Perioperative Fluid Management for Elective Major Surgery Patients at a Teaching Hospital in Rwanda

Pierre Irafasha[1*], Malachie Tuyizere[2], Joselyne Mukantwari[3], Lilian Omondi[3, 4]

[1]*University Teaching Hospital of Butare, Butare, Huye, Rwanda*

[2]*University of Rwanda, College of Medicine and Health Sciences, Physiotherapy Department*

[3]*University of Rwanda, College of Medicine and Health Sciences, School of Nursing and Midwifery*

[4]*Ministry of Health, Human Resource for Health NYU, P.O. Box 84Kigali, Rwanda*

***Corresponding author**: Pierre Irafasha, University Teaching Hospital of Butare, P.O. Box: 254 Butare, Rwanda. Email: irapeter2014@gmail.com

ABSTRACT

Background

Every year, over 312 million surgical operations are performed globally. While perioperative goal-directed fluid strategy may reduce postoperative complications among patients undergoing major surgery, poor perioperative fluids management has been linked to adverse postoperative patients' outcome.

Methods

This study used quantitative prospective design to assess the perioperative fluids management in 133 patients operated in the theatre of University Teaching Hospital of Butare (CHUB). The SPSS 21 was used to analyze the data, Chi-square test was performed to assess the association between fluid administered and patients' hydration status with an acceptable cutoff at $p<0.05$.

Results

The findings showed that 108 (81.2%) and 25 (18.8%) participants were in dehydration class A and B before surgery and strongly associated with age, surgeries, type and amount of intraoperative fluids. Participants received RL and NS (67.7%), 2091.73 ml, $\pm$803.6 ml and lost 218.42$\pm$131.9 ml fluid in average. Postoperatively, 53.4% and 46.6% participants were in dehydration class A and B respectively, strongly associated with type and duration of surgery ($P<0.05$). All participants fasted more than 6 hours.

Conclusion

The dehydration rate increased intraoperatively in relation to type and duration of surgery and type and amount of fluid administered. Reduced fasting time and effective intraoperative fluid management would improve the patients' hydration after surgery and postoperative patients' outcome.

Key words: Major Surgery, Elective Surgery, Perioperative care, Fluid management, patients

BACKGROUND

Globally, it is estimated that 312 million surgical operations are performed annually and poor perioperative fluid management have been linked to mortality and morbidity among people who undergo surgical operations.[1] Perioperative fluid management is an important part of overall surgical therapy. Proper administration of fluids is critical, especially in patients who undergo elective major surgeries. These are operations upon an organ within the cranium, chest, abdomen or pelvic cavity.[2] Fluids should be viewed as drugs that must be prescribed carefully, with attention to type, dosage, and toxicity in order to maximize efficacy and minimize toxicity. The application of the right kind of fluid therapy at the right time in the right amount is needed to optimize the patient's outcome.[3]

Absolute or relative hypovolemia is common in the perioperative period due to preoperative dehydration; vasodilation caused by anesthetic and adjuvant drugs, and surgical bleeding. This

leads to low cardiac output and decreased tissue perfusion and, if severe, can lead to shock and multi-organ failure.[4,5]

Perioperative fluid management is based on individualized goal and is guided by advanced hemodynamic monitoring. Effective perioperative fluid management is associated with reduced length of hospital stay after surgery and enhanced recovery.[6] Body fluid composition may change in minutes or hours, resulting in impaired wound healing and homeostasis. The choice of strategy in intraoperative and postoperative fluid management may be significant.

Perioperative fluid management in major abdominal surgery is based on the goal of hemodynamic stabilization and is reported to be associated with reduction of postoperative complications.[1]

Most of patients scheduled for major abdominal surgery can have clear fluids and/or administration of carbohydrate-rich drinks up to 2 hours before surgery; this will be helpful to patients as it reduce the fluids requirement to replace fluid deficits and dehydration from the time of fasting period and improve the patient outcome after surgery.[7]

A regular perioperative assessment of patients' fluids status and fluids requirement should be the milestone of perioperative fluid management during major abdominal surgery.[8] Perioperative assessment of fluids requirement includes looking for physical signs of dehydration or hypovolemia, or fluid overload, regular monitoring of vital signs and urine output.

