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6-15-2008

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Recommended Citation

Keckler, S. J., Tsao, K., Sharp, S. W., Holcomb, G. W., Ostlie, D. J., St Peter, S. D. Blood utilization in children managed non-operatively for blunt solid organ injury. *The Journal of surgical research* 147, 237-239 (2008).

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Published in final edited form as:

J Surg Res. 2008 June 15; 147(2): 237–239. doi:10.1016/j.jss.2008.03.027.

Blood Utilization in Children Managed Non-Operatively for Blunt Solid Organ Injury

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Abstract

Background—Blood product utilization is an important issue in health care, given the frequent shortages in hospitals and the societal burden required to maintain the supply. Therefore, we retrospectively audited our blunt spleen/liver trauma experience to determine the percentage of cross-matched blood that was transfused to see whether more stringent typing criteria should be applied.

Methods—A retrospective analysis of a recent 7-year experience with nonoperative management in patients with blunt spleen or liver injury was performed. Demographics, packed red blood cells prepared by cross-match, and transfusions were measured. Unmatched, O-type blood given in the trauma bay was excluded. Patients undergoing laparotomy for solid organ injury were excluded. Data are expressed as mean \pm standard deviation.

Results—During the study period, 130 patients were nonoperatively managed for spleen and/or liver injury. Mean age was 8.7 ± 4.6 years, and 62% were male. The mean grade of injury was 2.4 ± 0.9 . A total of 187 units of packed red blood cells was ordered in 60 patients. A total of 46.5 units was administered to 22 patients, revealing a 24.9% transfusion rate for the units ordered in 36.7% of the patients for whom it was ordered. When patients with other major injuries and those with ongoing bleeding requiring an operation or who clinically required blood on presentation were excluded, there were 80 patients. In this stable population, 104 units of PRBCs were ordered for 29 patients. A total of 18 units was then transfused in 5 patients, for a 17.3% transfusion rate for the units orders in 17.2% of the patients for whom it was ordered. None of the 5 patients received transfusion the day of admission.

Conclusion—Hemodynamically stable patients with blunt spleen/liver injury triaged to conservative management should have their blood typed and be monitored closely for signs or laboratory values that would mandate a cross-match. According to our data, this strategy would safely improve utilization of blood bank resources.

Keywords

blood products; blood transfusion; blunt solid organ injury; computed tomography; red blood cells

INTRODUCTION

Blood products are a life-saving and precious commodity that are frequently in short supply, so the proper utilization of this resource is of paramount importance. In the general pediatric

surgery population, one of the frequent uses of packed red blood cells (PRBCs) is for children with blunt solid organ injury. The paradigm of treatment of blunt solid organ injury has shifted to nonoperative management. This management has prevented operation in about 95% of patients with blunt solid organ injury in contemporary practice [1]. In addition to the benefit of avoiding a laparotomy and the physiological consequences of organ removal, recent long-term follow-up data have found that persistent sequelae of nonoperative management is quite rare [2]. In the management of disease process, the first goal is to maximize survival. The second is to minimize morbidity. Once both have been accomplished, then the third step is to minimize the utilization of resources. Patients with blunt solid organ injury, and particularly with isolated solid organ injuries, now face a very small chance of mortality, surgical morbidity, or long-term sequelae. As such, we can now turn our attention to the resources invested in this population to identify avenues that will allow us to produce the same level of success while reducing the utilization of resources. Therefore, we audited our experience with nonoperative management in patients with blunt solid organ injury to clarify the rate of transfused blood that has been cross-matched.

METHODS

After approval from the Internal Review Board, a retrospective analysis of all patients treated nonoperatively for blunt spleen or liver injury diagnosed by computed tomography over a 7-year period was performed. Patient demographics, grade of injury, mechanism of injury, additional injuries, and operative interventions were reviewed. Surgical notes were reviewed for grade of injury; if no grade was documented, the computed tomography was reviewed by two surgeons and a grade was assigned according to the standard grading scale [3]. Blood bank records were reviewed for PRBCs prepared by cross-match and transfusion. We did not include O-type blood that was given in the trauma bay. Data are expressed as mean \pm standard deviation.

A second set of stable patients without multiple injuries who did not have a clear reason on presentation for cross-matching blood was identified. This set was created because many patients present with other injuries that may justify a cross-match. This patient set was derived by excluding patients that presented with frankly hemorrhagic lesions or those with an indication to go the operating room for associated injuries, such as neurosurgical, oromaxillofacial, plastic, or orthopedic operations. In these cases, it is reasonable to cross-match in preparation for the operating room, and we are not in the position to judge the blood requirement for the surgeons of those specialties.

