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Determination of Conventional Hydric Balance, Bioimpedance Analysis, and Portable Ultrasound, and Their Agreement Level with Postoperative Complications in Oncological Patients Undergoing Abdominal Surgery at the General Hospital Zone 3 in Aguascalientes

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ABSTRACT

Background: Cancer is a significant public health issue, leading to substantial losses in human life and economic resources. The immediate adverse effects of surgery and cancer treatment—such as pain, fatigue, fluid retention, and weakness—can be alleviated with appropriate interventions. Increasing evidence suggests that a patient's physiological reserve capacity plays a crucial role in reducing perioperative complications. Among oncology patients, the overall rate of postoperative complications is high. In cases where extensive fluid therapy is administered, 41.3% of patients experience severe complications (Clavien-Dindo ≥ III).

Objective: To identify postoperative complications in oncology patients undergoing abdominal surgery and to correlate these complications with the level of edema assessed by conventional fluid balance, bioimpedance analysis, and portable ultrasound at General Hospital Zone 3 in Aguascalientes.

Materials and Methods: A prospective, comparative, analytical clinical trial was conducted in the General Surgery Department of the General Hospital of Zone 3, part of the Mexican Social Security Institute (IMSS), Aguascalientes.

Results: Based on sample size calculations, 28 patients were included. When analyzing the concordance between conventional fluid balance and portable ultrasound at 24, 48, and 72 hours, insignificant correlation was observed among the three methods. Similarly, the bioimpedance analyzer and portable ultrasound also showed insignificant agreement at these same intervals.

Conclusions: This study employed three diagnostic methods—conventional fluid balance, bioimpedance analysis, and portable ultrasound. Our findings indicate no significant concordance among the three methods in determining postoperative complications in oncology patients undergoing abdominal surgery. Furthermore, no correlation was observed between positive fluid balance and the development of perioperative complications.

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INTRODUCTION

From a biological perspective, cancer is primarily a genetic disorder characterized by an imbalance between cellular proliferation and apoptosis. This imbalance results in the development of cellular clones with the ability to invade and destroy nearby tissues, as well as spread to other parts of the body. As the disease progresses, this process ultimately leads to the deterioration of vital organs and death. Cancer is a significant public health issue, associated with substantial losses of both human life and economic resources. In Mexico, the prevalence of cancer cases in 2022 was reported to be 577,487 (21).

The immediate adverse effects of surgery and cancer treatments, including pain, fatigue, fluid retention, and weakness, can be mitigated with appropriate interventions, promoting faster recovery and earlier hospital discharge. A characteristic feature of the perioperative period is the accumulation of interstitial fluid due to various forms of

surgical stress during the postoperative phase. Effective fluid balance management in the perioperative period is a critical component in the postoperative treatment of patients undergoing oncological surgery. By targeting therapy to correct underlying capillary hemodynamic disruptions, it is possible to stop or reverse the edema formation process.

One approach to reducing complication rates is optimizing perioperative care and maintaining normal physiological conditions. Fluid management plays an essential role in this care. The use of goal-directed fluid therapy, as opposed to liberal fluid administration, was developed to maintain hemodynamic stability during surgery by regulating the administration of catecholamines and fluids based on specific hemodynamic targets. This optimization reduces postoperative complications, intensive care unit (ICU) stays, and the overall length of hospital stay across surgical patients. In oncology patients, the rate of postoperative complications is particularly high. Among those who receive liberal fluid therapy, 41.3% experience a severe complication (Clavien-Dindo ≥ III), compared to 26.9% of patients receiving goal-directed fluid therapy (3). Additionally, general morbidity related to the systemic nature of the disease can be as high as 31% (2).

Given this context, we proposed a protocol to evaluate and determine postoperative edema and fluid overload through conventional fluid balance, bioimpedance analysis, and portable ultrasound. This protocol also aims to assess the level of concordance between these methods and postoperative complications in oncology patients undergoing abdominal surgery.

MATERIALS AND METHODS

Study Design

A clinical trial was conducted in the General Surgery Department at General Hospital Zone 3 of the Mexican Institute of Social Security (IMSS). The study was analytical, comparative, and prospective, with a sample size of 28 patients.

