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Preference of Physician for Management of Patients with Trauma, (Crystalloids versus Colloids)

Gamal Ejaimi[1], Khalid Dealan[2], Ayed Jahrash[3], Saeed Moghram[4], Khulood Dealan[5]

[1]Assistant Professor of Anaesthesia& Intensive care. Department of Surgery, College of Medicine, King Khalid University. Aseer Central Hospital, Abha, KSA

[2, 3, 4]Intern, MBBS, King Khalid University (KKU), Aseer Central Hospital, Abha, KSA

[5]Medical scientists, BMedSc , The University of Technology Sydney (UTS), Abha Private Hospital (APH), Abha, KSA

Abstract: ***Objectives**: This is cross-sectional study was conducted in Abha and KhamisMushayt Hospitals, KSA, Aseer Region to assess and evaluate the use of fluids resuscitation among trauma patients. The aim of this experiment was to compare and contrast the use of colloids and crystalloids in fluid management for trauma among health practitioner. **Methods**: A number of 158 doctors were included in this study. The ranks of them ranged from house officer or internist up to senior consultants in most medical specialties. A self-administered questionnaire has been developed and distributed as hard copy and a google designed with a link. It comprised a personal characteristic, questions about common fluids which has been used during trauma resuscitation, and also the preferred fluids. Moreover, questions about a written local or international protocols in the hospitals and any experiences of fluids overload or pulmonary edema which occurred before. **Result**: More than 90% choose to work with crystalloids whereas the other 10% preferred colloids. On the other hand, out of the 10% who preferred colloids 8% had only less than 1-year experience in their specialties. With regards to crystalloids, the majority of participants (more than 60%) preferred the use of normal saline, 33% ringer lactate, and only 4.4% used dextrose in saline. The most popular colloid during trauma fluids resuscitation was found to be the human albumin (more than 60%), while more than 25% demonstrated dextran. More than 70% of participants had patients who developed pulmonary edema during management. Regarding this, those who were treated with the combination of crystalloid and colloids showed the high percentage (more than 50%). However, when crystalloids and colloids were used separately, it was found to be 33% and 14% respectively. **Conclusion**: The study concludes that the most preferred fluids therapy in trauma patients or seriously ill patients was found to be crystalloids regardless the theoretically findings that shows the exact opposite. Meanwhile, the high percentage of trauma patients who developed pulmonary edema was found among those who were treated with both crystalloids and colloids therapy. However, this issue needs more studies in the future. Also, a clear written protocol will help and guide fluids therapy.*

Keywords: Fluids, Crystalloids, Colloids, Trauma, Resuscitation

1. Introduction

Hemorrhage is considered as a major cause of preventable death for both civilian and military trauma. The main goal of fluid resuscitation in the face of hemorrhagic shock are to restore end-organ perfusion and to maintain tissue oxygenation while attempting definitive control of bleeding. Fluid resuscitation started in the early 1832 when Robert Lewins explained the effects of the intravenous administration of an alkalinized salt solution in treating patients during the cholera pandemic. He detected that "the quantity necessary to be injected will probably be found to depend upon on the quantity of serum lost; the object being to place the patient in nearly his ordinary state as to the quantity of blood circulating in the vessels." (Lewins and Robert 243-244).[7]

Moreover, fluid resuscitation was advanced later by Alexis Hartmann, who modified a physiologic salt solution developed in 1885 by Sidney Ringer to rehydrate children with gastroenteritis (LEE 1115-1121). [9]After that, in 1941 they developed blood fractionation then human albumin was used for the first time in large quantities for resuscitation of patients who were burned during the attack on Pearl Harbor in the same year (LEE 1115-1121). [9]

Nowadays, fluids resuscitation is used in almost in patients with severe trauma and burns, patients undergoing general anesthesia for major surgery and in patients in the ICU. It is one of the most abundant interventions in acute medicine. Fluids therapy in fact is only one component of a complex hemodynamic resuscitation strategy. Its primary target to restore intravascular volume. Since the venous return is in equilibrium with cardiac output, sympathetically mediated responses regulate both efferent capacitance (venous) and afferent conductance (arterial) circulations in addition to myocardial contractility (Funk, Jacobsohn and Kumar 255-262). [6] In addition, changes in the microcirculation in vital organs vary widely over time and under different pathologic states, and the effects of fluid administration on end-organ function should be considered along with effects on intravascular volume (Funk, Jacobsohn and Kumar 255-262). [6]However, if not performed correctly, resuscitation can exacerbate cellular injury caused by hemorrhagic shock, and the type of fluid used for resuscitation plays a significant role in this injury pattern.

