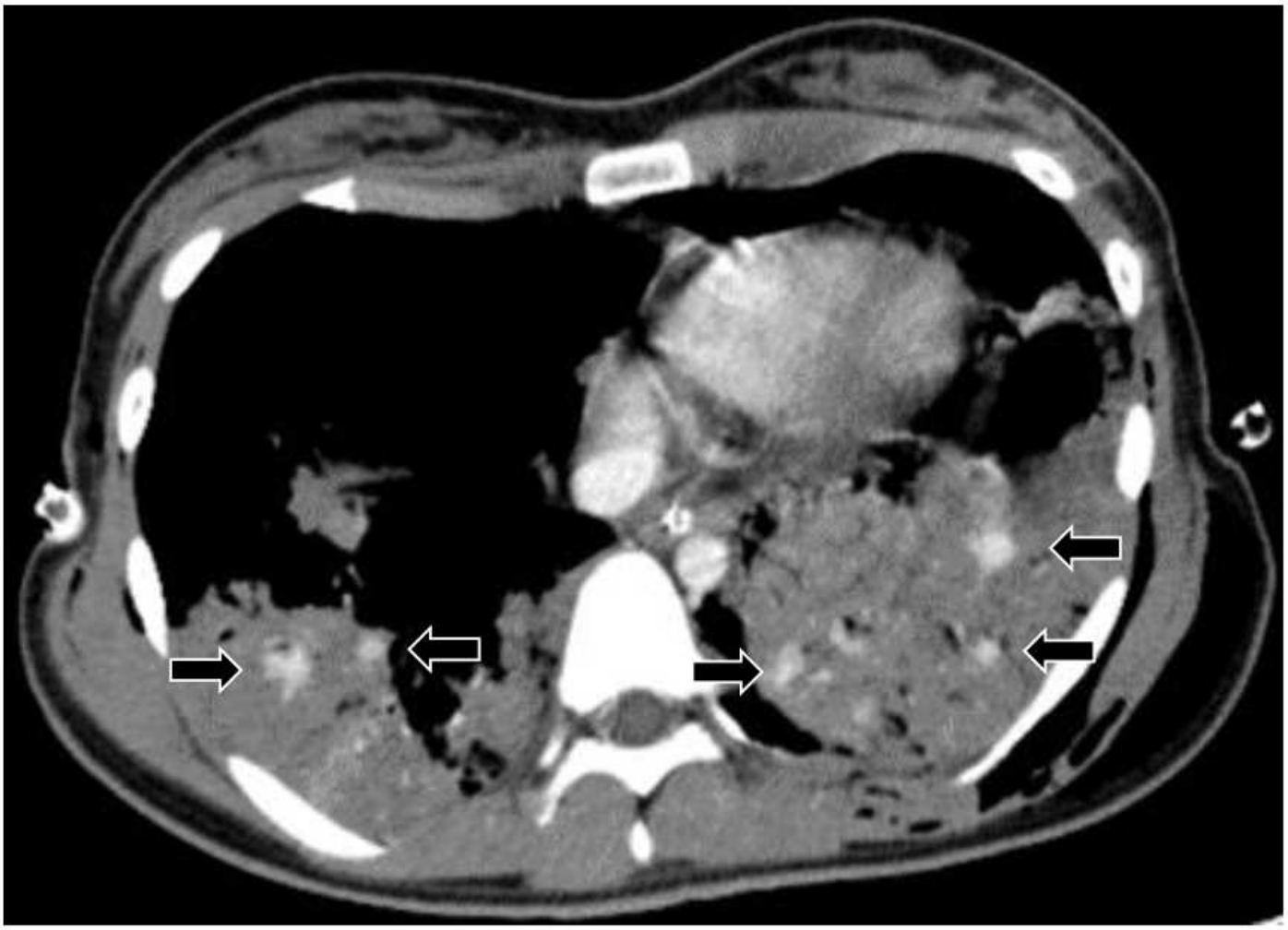

Figure 1

Typical blush in lung contusion. Arrows indicate extravasation of contrast media in the lung contusion, which are defined as blush.