Excess fluid administration has been linked to acute kidney injury, gastrointestinal dysfunction, cardiac and pulmonary complications like pulmonary edema.[9] Effective perioperative hemodynamic monitoring and fluid replacement are mandatory in major abdominal surgery.[10]

In post-operative patients, normal fluid balance is the result of effective perioperative fluid management leading to normal homeostasis. On the other side, poor perioperative fluids management increases the risk of fluid excess or deficit in the postoperative patient resulting to fluid overload or fluid deficit. The present study sought to assess perioperative fluids management by identifying the hydration status of patients before and after surgery and perioperative fluids received among elective major cases at a Teaching Hospital in Rwanda.

METHODS

Design, population and setting

A prospective cross sectional study design was used to assess perioperative fluid management among patients who underwent elective major surgeries in the operating theatre of University Teaching Hospital of Butare (CHUB). The hospital is located in the Southern, Rwanda. It has 490 beds and 511 clinical staff. The hospital operating theatre has five operating rooms and a recovery room. General surgery, orthopaedic surgery, ENT, oral-maxillo-facial surgery and ophthalmology, gynecology and obstetrics surgeries are the main functional units. An average of 200 major surgical operations are expected to be performed every month which served as target population for this study. The study considered adult patients who were planned for major elective surgeries only. Children, and people who underwent emergency surgeries were excluded in the study.

Sample size and sampling procedures

The study sample of 133 patients was estimated using simplified Yamane formula from a total of 200 patients that the hospital was expected to operate every month. Patients who were meeting the inclusion criteria, operated in the period of 1st to 31st May 2019 at UTHB were conveniently selected in the study until the estimated sample was reached.

Data collection procedures

A data capture sheet adopted from WHO dehydration assessment tool was used to collect data from the patients scheduled and operated for elective major surgeries and their files on everyday basis. Data collection was done during regular working shifts from Monday to Friday 7am to 5 pm. On admission in the operating theatre, the patient was interviewed on the fasting period and his /her hydration status was assessed. The hydration status was also reassessed before leaving the theatre to the recovery ward. Other characteristics assessed included the type of planned surgery performed, amount and type of fluids received, fluid and blood losses during surgery, and the time taken to perform the procedure. This information was retrieved from the patients' files before they were discharged from the recovery room. All data were captured on the operating data sheets.

Data analysis

After completion of the data collection, the data were entered into computer data entry sheet and the dataset was cleaned and analyzed using SPSS 21. Descriptive analysis using frequency, percentages, and mean was used to summarize

the data. In addition, Chi-Square test was performed to determine the associations between patient's factors, perioperative fluids administered, blood loss and hydration status before and after surgery.

A 95% confidence interval and a significance level of 0.05 were set. Hydration status was classified into three classes (A: hydrated; B: moderated dehydration, and C: severe dehydration) as recommended by the World Health Organization. Class C was removed because it was not represented among the participants. Fluids administered to patients during operation included Normal Saline (NS) and Ringer Lactate (RL), NS/ RL combined, Dextrose, and Blood products.

Ethical considerations

The present study was approved by the Institutional Review Board (IRB) of the University of Rwanda, College of Medicine and Health Sciences, CHUB Ethics committee and operating theatre manager. The patients were explained the purpose and the process of the study before they provided their consent to participate in the study and for the use of their data for research purpose. Anonymity of collected data was respected. Only the codes were recorded on the data sheet. The participants had right to withdraw from the study without inconvenience on their planned surgery and further health care.

RESULTS

Sociodemographic and clinical information of respondents

The current study was conducted on a sample of 133 clients who underwent major surgeries at a University Teaching Hospital of Butare. Nearly two thirds of the participants were females 81 (60.9%) and 52 (39, 1%) were males. The mean age of participants was 42.8 years and mean weight was 67.6 kg. The mean of the amount of intraoperative fluid loss was 218.4 ml, while fluid received was 2,091.7 ml.