Study Population

Patients aged 18 to 70 years, of both genders, diagnosed with cancer, who underwent major abdominal surgery and were beneficiaries of the Mexican Institute of Social Security (IMSS), affiliated with General Hospital Zone 3 in the Aguascalientes delegation.

Unit of Observation

Oncological patients who underwent abdominal surgery from May to July 2024, either through scheduled admissions or emergency routes, and who were beneficiaries of the Mexican Institute of Social Security (IMSS), affiliated with General Hospital Zone No. 3.

Selection Criteria

Inclusion: IMSS beneficiaries hospitalized at General Hospital Zone No. 3 in 2024, aged 18 to 70 years, diagnosed with cancer and who underwent abdominal surgery.

Sample Size

The sample size was calculated using the SELECT STATISTICAL SERVICE calculator (25) for finite populations, with a 95% confidence level and a 5% margin of error, resulting in a sample size of 28 patients.

Proposed Intervention

Measurement of conventional fluid balance, bioimpedance analysis, and portable ultrasound to assess their concordance with postoperative complications in oncological patients undergoing major abdominal surgery.

Methods for Data Control and Quality

To ensure data quality and accuracy, information was collected using a data collection instrument and recorded in a Microsoft 365 Excel spreadsheet. The accuracy and correct entry of the data were then verified.

Data Analysis

Clinical and surgical characteristics were documented upon admission to the General Surgery floor and recorded within the PHEDS medical history system. SPSS v.20 for Windows was used to analyze descriptive data, including mean, median, mode, and frequencies. Concordance analysis involved cross-tabulations with Cohen's kappa statistic, with an ideal concordance level set at a cutoff of >0.8. For graphical representation, pie charts were used based on the quantitative or qualitative nature of the data.

Ethical Aspects

The participants declared no conflicts of interest, and all procedures in this study will be conducted in accordance with the General Health Law on Health Research, as well as the principles of the Declaration of Helsinki and the World Medical Association.

In accordance with the procedure for evaluation, registration, monitoring, amendment, and cancellation of health research protocols submitted to the Local Health Research Committees and Ethics Committees for Research (2810-003-002) within the IMSS, this study is classified under Article 17 as:

- **Minimal risk research:** Prospective studies involving data collection through common procedures in physical or psychological exams, or routine diagnostic and treatment procedures.

The project will be submitted for approval to the local Research Committees of General Hospital Zone 3, IMSS. This study complies with the requirements outlined in Title V of the Federal Health Law dedicated to health research, specifically Articles 96, 97, 98, 99, 100, 101, and 102.

RESULTS

The study population consisted of oncological patients who underwent abdominal surgery from May to August 2024, either through scheduled admission or via emergency, and who were beneficiaries of the Mexican Institute of Social Security (IMSS), affiliated with General Hospital Zone No. 3. Using the inclusion criteria and based on the sample size calculation, 28 patients were included

Table 1 show the gender distribution of the study population. Of the 28 patients, 50% were male, with a frequency of 14 cases, and the other 50% were female, with a frequency of 14 cases. Patients were randomly included in this study.

Table 1. Gender distribution of oncological patients who underwent abdominal surgery at General Hospital Zone No. 3, Aguascalientes.

	Frequency	percentage
Male	14	50%
Female	14	50%
Total	28	100%

Table 2. Weight of the patients analyzed. The mean weight was 65.8 kg, with a minimum weight of 47 kg and a maximum weight of 114 kg

Table 2. Distribution of weight among oncological patients undergoing abdominal surgery at General Hospital Zone No. 3, Aguascalientes.

	Number	Minimum	Maximum	Mean	Standard deviation
Weight	28	47 kg	114 kg	65.8 kg	15.88

The results of height in the analyzed patients are detailed in **Table 3**. On average, the patients' height was 160.39 cm, with a minimum of 150 cm, a maximum of 170 cm, and a standard deviation of 6.5.

Table 3. Distribution of height among oncological patients undergoing abdominal surgery at General Hospital Zone No. 3, Aguascalientes.

