blood (LTO-WB) with those resuscitated with separate component transfusions. Trauma patients 16 years or older who received pre-hospital or emergency department (ED) transfusions of uncrossed blood products, including LTO-WB, RBCs and plasma, between 11/1/17 and 7/1/18 were included. Low-titer is defined as having anti-A and anti-B titers less than 1:256, which previous research has shown to be safe for emergency release blood products. While the indications for WB and component transfusions were the same, the decision to use one or the other was at the flight team or trauma attending's discretion. For analysis, the patients were divided into groups of those who only received component transfusions with RBCs and plasma (COMP group) and those who received any WB (LTO-WB group). The primary outcome was clinical or laboratory evidence of hemolytic transfusion reactions, specifically any change in serial hemolysis panel labs (creatinine, potassium, LDH, total bilirubin, and haptoglobin) or change in P/F ratios at 3, 24, and 48 hours. Patients were also monitored for clinical development of other transfusion related complications, including transfusion-related acute lung injury (TRALI) within 6 hours of last transfusion (defined as hypoxemia with P/F ratio less than 300 mmHg and new bilateral infiltrates on chest x-ray in the absence of left atrial hypertension), and transfusion associated circulatory overload (TACO) within 12 hours after transfusion (defined as acute worsening respiratory distress with evidence of acute or worsening pulmonary edema and volume overload).Other complications included transfusion reactions severe enough to be documented in the chart or necessitating pause or discontinuation of the transfusion, such as urticarial rashes, anaphylaxis, tachycardia, or chills and fever within 1 hour of transfusion. The secondary outcomes were post-ED blood product transfusions and 30-day survival, analyzed using a multivariate logistic regression model.

Of the 5029 trauma patients admitted over this 8 month period, a total of 350 patients received uncrossed, emergency release blood products in either the pre-hospital or ED setting. The LTO-WB group consisted of 198 of these patients, while the remaining 152 were in the COMP group. The groups did not differ in age, sex, race, BMI, mechanism of injury, or Injury Severity Score (ISS), however the LTO-WB group had higher chest-specific Abbreviated Injury Scale (AIS) (median 3 vs. 2; p=0.027). The LTO-WB group also had lower arrival systolic (median 94 vs. 105; p=0.005) and diastolic blood pressures (median 59 vs. 65; p=0.023), lower arrival pH (median 7.22 vs. 7.26; p=0.011), higher lactate levels (median 5.1 vs. 3.5; p<0.001), and worse base excess (median -7 vs. -5; p=0.014). The groups received a similar number of transfusions in the ED (WB equal to 1 unit plasma and 1 unit PRBC), however the LTO-WB group required less overall products after leaving the ED (median 0 vs. 3; p=0.001). There was no significant difference in hemolysis panels between the groups over time, with the exception of slightly lower total bilirubin at 24 hours in the LTO-WB group (median 0.7 vs. 1.1; p=0.014). This study only had two recorded transfusion reactions, with both cases of suspected TRALI being in the COMP group (p=0.061). Using a multivariate logistic regression model controlling for age, pre-hospital blood pressure, arrival pH, mechanism of injury, and chest AIS, the LTO-WB group was an independent predictor of increased 30-day survival (OR 2.19; 1.01-4.76; p=0.047) compared to the COMP group. When controlled for age, pre-hospital blood pressure, arrival pH, mechanism of injury, and ISS, the LTO-WB group was associated with reduced post-ED blood transfusions (OR 0.47; 0.23-0.94; p=0.033) compared to the COMP group.

The authors concluded that emergent transfusion of cold-stored LTO-WB is safe in civilian trauma patients. They go on to include that LTO-WB was not associated with increased transfusion reactions, increased laboratory evidence of hemolysis, or mortality. The authors highlight that their data is even more significant when you consider the LTO-WB group had more severe chest injuries with worse arrival vitals and higher evidence of shock by laboratory values. The logistics of WB transfusions are also important to consider. Not only is it more convenient to transfuse all the components in one bag, but it also reduces the number of donors a patient is exposed to while minimizing overall transfusion volume. The authors note this study was the first to identify a statistically significant association between WB transfusions and 30-day survival, however state that a randomized control trial is still needed to fully evaluate the effect of WB on mortality. The limitations of this study include possible selection bias in the decision between LTO-WB and COMP, with whole blood possibly being saved for the more severely injured patients, as well as difficulty generalizing this single center prospective observational study to other institutions considering the definition of "low-titer" for whole blood can vary between hospitals.

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Comment: Although there is obvious bias affecting this study, it still provides interesting information about a topic that has become more popular in recent years. If further research continues to support the use of LTO-WB, integrating it into practice will still largely depend on individual hospitals adopting it as standard of care.

☐ EFFECT OF LOW-DOSE SUPPLEMENTATION OF ARGININE VASOPRESSIN ON NEED FOR BLOOD PRODUCT TRANSFUSIONS IN PATIENTS WITH TRAUMA AND HEMORRHAGIC SHOCK: A RANDOMIZED CLINICAL TRIAL.

Sims CA, Holena D, Kim P, et al. *JAMA Surgery* 2019. doi:10.1001/jamasurg.2019.2884

Trauma is the leading cause of death in adults under the age of 45, with 72% of mortality attributable to hemorrhage. Shock in the setting of trauma has long been managed by volume resuscitation, both with crystalloid and blood products. However, resuscitation with large fluid volumes is not without adverse effects and can lead to coagulopathy, acute lung injury, and abdominal compartment syndrome. It is possible that vasopressors, such as the hormone arginine vasopressin (AVP), could limit blood transfusion volumes required during trauma resuscitation and decrease the risk of associated complications. AVP is widely used in critically ill medical patients, but evidence

regarding its use in trauma patients is limited, though studies in animal models have suggested benefit. This study aimed to determine if the use of AVP in trauma patients with hemorrhage decreased the need for blood product transfusion.