Three-quarters of respondents, 97 (72.9%) fasted for 12-18 hours and a quarter fasted for 6-12 hours. Participants underwent different surgeries including 42 (31.6%) orthopedics, 26 (19.5%) and 10 (19.5%) obstetrics and gynecology, 19 (14.3%) ENT surgeries, and 18 (13.5%) laparotomies (Table1).

Table 1. Sociodemographic and clinical details of participants

Variable (N=133)	**Mean**	**Standard deviation**
Age (in years)	42.80	17.5
Weight (in kg)	67.62	9.5
Intraoperative fluid loss (in ml)	218.42	131.9
Fluids received (in ml)	2091.73	803.6
	Frequency	**Percentage**
Sex		
Male	52	39.1
Female	81	60.9
Total	**133**	**100.0**
Fasting period (in hours)		
6	00	00
6-12	34	25.6
12-18	97	72.9
>18	2	1.5
Total	**133**	**100.0**
Type of surgery		
Orthopedics	42	31.6
Obstetrics	26	19.5
Gynecology	10	7.5
ENT surgery	19	14.3
Laparotomy	18	13.5
Breast surgery	10	7.5
Skin/plastic surgery	8	6.0
Total	**133**	**100.0**
Duration of operation procedure (in minutes)		
60-90	35	26.3
90-120	67	50.4
120-150	28	21.1
>150	3	2.3
Total	133	100.0

Patients' hydration status before and after surgery

The results show that 108 (81.2%), and 71(53%) patients were hydrated (class A) before and after surgery respectively, while 25 (18.8%), and 62 (46.6%) are moderately dehydrated (class B) before and after surgery respectively.

Table 2. Hydration status before and after surgery in elective major surgeries patients

	Frequency	Percentage
Hydration status before surgery		
A	108	81.2
B	25	18.8
Total	**133**	**100**
Hydration status after surgery		
A	71	53.4
B	62	46.6
Total	**133**	**100**

Types and amount of fluid administered to the patients during surgery

The amounts of fluids mostly administered to the patients during surgery were Ringer Lactate (RL) and Normal Saline (NS) 90 (67.7%). NS/RL and dextrose, NS/RL Blood products were administered in small proportions of 6 (4.5%) and 12 (9%) respectively.

Table 3. Fluids administered to the patients during surgery and fluid loss

Variables	Frequency	Percentage
Type of fluids received		
RL and NS	90	67.7
NS or RL	25	18.8
NS/ RL + Dextrose	6	4.5
NS/ RL Blood products	12	9.0
Total	**133**	**100**
Amount of fluid received (in ml)		
1000-2000	90	67.7
2001-3000	29	21.8
> 3000	14	10.5
Total	**133**	**100.0**
Amount of fluid lost (in ml)		
<100	40	30.1
100-300	49	36.8
>300	44	33.1
Total	**133**	**100.0**

Association between participant's characteristics, fluid administered and hydration status before surgery

Chi-square test was used for association between participant's characteristics, fluid administered and hydration status before surgery. Patients age, the amount and types of fluids received showed a significant association with hydration before surgery (P-value: 0.001)

Table 4. Association between characteristics of patients, fluid administered and hydration status before surgery