	Number	Minimum	Maximum	Mean	Standard deviation
Height	28	150 cm	170 cm	160.39 cm	6.579

The results of the Body Mass Index (BMI) are detailed in **Table 4**. In total, the mean BMI was 25.06, with a range from 18 to 49, and an overall standard deviation of 6.4.

Table 4. Distribution of Body Mass Index (BMI) among patients undergoing abdominal surgery at General Hospital Zone No. 3, Aguascalientes.

	Number	Minimum	Maximum	Mean	Standard deviation
BMI	28	18	49	25.06	6.4

When grouping the patients based on the results of the 24-hour fluid balance and the 24-hour portable ultrasound, **Table 5** shows that in 12 patients (42.9%), the fluid balance was positive and the characteristics of the portable ultrasound were abnormal. Additionally, in both assessments, the results were negative in 2 patients (7.1%). Among the discordant cases, 6 patients (21.4%) had abnormalities in the ultrasound characteristics with a negative conventional fluid balance, and 8 patients (28.6%) had no ultrasound abnormalities with a positive fluid balance.

Table 5. Cross-tabulation. Conventional fluid balance and edema measurement using portable ultrasound at 24 hours post-surgery.

			USG 24hr		
			A	N	Total
B24 hr	P	No.	12	8	20
		% of the total	42.9%	28.6%	71.4%
	N	No.	6	2	8
		% of the total	21.4%	7.1%	28.6%
Total		No.	18	10	28
		% of the total	64.3%	35.7%	100.0%

*USG24hr: 24-hour ultrasound measurement.
*B24hr: 24-hour fluid balance measurement

When comparing these results regarding the concordance between the two observers, The kappa index in **Table 6** was -0.140, indicating no concordance between the two., with a non-significant p-value of 0.454 ($p<0.05$).

Table 6. Kappa index for conventional fluid balance and edema measurement using portable ultrasound at 24 hours post-surgery.

		Value	Approx. Sig
Measures of agreement	Kappa	-.140	.454
No. of cases		28	

When grouping the patients based on the results of the fluid balance and 48-hour portable ultrasound, **Table 7** shows that in 8 patients (28.6%), the fluid balance was positive and the characteristics of the portable ultrasound were abnormal. Similarly, in both assessments, the results were negative in 4 patients (14.3%). Among the discordant cases, 14 patients (50%) had abnormalities in the ultrasound characteristics with a negative conventional fluid balance, and 2 patients (7.1%) had no ultrasound abnormalities with a positive fluid balance.

Table 7. Conventional fluid balance and edema measurement using portable ultrasound at 48 hours post-surgery.

			USG 48hr		
			A	N	Total
B48hr	P	No.	8	2	10
		% of the total	28.6%	7.1%	35.7%
	N	No.	14	4	18
		% of the total	50.0%	14.3%	64.3%
Total		No.	22	6	28
		% of the total	78.6%	21.4%	100.0%

*USG48hr: 48-hour ultrasound measurement.
*B48hr: 48-hour fluid balance measurement

When comparing these results regarding the concordance between the two observers, the kappa index in **Table 8** was 0.018, indicating insignificant correlation between the two, with a non-significant p-value of 0.891 ($p<0.05$).

Table 8. Kappa index for conventional fluid balance and edema measurement using portable ultrasound at 48 hours post-surgery.

		Value	Approx. Sig
Measures of agreement	Kappa	.018	.891
No. of cases		28	

When grouping the patients based on the results of the fluid balance and 72-hour portable ultrasound, **Table 9** shows that in 11 patients (39.3%), the fluid balance was positive and the characteristics of the portable ultrasound were abnormal. Similarly, in both assessments, the results were negative in 3 patients (10.7%). Among the discordant cases, 12 patients (42.9%) had abnormalities in

the ultrasound characteristics with a negative conventional fluid balance, and 2 patients (7.1%) had no ultrasound abnormalities with a positive fluid balance.

Table 9. Conventional fluid balance and edema measurement using portable ultrasound at 72 hours post-surgery.