There are two main types of volume expanders crystalloids and colloids. Crystalloids are aqueous solutions of mineral salts or other water-soluble molecules. They have short half-life time due to their rapid absorption. Colloids on the other hand, contain larger insoluble molecules, such as gelatin. They are characterized with longer half-life compared with crystalloids leading to an increase in the intravascular. The most Common colloids used in the medical context are albumin and fresh frozen plasmawhile the most common crystalloids are normal saline, Ringer's lactate and 5% dextrose. It was hypothesized that crystalloids have being

used more than colloids for trauma patients. The hypothesis was based on past researches findings, which have indicated that crystalloids are more popular because it can be given on large volume and it shows very fast effect on patients. Nevertheless, there is no evidence shows that resuscitation with colloids reduces the risk of death compared to resuscitation with crystalloids in critically ill patients (Lewins and Robert 243-244). [7]

2. MATERIAL AND METHODS

This a cross-sectional experiment was performed in Abha and KhamisMushayt Hospitals including both governmental and private during the period of six weeks started from the mid of October 2016. A number of 169 doctors was enrolled in the study. The ranks of participants ranged from internist up to consultant in most of medical specialties. A self-administered questionnaire has been developed having online and hard copies. It comprised a personal characteristic, questions about intravenous fluids types, indication of use during resuscitation of trauma patients. Also, it compromised questions about pulmonary edema and DIC during trauma patient management and types of fluids were used. The study was approved by ethical committee of King Khalid University, College of Medicine and Aseer Central Hospital.

Statistical analysis: Analysis of all the information obtained were performed by using the Statistical Package for Social Sciences (SPSS version 21.0)

3. Result

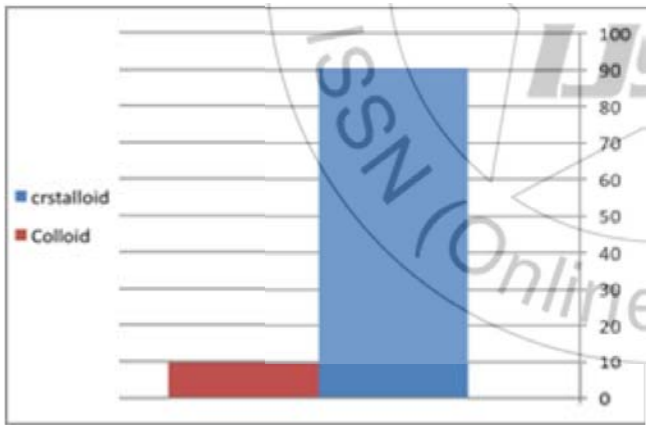

Figure 1: The percentage of the usage of crystalloid versus colloid.

As it seen in figure one the usage of crystalloid is ten times higher than colloid where 90% of the participants preferred to use crystalloid to manage fluid in trauma patient. However, the study shows that 73.5% think that crystalloid is no difference than colloid and choose to use it for other reason unrelated to efficacy of the two fluids.

Table1: The percentages versus the years of practice

The percentages of the usage of colloids	How many years after the participant finish his/her MBBS, Residency, specialty or fellowship training?
1%	10-Years 5
1%	3-5 years
3%	1-2 years
8%	<1 year

It clearly shows that 8% of the participant who choose colloids have been working for less than a year.