	Hydration status before surgery		Total	P-value
	A	B		
Age (in years)	**n (%)**	**n(%)**	**n (%)**	
<20	10 (90.9)	1 (9.1)	11 (100)	
21-40	56 (93.3)	4 (6.7)	60 (100)	
41-60	31 (81.6)	7 (18.4)	38 (100)	**0.000*** **
> 60	11 (45.8)	13 (54.2)	24 (100)	
Total	**108 (81.2)**	**25 (18.8)**	**133 (100)**	
Sex				
Male	44 (84.6)	8 (15.4)	52 (100)	
Female	64 (79.0)	17 (21.0)	81 (100)	**0.420**
Total	**108 (81.2)**	**25 (18.8)**	**133 (100)**	
Infection				
No	102 (82.3)	22 (17.7)	124 (100)	
Yes	6 (66.7)	3 (33.3)	9 (100)	**0.248**
Total	**108 (81.2)**	**25 (18.8)**	**133 (100)**	
Type of surgery				
Orthopedics	34 (81.0)	8 (19.0)	42 (100)	
Obstetrics	23 (88.5)	3 (11.5)	26 (100)	
Gynecology	7 (70.0)	3 (30.0)	10 (100)	
ENT surgery	18 (94.7)	1 (5.3)	19 (100)	**0.034** **
Laparotomy	10 (55.6)	8 (44.4)	18 (100)	
Breast surgery	8 (80.0)	2 (20.0)	10 (100)	
Skin/plastic surgery	8 (100.0)	0 (0.0)	8 (100)	
Total	**108 (81.2)**	**25 (18.8)**	**133 (100)**	
Fasting period (in hours)				
6-12	30 (88.2)	4 (11.8)	34 (100)	
12-18	76 (78.4)	21 (21.6)	97 (100)	**0.353**
18 and above	2 (100.0)	0 (0.0)	2 (100)	
Total	**108 (81.2)**	**25 (18.8)**	**133 (100)**	

Type of fluids received				
RL and NS	77 (85.6)	13 (14.4)	90 (100)	
NS or RL	23 (92.0)	2 (8.0)	25 (100)	
NS/ RL + Dextrose	3 (50.0)	3 (50.0)	6 (100)	**0.000*** **
NS/ RL Blood products	5 (41.7)	7 (58.3)	12 (100)	
Total	**108 (81.2)**	**25 (18.8)**	**133 (100)**	
Amount of fluid received (in ml)				
1000-2000	79 (87.8)	11 (12.2)	90 (100)	
2001-3000	23 (79.3)	6 (20.7)	29 (100)	**0.001*** **
> 3000	6 (42.9)	8 (57.1)	14 (100)	
Total	**108 (81.2)**	**25 (18.8)**	**133 (100)**	
Amount of fluid lost (in ml)				
<100	35 (87.5)	5 (12.5)	40 (100)	
100-300	40 (81.6)	9 (18.4)	49 (100)	**0.341**
>300	33 (75.0)	11 (25.0)	44 (100)	
Total	**108 (81.2)**	**25 (18.8)**	**133 (100)**	

***p < 0.05; ***p < 0.01*

Association between participant's characteristics, fluid administered and hydration status after surgery

The type of surgery showed a statistically significant association with hydration of the patients after operation (P-value: 0.001). The duration of surgery and types of fluid received also have some linkage with patient hydration status after surgery (P-value: 0.030, and 0.026 respectively) as shown in Table 5

Table 5. Association between patients' characteristics, fluids administered and hydration status after surgery

	Hydration status after surgery			
	A	**B**	**Total**	**P-value**
Age (in years)	**n (%)**	**n (%)**	**n (%)**	
<20	4 (36.4)	7 (63.6)	11 (100)	
21-40	37 (61.7)	23 (38.3)	60 (100)	
41-60	21 (55.3)	17 (44.7)	38 (100)	**0.143**
> 60	9 (37.5)	15 (62.5)	24 (100)	
Total	**71 (53.4)**	**62 (46.6)**	**133 (100)**	
Sex				
Male	25 (48.1)	27 (51.9)	52 (100)	
Female	46 (56.8)	35 (43.2)	81 (100)	**0.326**
Total	**71 (53.4)**	**62 (46.6)**	**133 (100)**	