			USG 72hr		
			A	N	Total
B72hr	P	No.	11	2	13
		% of the total	39.3%	7.1%	46.4%
	N	No.	12	3	15
		% of the total	42.9%	10.7%	53.6%
Total		No.	23	5	28
		% of the total	82.1%	17.9%	100.0%

*USG72hr: 72-hour ultrasound measurement.
*B72hr: 72-hour fluid balance measurement

When comparing these results regarding the concordance between the two observers, the kappa index in **Table 10** was 0.044, indicating no concordance due to moderate correlation between the two, with a non-significant p-value of 0.750 ($p<0.05$).

Table 10. Kappa index for conventional fluid balance and edema measurement using portable ultrasound at 72 hours post-surgery.

		Value	Approx. Sig
Measures of agreement	Kappa	.044	.750
No. of cases		28	

When grouping the patients based on the results of the bioimpedance analyzer and 24-hour portable ultrasound, **Table 11** shows that in 8 patients (28.6%), both the bioimpedance analyzer and the characteristics of the portable ultrasound were abnormal. Similarly, in both assessments, the results were negative in 4 patients (14.3%). Among the discordant cases, 10 patients (35.7%) had abnormalities in the ultrasound characteristics with a negative bioimpedance analyzer parameter (extracellular fluid), and 6 patients (21.4%) had no ultrasound abnormalities with a positive bioimpedance analyzer parameter (extracellular fluid).

Table 11. Bioimpedance analyzer parameter (extracellular fluid) and edema measurement using portable ultrasound at 24 hours post-surgery.

			USG24hr		
			A	N	Total
Bio24hr	A	No.	8	6	14
		% del total	28.6%	21.4%	50.0%
	N	No.	10	4	14
		% del total	35.7%	14.3%	50.0%
Total		No.	18	10	28
		% del total	64.3%	35.7%	100.0%

*****USG24hr: 24-hour ultrasound measurement
*Bio24hr: 24-hour bioimpedance measurement

When comparing these results regarding the concordance between the two observers, the kappa index in **Table 12** was -0.143, indicating no concordance between the two, with a non-significant p-value of 0.430 ($p<0.05$).

Table 12. Kappa index for bioimpedance analyzer and edema measurement using portable ultrasound at 24 hours post-surgery.

		Value	Approx. Sig
Measures of agreement	Kappa	-.143	.430
No. of cases		28	

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When grouping the patients based on the results of the bioimpedance analyzer and 48-hour portable ultrasound, **Table 13** shows that in 12 patients (42.9%), both the bioimpedance analyzer and the characteristics of the portable ultrasound were abnormal. Similarly, in both assessments, the results were negative in 3 patients (10.7%). Among the discordant cases, 10 patients (35.7%) had abnormalities in the ultrasound characteristics with a negative bioimpedance analyzer parameter (extracellular fluid), and 3 patients (10.7%) had no ultrasound abnormalities with a positive bioimpedance analyzer parameter (extracellular fluid).

Table 13. Bioimpedance analyzer parameter (extracellular fluid) and edema measurement using portable ultrasound at 48 hours post-surgery.

			USG48hr		
			A	N	Total
Bio48hr	A	No.	12	3	15
		% del total	42.9%	10.7%	53.6%
	N	No.	10	3	13
		% del total	35.7%	10.7%	46.4%
Total		No.	22	6	28
		% del total	78.6%	21.4%	100.0%

*****USG48hr: 48-hour ultrasound measurement
*Bio48hr: 48-hour bioimpedance measurement

When comparing these results regarding the concordance between the two observers, the kappa index in **Table 14** was 0.032, indicating a non concrodance between the two, with a non-significant p-value of 0.843 (p<0.05).

Table 14. Kappa index for bioimpedance analyzer and edema measurement using portable ultrasound at 48 hours post-surgery.

		Value	Approx. Sig
Measures of agreement	Kappa	.032	.843
No. of cases		28	

When grouping the patients based on the results of the bioimpedance analyzer and 72-hour portable ultrasound, **Table 15** shows that in 14 patients (50%), both the bioimpedance analyzer and the characteristics of the portable ultrasound were abnormal. Similarly, in both assessments, the results were negative in 0 patients (0.0%). Among the discordant cases, 9 patients (32.1%) had abnormalities in the ultrasound characteristics with a negative bioimpedance analyzer parameter (extracellular fluid), and 5 patients (17.9%) had no ultrasound abnormalities with a positive bioimpedance analyzer parameter (extracellular fluid).

