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IMPACT OF INTRAOPERATIVE FLUID MANAGEMENT ON POST OPERATIVE COMPLICATIONS IN ORTHOPEDIC PATIENTS OF LOWER LIMB SURGERIES

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Abstract

Background:

Maintaining hemodynamic stability and reducing postoperative complications depend heavily on optimal intraoperative fluid management. Both fluid restriction and overload can have detrimental effects on tissue perfusion, wound healing, and rehabilitation following orthopedic lower limb procedures. Recently, Goal-Directed Fluid Therapy (GDFT) has drawn interest due to its customized method of balancing fluid administration based on current physiological data. The purpose of this study was to examine the connection between postoperative problems and intraoperative fluid management techniques in orthopedic patients having lower limb procedures.

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Methodology:

Orthopedic surgical patients and perioperative specialists, such as anesthesiologists, surgeons, and technologists, participated in a cross-sectional quantitative study. In order to evaluate fluid strategy (restrictive, liberal, or goal-directed) and surgical outcomes such edema, infection, hypotension, and delayed recovery, data were gathered using a structured questionnaire and postoperative records. SPSS version 26 was used for statistical analysis. The relationship between hydration regimen and complication frequency was examined using spearmans rho, with a significance level of $p < 0.05$.

Result:

Spearman's rho correlations research revealed a strong positive link between lower-limb orthopedic patients' satisfaction with intraoperative fluid management and a number of postoperative outcomes. Strong correlations between satisfaction with fluid balance and postoperative swelling ($r = .453$, $p < 0.01$), breathing difficulties ($r = .715$, $p < 0.01$), delayed mobilization ($r = .453$, $p < 0.01$), and wound complications ($r = .583$, $p < 0.01$) were found, suggesting that poorer fluid control was linked to a higher incidence of these complications. Additionally, a significant association was seen between the requirement for rehospitalization or additional medical care ($r = .715$, $p < 0.01$) and postoperative nausea/vomiting or electrolyte imbalance ($r = .705$, $p < 0.01$). The largest correlation was seen for overall postoperative recovery ($r = .832$, $p < 0.01$), indicating that fluid management significantly affected the quality of recovery. Furthermore, there was a perfect correlation ($r = 1.000$, $p < .01$) between the perception of whether fluid balance affected recovery and the patient's knowledge of fluidrelated consequences. These strong associations support the goal of the study by demonstrating intra-operative fluid management to be important in predicting frequency and seriousness of postoperative problems after orthopaedic lower-limb procedures.

Conclusion:

The ideal approach to reducing postoperative complications and maximizing patient recovery was found to be goal directed fluid therapy. In order to improve results in orthopedic lower limb

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procedures, the study is highlighted with regards to the importance of customized, realtime fluid modifications guided by hemodynamic monitoring.

INTRODUCTION

For orthopedic patients undergoing lower limb surgeries, intraoperative fluid management is also critical when trying to maintain hemodynamic stability and affect recovery outcome postoperatively. As these treatments require a lot of blood loss, lengthy surgeries and extensive manipulation of tissues some of the time, there's a higher risk of fluid imbalance and circulation problems. Current research suggests that adverse outcomes including acute kidney damage (AKI), poor wound healing, lung congestion, electrolyte imbalances and prolonged hospital stay are linked to insufficient or excessive fluids. Thus, it is believed that an important factor in safe anesthetic management is the maintenance of optimal intravascular volume and organ perfusion, especially for orthopedic procedures in which large muscles are involved and that place significant metabolic demands. There is increasing evidence that morbidity, mortality and overall rehabilitation time of lower limb orthopedic patients can be decreased significantly by controlling intraoperative fluid management (1,2,3).