The primary outcome of this single-center randomized clinical trial was the volume of blood products transfused within 48 hours, including packed red blood cells (PRBC), fresh frozen plasma (FFP), and platelets. Secondary outcomes included total volume of crystalloid infused, estimated blood loss, overall fluid balance, and total vasopressor requirement in the first 48 hours. Trauma patients age 18-65 who received at least 6 units of blood product within 12 hours were enrolled and randomly assigned by a computer process in groups of six to the study group (AVP administration) or a placebo group. In the study group, a 4-unit bolus of AVP was given, followed by an infusion which was started at 0.04 U/min. In the placebo group, an identical volume of saline was bolused and infused. Once hemorrhage was controlled as determined by the operating surgeon, the infusion could be titrated to maintain a mean arterial pressure (MAP) of at least 65 mmHg for 48 hours. If additional vasopressors were needed, neosynephrine, norepinephrine, and/or epinephrine were used. Blood products were given at the discretion of the primary treating physician, as well as in the operating room or interventional suite. Blood products were ideally transfused in a 1:1:1 fashion. All investigators and study participants were blinded to the study group assignments. Exclusion criteria included prehospital cardiopulmonary resuscitation, emergency department thoracotomy, corticosteroid use, chronic renal insufficiency, coronary artery disease, traumatic brain injury requiring neurosurgical intervention, pregnancy, prisoner status, or administration of AVP prior to study enrollment. Investigators performed both intention-to-treat (ITT) and per-protocol analyses. The per-protocol analysis excluded 9 patients with non-survivable injuries who expired in the operating room.

Of 257 hypotensive trauma patients who presented during the study period, 157 were excluded mostly due to insufficient blood product transfusion. Seven patients who were treated with AVP prior to randomization and one whose family did not consent to enrollment were also excluded. There were no significant differences in patient demographics, injury characteristics, primary source of hemorrhage, hemorrhage control, initial trauma bay vitals, time to enrollment, pre-enrollment resuscitation requirements, or initial laboratory values. Forty-nine participants received AVP, and 51 received placebo. In the ITT analysis, AVP was associated with significantly less cumulative volume of all blood products with a median difference of -1.00 L (95% CI, -2.03 to 0.00 L; $p = .03$). When blood products were analyzed individually in the ITT analysis, AVP was associated with significantly lower volumes of FFP (median, 0.9 [IQR, 0.8-1.3] vs 1.0 [IQR, 0.5-1.8]L; $p = .03$), platelets (median, 200 [IQR, 0-300] vs 300 [IQR, 0-600] mL; $p = .02$), and cryoprecipitate (mean [SD], 12.6 [75.4] vs 34.7 [84.8] mL; $p = .04$). In the per-protocol analysis, there was a significant difference in the volume of all blood products used (median, 1.4 [IQR, 0.5-2.6] vs 2.9 [IQR, 1.1-4.8] L; $p = .01$). AVP had no effect on overall complications, including acute respiratory distress syndrome, length of mechanical ventilation, or acute kidney injury, in either analysis, but AVP was associated with a decrease in rate of deep vein thrombosis in the ITT analysis (10 of 49 [20%] vs 20 of 51 [39%]; $p = .05$) and in the per protocol analysis (5 of 44 [11%] vs 16 of 47 [34%] ; $p = .02$). The ITT analysis showed no significant effect of AVP on overall mortality or risk of operative death. Both analyses showed no significant influence of AVP on length of stay in the intensive care unit or hospital.

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The authors concluded that use of AVP in the setting of traumatic hemorrhagic shock can significantly reduce the need for blood product resuscitation. Though it does not limit overall complications, AVP was associated with a significantly lower rate of DVTs. The authors note this study was underpowered to determine whether significant differences existed in clinically important outcomes such as acute kidney injury, acute respiratory distress syndrome, mechanical ventilation, length of stay, or mortality. Another limitation was the total dose of vasopressin administered varied between patients. Overall management of the patient was at the discretion of the clinical team, and though the goals of treatment were standardized, variation in treatment may have occurred. No standardized dosing schedule, such as one based on serum AVP level, was used. Overall, the authors felt that AVP can reduce the need for blood product administration in trauma, but a larger study is needed to confirm the generalizability of these findings.

☐ TRACHEAL ULTRASOUND FOR THE ACCURATE CONFIRMATION OF THE ENDOTRACHEAL TUBE POSITION IN OBESE PATIENTS.

Xiao QM and Xi XY *Journal of Ultrasound Medicine.* April 24; 00:1-5

Endotracheal intubation is a commonly performed procedure within the healthcare system. Options for placement confirmation include direct visualization of the tube pass through the cords, fogging in the tube, carbon dioxide colorimetry, end tidal Co2, breath sounds, radiography and bronchoscopy. Breath sounds are often used as the first confirmatory method but are unreliable especially in obese patients. The goal of this study was to evaluate an alternative bedside test that could be used to quickly confirm tube placement in this patient population.

The authors conducted a prospective and blinded study to determine utility of ultrasound in confirmation of endotracheal intubation in obese adults when compared to auscultation. Adults with a BMI defined as greater than 30kg/m^2 undergoing general anesthesia were recruited. During the study if patients became hemodynamically unstable or hypoxic (< 90% spo2) they were removed from the study. Intubation was performed by two anesthetists who were not involved in data collection. Following induction with 2 μg/kg of Fentanyl and 2mg/kg of propofol, patients were preoxygenated for 3 minutes. Seven mm and 7.5mm tubes were used for females and males respectively. Correct ETT placement was defined as placement at the trachea while incorrect placement included right or left mainstem bronchus intubation or esophageal intubation.