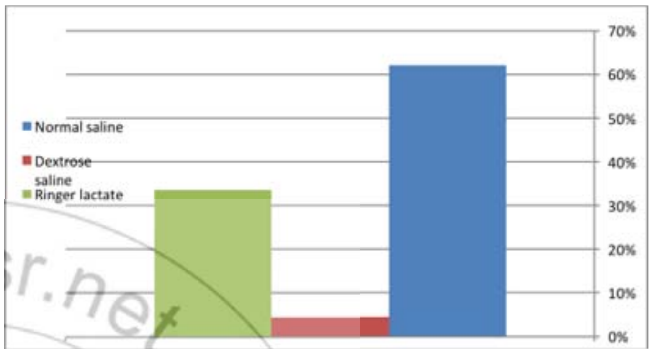

Figure 2: The percentages of the usage of the three most popular crystalloids.

Figure 2 shows Normal saline reach the peak with more than 60% participant choose to work with as their first line to manage fluid in trauma patient where Ringer lactate come second with 33 % and the least preferred with only 4.4%.

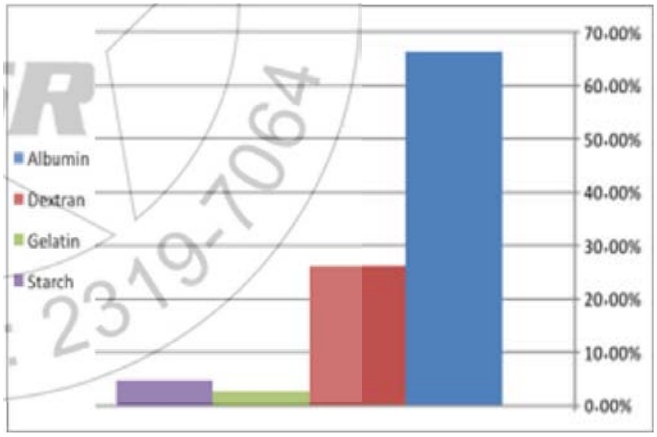

Figure 3: Comparison between the usages of the most popular colloids.

Figure 3 clearly shows that human albumin is the most preferred type of colloid despite its price where more than 60% participants who choose colloids preferred to work with human albumin over the rest of the colloid. Moreover, only 2% choose to work with starch that is slightly higher than Gelatin which was the least preferred fluid.

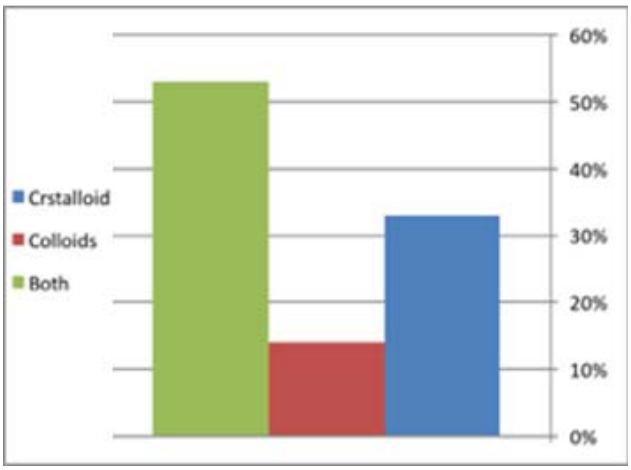

Figure 4: The type of fluid that mainly cause pulmonary edema.

More than 70% of participants had patients who developed pulmonary edema during their treatment (Figure 4). It demonstrates that when both colloids and crystalloids used in fluid management more patients developed pulmonary edema.Use of colloids were the least fluid causing pulmonary edema with only 14% compare to crystalloids.

Table 2: The usual percentage of the volume of crystalloids was administrated

Volume	%
5-10ml/kg	21%
10-20ml/kg	45%
>20ml/kg	24%

Table 2 shows the percentage of the given volume for crystalloids. It shows that more than 60% of the participants give three times the lost volume.

4. Discussion

From the results, the vast majority of all participants prefer to use crystalloids over colloids. It was found that more than 90% choose to use crystalloids (Figure 1). Due to the fact that crystalloids have a short half-life so they will stay in the intravascular space for a short time about 30 to 60 minutes. Only about one-third of the fluid administered will stay in the intravascular space, with two-thirds passing directly into the tissues. Thus, the practitioners need to administer more amount of fluids.[1,2]In contrast, colloids maintain plasma expansions well (Webb, 1999).[3] The initial crystalloids used for resuscitation of trauma patient were found to be ranging from 10 - 20 ml per kilogram body weight (table 2).