The primary tenets of surgical fluid treatment are to support sufficient cardiac output, preserve microcirculatory perfusion, and avoid hypoxia at tissues over the duration of the perioperative period. In the past liberal fluid techniques have often been used to avoid intraoperative hypovolemia. But based on new studies, too much crystalloid leads to pulmonary impairment and interstitial edema and can delay healing. Extreme restrictive regimens may lead to face inadequate perfusion and damage to kidney, which highlights the risks of controlling volume at the risk of organ oxygenation. These findings have resulted in the increased use of GDFT in the clinical context. GDFT uses dynamic hemodynamic markers, stroke volume change, to provide a guide to the tailored fluid supply and try to minimize both hypovolemia and overload. GDFT has proven to demonstrate

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measurable decreases in surgical complications, ICU admission and general recovery time when compared to traditional fluid techniques (4,5,6).

The large inflammatory reaction and capillary leakage when performed in the lower limb as in orthopedic surgical procedures, such as prosthetic replacement and fracture repair, and reconstructive treatment methods, create special fluid management issues. Fluid shifts into the interstitial space during these procedures could affect the intravascular volume and hemodynamic status, making close intraoperative monitoring very important. According to research, providing too much fluid may worsen tissue swelling, reduce wound healing, and delay mobilization, whereas under provision of fluid nanocomponsiation may lead to hypoperfusion and early postoperative organ failure. Aside from rising hospital admissions and healthcare expenses, these consequences also have a bad effect on long-term functional outcomes (especially in elderly populations, who represent a large proportion of orthopedic patients). Therefore a balanced and patient-specific intraoperative fluid strategy is important to optimize surgical outcome in lower limb orthopedic surgeries (7,8).

The post operative phase is where the effects of intraoperative fluid techniques really are evident. These two extremes, fluid overload and hypovolemia, have both been associated with organ dysfunction and surgical site problems. Under-resuscitation, however, gives a chance to increase the risk of ischemia injury and wound healing delay as it may lead to hypotension, reduced urine output, and tissue oxygenation. One of the more common effects of inadequate fluid therapy management after orthopedic procedures is still acute kidney injury. Further, the accumulation of interstitial fluid by surgical sites supports growth of bacteria thereby increasing the likelihood of infections following surgical interventions (9,10).

Real-time hemodynamic monitoring devices become available due to technological developments, allowing surgeons to make dynamic modifications during surgery. Variables such as cardiac output, central venous pressure (CVP), and stroke volume fluctuation based on patient's physiological response continuously are used to guide the fluid supply. Goal-directed monitoring has been shown

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to improve recovery, reduce postsurgical complications, and reduce hospital length of stay in high-risk surgical patients. To improvise fluid management procedures, the multidisciplinary collaboration between anesthesiologists, orthopedic surgeons, and nursing personnel has become ever more important Standardized communication and productive collaboration in fluid management improve intraoperative decision making, reduces variability in practice, and ensures consistent delivery of care.

Despite all of these advancements, the intraoperative fluid management procedures of hospitals have continued to vary because of the disparities in clinical preferences, resources, and experience. In orthopedic settings, this is due to the lack of commonly used techniques, which produce uneven results and poor research comparability. While many studies have been done on fluid management in general or abdominal operations, less is known about orthopedic lower limb surgeries, in which complicated hemodynamic shifts, long operating time, and the use of tourniquets offer particular problems. Therefore, in an attempt to develop standardized, evidence-based procedures, an effort is required to evaluate the link between intraoperative fluid management and postoperative problems in orthopedic patients. In addition to improving patient safety, this strategy will result in better recovery profiles, reduced lengths of stay and better outcomes.

The physiologic homeostasis of surgical patients is greatly affected by intraoperative fluid management and especially in orthopedic surgery of the lower extremity. During surgery, if the ideal fluid balance is maintained, then sufficient perfusion of tissues, oxygen delivery and avoidance of cellular hypoxia will occur; all these are important factors that influence the recovery post-surgery. Because anesthesia, loss of blood, and surgical stress are associated with large oscillations in hemodynamic variables, correct management of the fluid balance is important in maintaining cardiovascular stability in the perioperative period. While underresuscitation may lead to hypovolemia, renal hypoperfusion and metabolic acidosis, overresuscitation can cause an interstitial edema which can impair wound healing and pulmonary function. Thus, the basis of safe

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intraoperative management lies in the balancing act between restricted replacement and liberal replacement of fluids (11,12,13).