RESULTS

During the 7-year study period, a total of 130 patients with blunt liver or spleen injury were identified. These patients represented the normal spectrum of injuries seen with blunt trauma and are not simply isolated solid organ injuries. Mean age and gender of the study population were 8.7 ± 4.6 years, 81 males (62%), and 49 females (38%). The mean grade of solid organ injury was 2.4 ± 0.9 . Mechanism of injury was distributed as follows: motor vehicle driver/passenger, 45 (35.6%); struck by motor vehicle, 20 (15.4%); fall, 15 (11.5%); bicycle, 11 (8.5%); horse, 10 (7.7%); abuse, 9 (6.9%); off-road vehicle/motocycle, 6 (4.6%); sports, 4 (3.1%); sled, 3 (2.3%); and miscellaneous, 7 (5.4%). Mean length of stay was 6.4 ± 6.5 days. There were 5 patients who did not survive (3.8%); one was a portal vein injury, and the others were related to intracranial injuries.

According to cross-match and transfusion records, 187 units of PRBCs were ordered in 60 patients. A total of 46.5 units were administered to 22 patients, revealing a 24.9% transfusion rate for the units ordered in 36.7% of the patients for whom it was ordered. Two

study populations were then created: hemodynamically stable patients and those requiring operation and/or requiring transfusion upon presentation. When patients in the latter group were excluded, a total of 80 patients were identified. There was no mortality in this group. Review of records for the hemodynamically stable patients revealed 104 units of PRBCs were ordered in 29 patients. A total of 18 units were then transfused in 5 patients for a 17.3% transfusion rate for the units orders in 17.2% of the patients for whom it was ordered. The 5 patients transfused included 2 patients with grade 4 liver injury, 1 with grade 3 liver injury, 1 with grade 3 spleen injury, and 1 patient with a combined grade 3 liver injury and grade 2 spleen injury. None of the 5 patients was transfused during the day of admission.

DISCUSSION

The surgical management of blunt solid organ injury has changed since the first report advocating nonoperative management [4]. The immunological consequences of splenectomy [5, 6] and the realization that most splenic injuries stop bleeding spontaneously in the vast majority of cases created the impetus for nonoperative management, which is now the standard of care [7]. The current recommendation of bed rest equaling 1 day plus the grade of injury has recently been reviewed, and an attenuated protocol has been recommended for hemodynamically stable patients to facilitate concise utilization of health care resources [8]. This was the management scheme during the time of this study.

As the hospital treatment has changed, further scrutiny of resource utilization has been suggested for routine laboratory analysis. The utility of routine laboratory analysis for pediatric trauma resuscitations has been questioned, and it was concluded that routine laboratory panels were of little value, in that only 10% of patients were shown to benefit [9]. Transfusion of blood is not without risks, including both blood-borne pathogens and immunosuppressive effects [10]. Patients who were transfused compared with those who were not showed increased days of mechanical ventilation, intensive care stay, and overall length of hospitalization [11]. With these studies showing increased risk and consumption of resources associated with blood transfusion, the question of routine ordering of a type and cross-match for pediatric trauma patients in the emergency room has been reviewed by 1 other group. This group found that 38 trauma patients had a type and cross-match, whereas only 4 patients were transfused, concluding that routine type and cross-match are often times unnecessary concordant with the results from our data bolstering the strength of our conclusions [12].

A more selective approach to ordering a type and cross-match should be undertaken, especially in patients who are hemodynamically stable upon presentation. Reviewing our data supports this statement, especially since only 17% of the stable patients in whom a cross-match was obtained ended up receiving blood. No patient who was hemodynamically stable required transfusion on the first day of admission. All 5 of the patients requiring transfusion presented with decreasing hemoglobin and tachycardia after initial assessment. Since none of these patients had a transfusion the day of admission, there was ample time to obtain the cross-match as these patients were being observed and continued to have drifting hemoglobin levels. This further enforces the point that patients without the need for transfusion on admission can be observed and a cross-match can be obtained later if necessary. Employing this strategy to the retrospective data set of stable patients would have avoided the cross-match of 86 units of blood. Each cross-match adds approximately \$50 additional charge to a type and screen. There is clearly a role to decrease the amount of cross-matches performed from these data. More importantly, cross-matched blood is held specifically for that patient for the next 2–3 days. Cross-matched blood not used is not discarded but held for the potential of future cross-matches. Therefore, although the blood is not discarded, the window of opportunity for use may be lost while it is held inappropriately. Further, as

packed RBCs are held in storage, the oxygen-carrying capacity and life span of those cells decreases. Thus, unused blood that is held loses viable time during which another patient may have received the blood when it possessed higher integrity.

The data described in this discussion, including our own, represent historical experiences as the management of these patients is under active progression. There was no specific transfusion trigger during the time of the study. We feel as our experience continues to evolve we are growing more comfortable with non-operative management, and as a result, our transfusion trigger is becoming gradually more stringent. Although we do not have data on our evolution of management or our current transfusion threshold, others have documented that healthy children with hemodynamic stability could tolerate hemoglobin levels of 7 g/dL [13]. Therefore, whereas these retrospective data support cross-matching only patients with an active need for transfusions, moving forward with these conclusions in mind will not only omit frankly unnecessary cross-matches in stable patients, but may also result in even fewer cross-matches than would be predicted from the retrospective experience. We have initiated a prospective protocol employing a brief period of bedrest for patients with blunt spleen and liver injuries. In this protocol, we are cognizant of obtaining only type and screen for patients who present without an indication for transfusion.

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