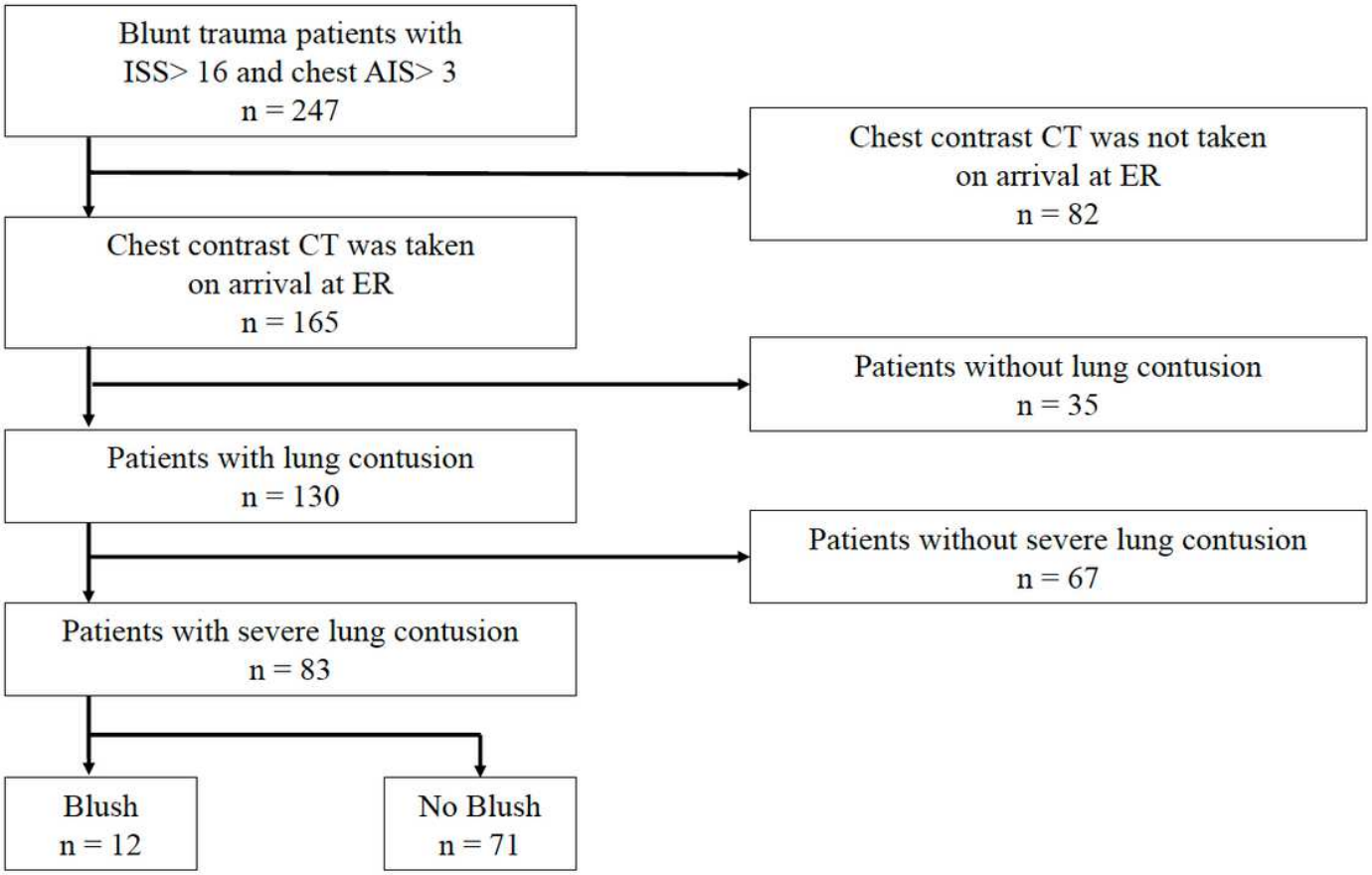

Figure 2

Flowchart of the s tudy selection process . The Blush group included patients who were detected brush in the severe lung contusion (≥ 5cm of maximum diameter) on contrast enhanced CT on arrival at the ER. No blush group included patients who had severe lung contusions, but blush was not detected. ISS, injury severity score; AIS, abbreviated injury scale; CT, computed tomography; ER, emergency room

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