Clinicians can now easily tailor fluid therapy using the dynamic characteristics instead of static readings because of recent progress with monitoring technologies such as esophageal Doppler and pulse contour analysis. Dynamic indicators such as stroke volume variation (SVV) and pulse pressure variation (PPV) have been found to be more sensitive in the process of determining fluid responsiveness during orthopedic surgery, giving fewer potential for postoperative sequelae such as pulmonary edema and acute kidney damage (AKI) to occur. Additionally there is evidence that goal-directed fluid therapy (GDFT), which includes realtime hemodynamic monitoring, improves tissue oxygenation and reduces hospital stays (14,15,16).

Due to extended operating times and tissue manipulation, orthopedic procedures including total hip or knee replacements and open fracture repairs can occasionally result in considerable blood loss and third-space fluid movements. If left unchecked, these fluctuations in plasma oncotic pressure could lead to interstitial buildup and edema, which would impede wound healing and delay functional recovery.

As a result, controlled intraoperative fluid replacement reduces the risk of postoperative complications such infection, delayed ambulation, and wound dehiscence. According to research, postoperative morbidity can be decreased and microcirculatory flow preserved by minimizing intraoperative crystalloid injection and using colloids sparingly. Additionally, because a high chloride load from saline can cause metabolic acidosis and renal impairment, balanced electrolyte solutions are growing in popularity over ordinary saline (17,18).

Effective perioperative fluid management is essential for orthopedic patients to recover from surgery and preserve physiological stability. In major orthopedic procedures such as full hip and knee arthroplasty, spinal fixation, and trauma repair, invasion of the proper intravascular volume is of utmost importance in order for adequate tissue perfusion to happen and to prevent fluid overload and problems associated with it. Inappropriate fluid balance (either too liberal and too tight) has

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been repeatedly shown to be associated with increased postoperative morbidity and death. Data that is received from arthroplasty patients show that higher intraoperative fluid administration, when adjusted for BMI, can be supported for improving same-day patient release and early recovery outcomes as well, highlighting the risks of underresuscitation. Negative effects could be brought on both by excessive fluid supply as well as by dehydration.

Excess fluid administration may cause pulmonary edema, edema of the tissue, hyperexcitability of wounds, while restriction of therapy may cause hypophysis, hypotension, and renal failure. Therefore, maintaining perfusion often without edema is a major challenge in orthopedic anesthesia and surgery. Recent research indicated a U-shaped curve between the amount of fluid used during surgery and postoperative complications; extremely low fluid dosages as well as extremely high doses were associated with increased risk of respiratory problems and renal damage. Due to the long durations of operation, significant blood loss, and significant muscle mass, this is an especially relevant issue in orthopedic settings. For instance, a retrospective cohort study in spine complex surgery showed that net fluid administration exceeding around 1,865 millilitres was linked to significantly more risks of postoperative complications such as acute renal damage and respiratory problems. In a study of geriatric hip fracture surgical cases, high fluid volumes during surgery were linked to a much greater risk of postoperative complications (69.7% vs. 43.6%).

Following elective joint arthroplasty, proper management of hydration has been linked to increased speed and decreased length of hospital stays. Patients undergoing same-day total joint arthroplasty had a significantly higher fluid to body mass index ratio compared to those detained overnight, and therefore, fluid hydration may facilitate early discharge and recovery. Similarly, patients treated based on the fluctuation of stroke volume using GDFT after major orthopedic surgeries have had less gastrointestinal and wound-associated problems than those treated traditionally. These results confirm that precise titration of fluid based on patient physiology and intraoperative monitoring data can be used to minimise complications and improve surgical outcome. Negative effects could be brought on both by excessive fluid supply as well as by dehydration. Excess fluid administration

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may cause pulmonary edema, edema of the tissue, hyperexcitability of wounds, while restriction of therapy may cause hypophysis, hypotension, and renal failure. Therefore, realizing perfusion without edema remains a big challenge in orthopedic anesthesia and surgery (19,20).