Infection				
No	64 (51.6)	60(48.4)	124(100)	
Yes	7 (77.8)	2(22.2)	9(100)	**0.129**
Total	**71 (53.4)**	**62(46.6)**	**133(100)**	
Type of surgery				
Orthopedics	16 (38.1)	26 (61.9)	42 (100)	
Obstetrics	21 (80.8)	5 (19.2)	26 (100)	
Gynecology	1 (10.0)	9 (90.0)	10 (100)	
ENT surgery	16 (84.2)	3 (15.8)	19 (100)	**0.001*** **
Laparotomy	8 (44.4)	10 (55.6)	18 (100)	
Breast surgery	5 (50.0)	5 (50.0)	10 (100)	
Skin/plastic surgery	4 (50.0)	4 (50.0)	8 (100)	
Total	**71 (53.4)**	**62 (46.6)**	**133 (100)**	
Duration of surgery (in hours)				
<=2	57 (62.0)	35 (38.0)	92(100)	
> 2	14 (34.1)	27 (65.9)	41(100)	**0.030** **
Total	**71 (53.4)**	**62 (46.6)**	**133(100)**	
Type of fluids received				
RL and NS	46 (51.1)	44 (48.9)	90 (100)	
NS or RL	19 (76.0)	6 (24.0)	25 (100)	
NS/ RL + Dextrose	1 (16.7)	5 (83.3)	6 (100)	**0.026** **
NS/ RL Blood products	5 (41.7)	7 (58.3)	12 (100)	
Total	**71 (53.4)**	**62 (46.6)**	**133 (100)**	
Amount of fluid received (in ml)				
1000-2000	49 (54.4)	41 (45.6)	90 (100)	
2001-3000	14 (48.3)	15 (51.7)	29 (100)	**0.809**
> 3000	8 (57.1)	6 (42.9)	14 (100)	
Total	**71 (53.4)**	**62 (46.6)**	**133 (100)**	
Amount of fluid lost (in ml)				
<100	27 (67.5)	13 (32.5)	40 (100)	
100-300	25 (51.0)	24 (49.0)	49 (100)	**0.076**
>300	19 (43.2)	25 (56.8)	44 (100)	
Total	**71 (53.4)**	**62 (46.6)**	**133 (100)**	

***p < 0.05; ***p < 0.01*

DISCUSSION

To anticipate the hypovolemia secondary to vasodilation caused by anesthesia, and adjuvant drugs, and surgical bleeding, and prevent further complication [4,5], an optimum hydration status is recommended before surgery. A stable hydration status also improves the overall metabolic balance, decreases insulin resistance, anxiety, nausea and vomiting. Contrarily to finding from this study of prolonged fasting, continuation of oral carbohydrate rich fluid up to 2 hours before surgery is beneficial to the patient.[11] This fluid administration reduces the requirement to replace fluid deficits and dehydration from the time of fasting and therefore improves the overall postoperative patient outcome.[7] It also prevents the perioperative acute kidney injury which is commonly ignored.[12]

The decision about the choice the type and volume of intravenous fluid to be administered perioperatively has been a subject of long debate than the choice of type of IV fluids. This is because perioperative IV fluids is commonly associated to many complications from IV fluid overload.[13,14] Similarly to previous studies and recommendations, crystalloids, which are electrolyte solutions are best used to replace extra cellular volume losses, to increase vascular volume and improve hemodynamics, though their effectiveness is transient.[15] Considering the mean weight and volume of fluid received, in addition to long fasting, the need for fluid resuscitation was underestimated and only few patients had received carbohydrates containing fluids intraoperatively.

Unmeasured losses amounting to 10 ml per kg per hour when the body cavity is open may explain the increased rate of dehydrated patients after surgery in addition to bowel preparation and prolonged starvation before surgery among patients who underwent laparotomy surgeries.[16] The association between age and dehydration status, demonstrated the need for special attention to old people and special needs of the perioperative patients.