Table 15. Bioimpedance analyzer parameter (extracellular fluid) and edema measurement using portable ultrasound at 72 hours post-surgery.

			USG72hr		
			A	N	Total
Bio72hr	A	No.	14	5	19
		% del total	50.0%	17.9%	67.9%
	N	No.	9	0	9
		% del total	32.1%	0.0%	32.1%
Total		No.	23	5	28
		% del total	82.1%	17.9%	100.0%

*****USG72hr: 72-hour ultrasound measurement
*Bio72hr: 72-hour bioimpedance measurement

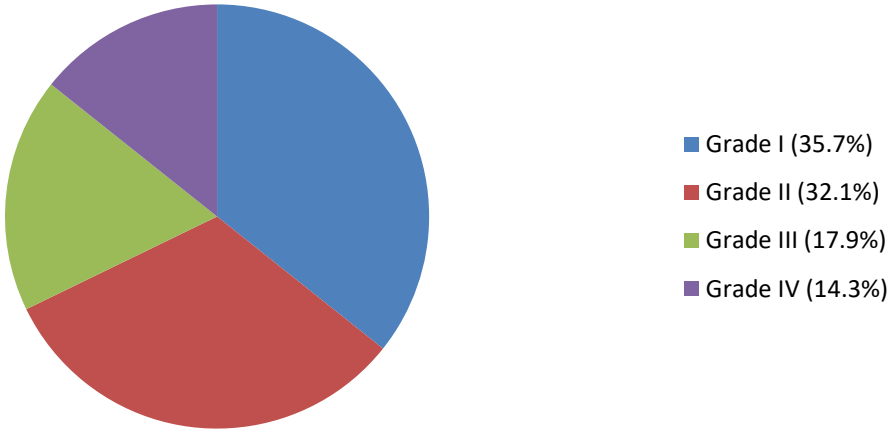
When comparing these results regarding the concordance between the two observers, the kappa index in **Table 16** was -0.298, indicating no concordance between the two, with a non-significant p-value of 0.090 (p<0.05).

Table 16. Kappa index for bioimpedance analyzer and edema measurement using portable ultrasound at 72 hours post-surgery.

		Value	Approx. Sig
Measures of agreement	Kappa	-.298	.090
No. of cases		28	

Post-surgical complications were determined based on the Clavien-Dindo classification, as shown in **Graph 2**. Among the results, 10 patients (35.7%) had Grade I complications, 9 patients (32.1%) had Grade II, 5 patients (17.9%) had Grade III, and 4 patients (14.3%) had Grade IV.

Graph 2. Distribution of post-surgical complications according to the Clavien-Dindo classification in oncological patients undergoing abdominal surgery at the Hospital General Zona No. 3, Aguascalientes.



To analyze whether there is a correlation between overhydration measured by bioimpedance analysis, conventional fluid balance, and edema assessed with portable ultrasound, and perioperative complications, a non-parametric statistical test was used: the Spearman rank correlation coefficient.

Table 17. Correlation between findings from bioimpedance analysis at 72 hours and complications.

			Bio72hr	Complications
Spearman's rho	Complications	Correlation coefficient	1.000	.010
		Sig. (2-tailed)	.	.960
		N	28	28
	Bio72h	Correlation coefficient	.010	1.000
		Sig. (2-tailed)	.960	.
		N	28	28

*Bio72hr: Bioimpedance at 72 hours

In **Table 17**, a positive Rho is observed; however, the correlation coefficient has a non-significant value of 0.960 ($p<0.05$).

Table 19. Correlation between findings from conventional fluid balance at 72 hours and complications.

			B72hr	Complications
Spearman's rho	Complications	Correlation coefficient	1.000	-.320
		Sig. (2-tailed)	.	.097
		N	28	28
	B72h	Correlation coefficient	-.320	1.000
		Sig. (2-tailed)	.097	.
		N	28	28

*B72hrs: Fluid balance at 72 hours

In **Table 18**, a positive Rho is observed; however, the correlation coefficient has a non-significant value of 0.960 ($p<0.05$).