Recent studies have established a U-shaped relationship between difficulties and intraoperative fluid delivery in which fluid surpluses and shortfalls are both associated with increased risk of adverse outcomes. This connection is especially important to the orthopedic patient due to the physiological demands of large skeletal muscles, prolonged surgical procedures, and possible blood loss. Large surgical studies have also found modifiable risk factors for postoperative acute kidney injury (AKI), such as extreme fluid restriction; restrictive regimens were found to be associated with a higher risk for AKI in the RELIEF research. Negative effects could be brought on both by excessive fluid supply as well as by dehydration. Excess of fluid can cause pulmonary edema, tissue edema and retarded wound healing, whereas restriction of therapy can cause hypoperfusion, hypotension and renal failure, so maintenance of perfusion without development of edema remains a major challenge in orthopedic anesthesia and surgery (21).

As a result, the idea of goal-directed fluid treatment (GDFT) has taken hold. By titrating fluids based on individual patient requirements by assessment of real-time hemodynamic monitoring (e.g. stroke volume or cardiac output), this approach avoids harming blood volume and maintains normal blood perfusion conditions. Research indicates that GDFT lowers postoperative morbidity in all surgical specialties. Stroke-volume-guided GDFT during major orthopedic surgery improves fluid management and may increase perfusion, according to preliminary evidence (22,23).

Additionally, preoperative hydration status has a major impact on postoperative recovery. Dehydration as determined by BUN-to-creatinine ratio (> 20) was common in arthroplasty patients in a large NSQIP-database study, although it was not independently associated with increased 30-day postoperative complications. However, in revision shoulder arthroplasty, preoperative dehydration (BUN/Cr ≥ 25) has been proven to be an independent predictor of early postoperative issues and a prolonged hospital stay (>2 days) (24,25).

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The type of fluid administered and its contents have a significant impact on clinical outcomes. Balanced crystalloids have been associated with better acid-base equilibrium preservation, a lower risk of hyperchloremic metabolic acidosis, and a lower incidence of acute kidney injury when compared to normal (0.9%) saline. Balanced electrolyte solutions are commonly used in the perioperative context because their electrolyte composition more closely resembles plasma and reduces the physiological impact of excessive chloride loads. Though their benefits must be weighed against risks and costs, colloids nevertheless play a role by virtue of their increased intravascular retention especially in situations where there is significant blood loss (26,27).

In addition to renal and metabolic effects, fluid composition may have an effect on recovery after surgery. For example, a recent analysis revealed that different fluid techniques (composition-guided, goal-directed and restrictive) have different effects on morbidity in major surgeries, which might mean "fluid quality" can control the rate of complications, such as wound problems or infections (28).

Another factor that is important is the interaction between fluid therapy and Enhanced Recovery After Surgery (ERAS) regimens. ERAS emphasizes early oral intake, minimizing unnecessary IV fluids, and preservation of euvolemia in order to create a speedy recovery. The introduction of goal-directed fluid treatment in ERAS pathways has been associated with improvement in results, including a reduction in surgical complications, reduced hospitalization time, and maintenance of haemodynamics. To develop a rational framework to optimise perfusion, these structured and data-driven methods provide a rational framework for optimizing perfusion and hydration during the whole perioperative period, especially in orthopedic surgery where patients (like the elderly) are vulnerable to fluid imbalance (29, 30).