The reduced fasting time before surgery, fluid Goal Directed Therapy (GDT) during the intraoperative period is a very important aspect of individualized plans for fluid and hemodynamic management and zero balance approach would prevent post-operative complications.[16] Perioperative fluid management, however, should also include the preoperative and postoperative periods, given the added benefit to provide oral hydration at those times. When the option is available, oral hydration is preferable to intravenous (IV) hydration. Preoperative hydration with complex carbohydrate drinks has been linked to multiple benefits, including a reduction in postoperative insulin resistance, improved metabolic state, decreased hospital length of stay (LOS), and reduced nausea and vomiting.[18] Maintaining proper hydration without fluid overload in the intraoperative period is just as important as maintaining proper fluid management in the postoperative period.[11]

CONCLUSION AND RECOMMENDATION

The present study assessed the hydration status of patients before surgery and after surgery at CHUB. Based on the findings**,** the study found that the participants had fasted too long though the majority were classified into dehydration class A before surgery. The dehydration status before surgery was associated with advanced age and type of surgery. However, the number of dehydrated patients increased after surgery. The amount and type of intraoperative fluid, and the type and duration of surgery were associated with post-operative dehydration. The study therefore recommends reduced preoperative fasting time, individualized Goal Directed Fluid Therapy basing on the age, and type of surgery, monitoring of the fluids balance to ensure the overall patient hydration and positive patients' outcome.

Authors' contribution

PI, LO and JM participated in project conception and development, supervised the project and participated in manuscript writing. MT contributed to the manuscript write-up.

Conflict of interest

The authors declare that there is no conflict of interest.

REFERENCES

1. Türkan Kudsioğlu SE. Perioperative and Postoperative Fluid Management in Pediatric Cardiac Surgery. J Anesth Crit Care. 2016;4:4–6.
2. Webster M. Major Surgery Medical Definition | Merriam-Webster Medical Dictionary.
3. Kayilioglu SI, Dinc T, Sozen I, Bostanoglu A, Cete M, Coskun F. Wj ccm. 2015;4:192–202.
4. Corcoran T, Rhodes JE, Clarke S, Myles PS, Ho KM. Perioperative fluid management strategies

in major surgery: a stratified meta-analysis. Anesth Analg. 2012.
5. Scott NB. Enhanced recovery after surgery- the way forward. Reg Anesth Pain Med. 2012.
6. Mythen MG, Swart M, Acheson N, Crawford R, Jones K, Kuper M, et al. Perioperative fluid management : Consensus statement from the enhanced recovery partnership. J Perioper Med. 2012;2–5.
7. Patel N, Sigamoney K, Balasubraniam D. Perioperative fluid management of orthopaedic patients. MOJ J Orthop Rheumatol. 2018;10:317–20.
8. Shields CJ. Towards a new standard of perioperative fl uid management. Med J. 2008;569–71.
9. Marsh C, Brown J. Perioperative fluid therapy. Anaesth Intensive Care Med. 2012;
10. Khan M, Siddiqui K, Asghar M. Fluid choice during perioperative care in children: A survey of present-day proposing practice by anesthesiologists in a tertiary care hospital. Saudi J Anaesth. 2018;
11. Makaryus R, Miller TE, Gan TJ. Current concepts of fluid management in enhanced recovery pathways. Br J Anaesth. 2018;120:376–83.
12. Zarbock A, Koyner JL, Hoste EAJ, Kellum JA. Update on perioperative acute kidney injury. Anesth Analg. 2018;127:1236–45.
13. Chappell D, Jacob M, Hofmann-Kiefer K, Conzen P, Rehm M. A Rational Approach to Perioperative Fluid Management. Am Soc Anesthesiol Inc. 2008;109:723–40.
14. Boller E, Boller M. Assessment of Fluid Balance and the Approach to Fluid Therapy in the Perioperative Patient. Vet. Clin. North Am. - Small Anim. Pract. 2015.
15. Navarro LHC, Bloomstone JA, Auler JOC, Cannesson M, Rocca G Della, Gan TJ, et al. Perioperative fluid therapy: a statement from the international Fluid Optimization Group. Perioper Med. 2015;4:1–20.
16. Voldby AW, Brandstrup B. Fluid therapy in the perioperative setting-A clinical review. J. Intensive Care. 2016.
17. Rassam SS, Counsell DJ. Perioperative fluid therapy. Contin Educ Anaesthesia, Crit Care Pain. 2005;5:161–5.
18. Garrioch SS, Gillies MA. Which intravenous fluid for the surgical patient? Curr. Opin. Crit. Care. 2015.