In **Table 19**, a negative Rho is observed with a correlation coefficient having a non-significant value of 0.960 ($p<0.05$).

In **Table 20**, a cross-tabulation between fluid balance results and the development of perioperative complications can be observed. It shows that a total of 15 patients had a negative fluid balance, with the following complications: 3 patients (grade I), 6 patients (grade II), 3 patients (grade III), and 3 patients (grade IV). On the other hand, 13 patients had a positive fluid balance, with the following complications: 7 patients (grade I), 3 patients (grade II), 2 patients (grade III), and 1 patient (grade IV).

Table 18. Correlation between findings from portable ultrasound at 72 hours and complications.

			USG72hr	Complications
Spearman's rho	Complications	Correlation coefficient	1.000	.115
		Sig. (2-tailed)	.	.561
		N	28	28
	USG72hr	Correlation coefficient	.155	1.000
		Sig. (2-tailed)	.561	.
		N	28	28

*USG72hr: Ultrasound at 72 hours

Table 20. Cross-tabulation of fluid balance and complications

		Complications				
		I	II	III	IV	Total
Balance	N	3	6	3	3	15
	P	7	3	2	1	13
Total		10	9	5	4	28

*N: negative
*P: positive

DISCUSSION

Our findings, consistent with the existing literature, suggest that evaluating fluid balance using conventional methods such as clinical assessment and fluid balance measurement is insufficient for early diagnosis. This limitation hinders both primary and secondary interventions for postoperative complications in oncology patients undergoing abdominal surgery. According to the literature, patients typically develop edema when fluid retention exceeds 2.5 liters; however, there are no clinical signs that effectively detect edema in oncology patients.

Therefore, this study employed three measurement methods to evaluate postoperative edema and overhydration: conventional fluid balance, bioimpedance analysis, and assessment of subcutaneous tissue changes in the pelvic limb using portable ultrasound. The primary objective was to identify postoperative complications in oncology patients undergoing abdominal surgery and correlate these complications with edema levels using conventional fluid balance, bioimpedance analysis, and portable ultrasound at General Hospital Zone 3 in Aguascalientes.

In a 2023 study by Weiqing Zhang, the onset and distribution of subcutaneous edema, along with associated risk factors, were evaluated in critically ill patients using the FLUID protocol (focused liquid ultrasonography in dropsy). The FLUID protocol and the "pitting" test were administered to 145 critically ill patients, of whom 40 (27.6%) experienced subcutaneous edema. In 1,440 measurements, ultrasound detected more subcutaneous edema than the pitting test (ultrasound: 522 [36.3%], pitting test: 444 [30.8%], $\chi 2$ = 9.477, p = 0.002), concluding that ultrasound is superior to the pitting test in detecting the onset and severity of edema.

In another study by Adi-Ionut Ciumanghel in 2019, bioimpedance analysis results were compared with intraoperative fluid balance and various outcome parameters, such as organ dysfunction, ICU duration, and hospital stay. The study included 71 patients over 18 years of age who underwent major open abdominal surgery. Postoperative fluid balance was positive on both days following surgery. Complications included acute renal failure in 10 cases (14.0%), respiratory dysfunction in 14 cases (19.7%), and infections in 20 patients (28.1%). Preoperative bioimpedance measurements were as follows: TBW 35.9 ± 7.6 L, ECW 16.3 ± 3.5 L, ICW 19.5 ± 4.4 L, ECW/ICW 0.85 ± 0.11, AFO 0.2 ± 1.4 L, and RFO 3 (−3.5 to 7)%. Preoperatively, 10 patients (14.1%) were dehydrated (RFO <−10%) and 2 (2.8%) were overhydrated (RFO >15%). Postoperative measurements were TBW 37.3 ± 7.6 L, ECW 17.7 ± 3.8 L, ICW 19.4 ± 4.2 L, ECW/ICW 0.93 ± 0.12, AFO 1.3 ± 1.5 L, and RFO 8 (2 to 12)%. Apart from intracellular fluid, all BIA parameters increased significantly postoperatively: TBW 1.4 ± 2.4 L (p < 0.001), ECW 1.4 ± 1.2 L (p < 0.001), AFO 1.1 ± 1 L (p < 0.001), and RFO 5 (2 to 10)% (p < 0.001). Positive intraoperative fluid balance (2.4 ± 1.0 L) correlated with a significant increase in total body water (1.4 ± 2.4 L) and extracellular fluid (1.4 ± 1.2 L). Bioimpedance proved to be an objective and simple method, revealing that 31% of patients were overhydrated at the end of surgery.