Despite these developments, the fluid management literature and postoperative issues specific to orthopedics has large gaps. The majority of research in the recent past involves data from multiple surgical populations which reduces the relevance of these studies to patients suffering from a musculoskeletal condition. When prosthetic implants or prolonged use of tourniquets are involved,

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orthopedic treatments are associated with special physiological obstacles which may involve changes in fluid dynamics, inflammatory reactions, and endothelial permeability. Consequently, orthopedic realities could not be correctly reflected by outcomes from general surgical cohorts. In a quality-implementation study in hip revision arthroplasty, a crystalloidbased goal-directed fluid therapy (GDFT) method has significantly reduced perioperative complication rates indicating that customizing fluid regimes is useful and practicable in orthopedics. Additionally, results from meta-analysis for thoracic surgical procedures indicate that GDFT is linked to a reduction in postoperative difficulties by almost 50%, compared to standard fluid management, indicating the potential for application in other surgical disciplines, such as orthopedic (31).

In light of these findings, the idea that perioperative fluids therapy needs to be customized, evidence-based and context-specific is generally gaining steam. By measuring the link between what people actually do with regard to fluids and what happens after surgery, it will improve perioperative management strategies for orthopedic patients. By assessing factors such as total perioperative volume, intraoperative/ postoperative balance, fluid type and monitoring techniques researchers can determine safe administration levels that result in minimal issues without jeopardizing hemodynamic stability. The result of these research may directly impact the everyday work of anesthesiologist and orthopedic surgeon resulting in the standardized, evidence-based regimen of hydration reducing morbidity and expediting recovery. Therefore, it is the clinical need and intellectual activity to examine the link between fluid management strategy and postoperative problem in orthopedic patients. Evidence accumulated over the last several years suggests that fluid balance is a variable factor with significant implications in the surgical safety, wound integrity, renal and pulmonary outcome, and general rehabilitation.

This growth in evidence both provides a practical and scientific impetus for the current effort, which aims to evaluate and quantify this link to the orthopedic setting in order to contribute to safer, more effective perioperative therapy. Fluid management has a major impact on immunological and inflammatory response as well as acute hemodynamic issues. By promoting the release of cytokines,

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capillary leakage and oxidative stress, improper fluid overload may exacerbate the systemic inflammatory response syndrome (SIRS). This cascade hinders the process of healing after orthopedics and leads to multi-organ dysfunction. When applied in the correct manner, restrictive fluid treatments have been shown to decrease inflammation and accelerate wound healing. However, severe limitations, which may compromise the perfusion of the surgical field and the skeletal muscular, support the need of dynamic intraoperative evaluation. Fluid optimization is extremely important in Enhanced Recovery After Surgery (ERAS) techniques which have evolved into revolutionary concepts in operative care.

To accelerate time to recovery and reduce the complications of the surgery, these approaches are based on promoting early movement, reducing fasting, and carefully managing hydration. Following ERAS guidelines have been linked to less pulmonary problems, less use of pain killers and shorter hospital stay in orthopaedic settings. In an effort to establish euvolemia, rather than fluid surplus or deficit, the treatment of fluids under ERAS often is a combination of intraoperative goal-directed treatment with preoperative fluid optimization. Multimodal approaches have also improved patient satisfaction and longer-term functional recovery following lower limb procedures, as well as improving physiological outcomes. The type of anesthesia used also influences the outcome of surgery and the need for hydration. Sympathetic blocking and vasodilation induced by using spinal anesthetic, which is commonly used in the lower limb orthopaedic surgeries, may need careful augmentation of volume to maintain perfusion. However, greater hemodynamic instability and fluid redistribution brought on by general anesthesia may require specific titration. Coherent intraoperative decision-making will be guaranteed if anesthesiologists, orthopaedic surgeons, and perioperative nurses work closely across the boundaries between their fields to coordinate anesthetic management with fluid therapy. This form of cooperative treatment reduces the risks of protracted artificial breathing, postoperative oedema and overtransfusion (32).