However, the choice of the type of the fluid been given depend on the primary origin of the exact kind of fluid loss, the condition of the patient and the preference of the prescribing clinician (Krau, 1998).[8] For example, Dextran can only be given if the patient is at risk for having low blood sugar or high sodium (Perel, Roberts and Ker,2013).[3]Figure two shows the most favorable type of crystalloids which is Normal Saline. Schierhout and Roberts 1998, described normal saline as safe and easy for administration.[11]However, there is sufficient evidence shows that the rapid infusion of the normal saline is the main cause of metabolic acidosis (Schierhout and Roberts, 1998).[11]In fact, this research shows an identical result where participants reported a higher adverse side effect when treating patients with crystalloids compare to colloids by 20%. Moreover, the risk increased by 40% when combined with colloids. The large volume accumulates into an intra and extravascular space could be the cause leading to peripheral and pulmonary oedema.[1]

Colloids have larger molecules that are retained more easily in the intravascular space which makes them better than crystalloids as plasma expanders (Krau, 1998).[8] This lead to increase in the osmotic pressure (Bradley, 2001).[1] On the other hand, the excessive use of colloids may lead to pulmonary and peripheral oedema or cardiac failure (O'Neill, 2001).[2] Although the pulmonary oedema due to colloids use is a late presentation compared with crystalloids, it will be more sustained (Bradley, 2001).[1]Schierhout and Roberts (1998) also highlighted that fluid resuscitation using colloids could cause pulmonary oedema as well as anaphylactic shock and they can lead to a small increase in the rate of death.[11]In addition, colloids are required for fluid challenges, as 200ml of the colloid solution will re-expand intravascular volume by 200 ml (Webb, 1999).[3]Although,it is more effective at expanding the circulation the evidence shows that they could not improve mortality in the critically ill patient (Alderson et .al, 2001). [5]The same report goes so far as to suggest that there is little justification for the use of colloids outside the context of randomized controlled trials. Moreover, A systematic review by Choi et .al (1999) highlighted the need for further trials and indicates that insufficient data is available to suggest abandoning the use of colloids in practice.[4] Another study was conducted by Schortgen and collogues in (2001) assert that the little evidence that exists is contradictory.[12]During study of small volume of resuscitation using combination of hypertonic crystalloid with a colloid, it was found that there was improvement in outcome in patients with penetrating trauma injury or traumatic brain injury who required intensive care. This may be due to the reduction in inflammatory process. However, the sample was small reflect the recommendation a meta-analysis and sub-group analysis for more evidences. [1]

Finally, it is important to remember that the choice of fluid for resuscitation is only one small part of measures taken in the quest for reduced mortality (Webb, 1999).[3] There is a little conclusive evidence that mortality or morbidity outcomes are affected by choice of either colloid or crystalloid fluid (Bradley, 2001) and mortality has not been found to be related to the particular fluid used for resuscitation (Moretti et al, 2003).[1,10]

5. Limitations of the Research

The research available is subject to major criticisms:

- Firstly, the study did not analyze each type of crystalloids either colloids separately.
- Secondly, a supposition that mortality is affected by choice of fluid may have been implicit in the design of the recent meta-analyses.

6. Conclusion

Despite numerous and extensive clinical trials, there remains little evidence that either classification of plasma volume expander, when used in fluid resuscitation of a patient with hypovolaemia, is more beneficial than the other. Consequently, there is wide agreement that more researches are needed. In the meantime, in the absence of definitive data, critically ill patients should be treated according to their clinical needs at the time with due consideration of all relevant factors. The contentious issue of colloid versus crystalloid solution in fluid resuscitation will continue to be debated. As the body of available research increases, it is vital therefore for all medical practitioners including nurses to keep abreast of all developments so that they can be safe practitioners and ensure optimal care for their patients.

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