Our protocol aimed to assess concordance between the three methods. Concordance analysis between conventional fluid balance and portable ultrasound at 24, 48, and 72 hours revealed insignificant concordance, with kappa values of -0.140 at 24 hours, 0.018 at 48 hours, and 0.044 at 72 hours. Similarly, concordance analysis between bioimpedance analysis and portable ultrasound at these same intervals also showed insignificant concordance, with kappa values of -0.143, 0.032, and -0.298, respectively.

Postoperative complications were classified using the Clavien-Dindo classification. Our results showed that 9 patients (32.2%) experienced grade III and IV complications, with 5 patients (17.9%) in grade III and 4 patients (14.3%) in grade IV. This contrasts with the literature; a study by Peltoniemi P (2023) reported high rates of severe postoperative complications (41.3%) among oncology patients receiving liberal fluid therapy (Clavien-Dindo ≥ III), compared to 26.9% among those receiving goal-directed fluid therapy. In another retrospective study by Yuto Kubo (2022) involving 115 patients with thoracic esophageal squamous cell carcinoma, no significant differences were found in general complications (Clavien-Dindo grade ≥ II) from postoperative care to discharge. However, higher fluid balance on the first postoperative day (≥3000 ml) was linked to increased risks of complications, such as acute pneumonia within 7 days and anastomotic leakage (p = 0.029, p = 0.024, respectively). Fluid overload was found to be negatively associated with complications, including pneumonia and anastomotic leakage.

When correlating fluid balance at 72 hours with perioperative complications, we observed a negative Rho value, with a correlation coefficient of 0.960 (p < 0.05), which was not

statistically significant. Additionally, cross-tabulation indicated that, among patients with a negative fluid balance, 3 developed grade I complications and 3 developed grade IV complications. These findings suggest a possible association between negative fluid balance and complications, contrary to findings in the literature.

In summary, while conventional fluid balance, bioimpedance analysis, and portable ultrasound are valuable for assessing edema and overhydration, the low concordance between these methods in postoperative evaluation highlights the need for further research to develop more effective diagnostic protocols. Identifying postoperative complications in oncology patients is critical for improving outcomes, and the findings from this study may contribute to establishing more accurate methods for monitoring fluid balance and edema detection in this patient population.

CONCLUSIONS

The use of intravenous fluids is one of the most common treatments for hospitalized patients. To minimize risks associated with fluid overload, diagnostic methods are essential for early diagnosis and for both primary and secondary intervention in postoperative complications.

In our study, three diagnostic methods were used: conventional fluid balance, bioimpedance analysis, and portable ultrasound. Based on the results, we conclude that there is no significant concordance among the three methods used to identify postoperative complications in oncological patients undergoing abdominal surgery. Additionally, our findings show no correlation between positive fluid balance and the development of perioperative complications. Therefore, our protocol hypothesis is null, indicating no concordance between overhydration and perioperative complications based on fluid levels.

Among the three methods used, our gold standard for detecting immediate changes in postoperative patients, specifically edema, is portable ultrasound. This method provides a non-invasive and cost-effective approach for clinical evaluation and diagnosis. It is particularly useful for the early detection of fluid overload in postoperative patients by identifying ultrasonic changes in subcutaneous tissue. This is essential, as edema typically becomes evident in physical examinations only when fluid retention exceeds 2.5 liters.

Thus, we recommend that portable ultrasound be available in the general surgery department for both residents and attending physicians. This method is safe, non-invasive, harmless to the body, does not use radiation, is economical, and can be performed at the patient's bedside. Making this method accessible would allow for early therapeutic interventions, thereby improving patient prognosis.

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