Intraoperative fluid requirements are also greatly affected by patient-specific factors including age, comorbidities and baseline hydration status. Elderly patients - who are a significant segment of the

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orthopedic population - are more susceptible to fluid imbalances because of reduced renal reserve and reduced baroreceptor sensitivity. For example, in a study of geriatric hip fracture surgery, increased intraoperative fluid volumes were linked with much more problems. A personalized approach is therefore very important in this regard and constant hemodynamic monitoring and adjustment are necessary. Emerging precision fluid treatment research is exploring machine learning methods to make predictions of fluid responsiveness and postoperative outcomes. Recent data indicates that the accuracy of forecasts can be significantly improved with the help of machinelearning techniques to fluid responsiveness. ERAs-guided operations, technology-driven monitoring, an interdisciplinary teamwork is giving a new face to intraoperative and postoperative fluid management. The emphasis for modern orthopedic anesthesia practice is evidence-based and individual methods. Optimizing fluid management remains important to enhancing recovery as well as lowering complications from lower leg orthopedic procedures.

Rationale of Study

The rational of the study is based on the urgent need to understand the impact of intraoperative fluid management strategies on the outcome of orthopedic patients after surgery, especially those performing lower limbs surgeries. Maintaining the perfect balance between excess and deficit fluid is important to the function of organs, healing of tissues, and the safety of patients in surgical settings. Even with a number of guidelines, the practice of varied fluid management by surgical teams can lead to differences in postoperative recovery, wound healing, and rates of complications. Orthopedic therapies, particularly large joint replacements and trauma surgery, are known to be associated with large fluid shifts, blood loss and inflammatory response. Therefore, selecting the optimal fluid management plan is essential to minimizing phenomena such as edema, delayed mobilization, or lack of healing for the wounds incurred at pertinent measures are incomplete in conjunction with the inability to predict optimal patient management, accordingly the study purpose is to bridge this critical knowledge gap, enhance patient management and circumscribe orthopedic

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care surgical practices in order to assess the direct relationship between intraoperative fluid treatment and postoperative recovery.

The growing awareness that fluid therapy is a therapeutic tool that has a direct impact on the surgical prognosis as opposed to being merely a supportive therapy justifies this investigation. Orthopedic patients may also experience certain physiological complications because commonly they experience large musculoskeletal injuries, blood losses and the administration of anesthesia during surgery. Overhydration is likely to cause tissue edema, decreased oxygen delivery and heart stress, while dehydration has the potential to decrease renal perfusion and delay recovery. This study aims to provide evidence based insight into the extent to which balanced and goal-directed fluid management can help reduce these risks, as well as providing better hemodynamic stability, optimize postoperative outcomes for orthopedic patients in the hope of informing clinical decision-making while elevating a more accurate approach to fluid management for the patient, consistent with the modern standards for perioperative care and augmenting recovery files.

Aims and Objectives of the Study

Aim:

To explore the impact of intraoperative fluid management practices and the incidence of postoperative complications in orthopedic patients of lower limb surgeries.

Objective:

To evaluate the relationship between fluid management practices and the incidence of postoperative complications in orthopedic patients.

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LITERATURE REVIEW

Lee et al. (2025) were studies one essential but complicated aspect that is surgical care have a direct impact on patient outcomes is the efficient provision of intravenous fluids during the perioperative phase. Fluid management in surgery are intravenous crystalloids, colloids, blood products, intravascular volume monitoring during and after surgery. Maintaining ideal intravascular volume and ensuring adequate tissue perfusion and avoiding the following are the key goals: both hypovolemia and fluid overload These objectives become especially very important during large surgical procedures due to the problems associated with blood loss, Anaesthesia-induced vasodilation, third space fluid shifts, and systemic inflammatory reactions. Extremely high as well as extremely low amounts of perioperative fluids in patients undergoing non-cardiac surgery were linked to an increased problems after surgery and longer hospital stays, according the large multicenter retrospective analysis (33).

Messina et al. (2021) carried out a thorough physiological justification highlights the vital importance of ideal fluid control.Reduced cardiac output, organ hypoperfusion, and ischemia of critical tissues, such as the kidneys and surgical sites, can result from hypovolemia, which eventually raises the risk of acute renal injury and delayed wound healing. On the other hand, administering too much fluid might be causing pulmonary and interstitial edema, decreased diffusion of oxygen, increased swelling of tissues, delayed recovery of gastrointestinal motility and extrinsic infections (increased vulnerability to infection and pulmonary problems. Goaldirected fluid therapy (GDFT) has a dramatic reduction in postoperative complications when compared to non-GDFT treatments based on the evidence from a rigorous systematic review. This shows that personalized fluid administration can improve results while the total amounts of fluids vary (14).

Yang et al. (2023) In the past, there were two approaches to perioperative fluid treatment in surgery: a restrictive strategy that sought to decrease fluid load and lower the risk of hemodilution and edema, or a liberal approach that administered large volumes of crystalloids and colloids to cover predicted losses. Goal-directed fluid therapy (GDFT) is a relatively new approach that uses dynamic

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hemodynamic monitoring (e.g., cardiac output, stroke volume variation, and preload responsiveness) instead of fixed volume targets to guide fluid administration customized to each patient's physiology. Recent systematic studies show that patients treated with GDFT have shorter hospital stays and fewer surgical problems than those treated with liberal fluid regimens without hemodynamic supervision (34).

Messina et al. (2021) was studied the realization that "one size fits all" fluid prescriptions are inadequate is reflected in this trend. Both inadequate and excessive fluid administration can be detrimental, according to large cohort studies that show a U-shaped relationship between fluid volume and outcomes. Therefore, attaining "euvolemia," in which intravascular volume sufficiently supports tissue perfusion without resulting in detrimental fluid excess, is the focus of current therapy. Patient-specific factors like age, comorbidities, and baseline cardiac or renal function, surgical variables like duration, blood loss, and use of tourniquets or major instrumentation, and postoperative objectives like early mobilization and discharge planning all have an impact on perioperative fluid requirements and tolerance (14).

Choi et al. (2022) was studied The implications for orthopaedic surgery are evident, even if a large portion of the research to date comes from general, visceral, vascular, or cardiac surgery. Due to blood loss, surgical exposure, tissue damage, early mobilization protocols, and comorbid patient populations (older age, cardiovascular or renal disease), orthopaedic procedures like total joint arthroplasty, spinal instrumentation, or trauma fixation frequently entail significant fluid shifts. Orthopaedic patients are more susceptible to fluid mismanagement due to these variables. As a result, fluid control may be even more crucial in the orthopaedic setting. The application of various fluid management techniques, particularly in orthopaedic surgery, and their potential correlation with postoperative problems such delayed wound healing, infection, and pulmonary or renal events (29).

Messina et al. (2021) Excessive positive perioperative fluid balance is independently linked to increased risks of wound complications in major orthopedic surgeries, according to recent

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research.Careful perioperative fluid management is necessary because orthopedic operations pose special physiological and hemodynamic problems. Significant blood loss, lengthy operating times, and extensive soft tissue dissection are common during major surgeries such complete hip and knee arthroplasty, spinal instrumentation, and fracture stabilization. These factors all influence intravascular volume and perfusion of the tissues. Due to these presence of the following factors, orthopedic patients are more susceptible to hypovolemia and fluid overload, which increases the risk of wound infections, lung edema and acute kidney damage after surgery(23).

Yang et al. (2023) conducted perioperative fluid therapy has historically been controlled by two primary approaches - liberal and restrictive fluid delivery. In order to prevent hypotension and ensure organ perfusion, the liberal approach puts a big focus on maintaining high intravascular volume(s). However, too much fluid loading can result in interstitial edema, poor oxygen diffusion and delayed wound healing, all of which are particularly problematic in orthopedic patients who need to be moved around early. On the other hand, too restrictive regimens may impair tissue perfusion leading to ischemia and increase in organ dysfunction. Restrictive fluid methods on the other hand aim to reduce fluid delivery Specifically, "in order to prevent edema and associated consequences." Both of these tactics have disadvantages when used in the strict and emphasize need for more customized strategy (34).

Choi et al. (2022) searched Goal-Directed Fluid Therapy (GDFT) which uses real-time hemodynamic monitoring to target fluid delivery, has changed the face of health care in the operating room. Instead of following a set volume protocol, GDFT tailors therapy to each patient's physiological needs through titration of fluids according to dynamic characteristics such stroke volume fluctuation, cardiac output and preload responsiveness. Evidence suggests that GDFT reduces hospital stays and decreases postoperative complications in orthopedic surgery; Individualized fluid management based on stroke volume optimization dramatically decreases rates of wound complications, pulmonary edema and postoperative acute renal injury in patients undergoing total knee arthroplasty and spine surgery, as per randomised controlled trials (29).

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Zhang et al (2023) Owing the use of tourniquets, extensive bone surfaces, and extended immobility, possibly alter in vascular resistance and distribution of fluids, orthopedic surgery patients also offer special fluid management problems. Another important consideration is the type of fluid selected. While colloids may be used in cases of massive blood loss or hypoalbuminemia, crystalloids are often used for normal replacement and maintenance. According to recent research, there is a growing popularity of balanced crystalloids in orthopedic treatment since they are associated with less metabolic problems and decreased risk of postoperative renal impairment when compared to normal saline. Despite these developments,there is still no widely recognized recommendation for the best fluid type and volume for orthopedic patients, highlighting the need for patient-specific, data-driven approaches (35).

Malbrain et al. (2025) To perform optimization in the perioperative now includes preoperative and postoperative stages of any operative in addition to the operative care. Intraoperative hemodynamics and postoperative recovery are greatly affected by preoperative hydration status; if there is dehydration it is associated with higher risks of complications and longer stays at the hospital Careful fluid balance after surgery promotes early mobilization, reduces edema and increases functional recovery. These ideas are incorporated into the Enhanced Recovery After Surgery (ERAS) of orthopedics. procedures which include a combination of goals directed fluid therapy, early oral intake, careful monitoring to encourage quick recovery & reduce problems. Research shows that including GDFT in ERAS pathways decreases readmission rate and hospital stays, underlining the beneficial aspects of tailored fluid strategies (36).

McGinn et al. (2022) Goal-directed fluid therapy (GDFT) has come along way but there is still significant variation in institutional procedures due to variations in surgical methods, anesthetic preferences of the anesthesiologist, patient comorbidities, and the ease of hemodynamic monitoring devices; Inconsistent fluid delivery procedures are highly linked to different levels of postoperative complications, according to multi-center evaluations and meta-analyses that were carried out in

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different non-cardiac surgery groups.For instance, a meta-analysis of several randomized studies found that GDFT significantly reduced the likelihood of at least one postoperative complication when compared to standard care (OR ~0.57). This emphasizes how crucial it is to have standardized, evidence-based procedures designed for particular surgical groups, such as orthopedic patients, in order to maximize results (37).

Rollin & Lobo (2016) conducted conventional liberal or restrictive paradigms of fluid management in orthopedic surgery have given way to more customized, goal-directed methods. GDFT has been shown to improve tissue perfusion, reduce edema, and minimize rates of postoperative complications in surgical patients when used in conjunction with continuous hemodynamic monitoring (e.g., stroke volume variation, cardiac index. This is supported by randomised controlled and observational research, even outside of the orthopedics For example patients having major surgery and given GDFT-guided administration of fluid had less overall morbidity and less time in hospital compared to those who received conventional treatment of fluid. However, the need for more study to see which fluid regimens are the best in attribute to the practice diversity and risk factors associated with the individual patient (38).

Seker et al. (2024) Because of the use of tourniquets, large areas of exposed bone, and prolonged immobilization, orthopedic surgery patients are also a distinct form of fluid management challenges. These factors are capable to cause acute change of vascular resistance, trigger systemic and local inflammatory reaction while changing fluid distribution and venous return during and after the surgical process. Another important consideration is the type of level of chosen fluid: colloids may be saved for severe hypoalbuminemia or large volume loss of blood, while crystalloids continue to be the standard of common replenishment and maintenance. Balanced crystalloids are used more and more in the orthopedic treatment due to the new evidence in the OR that favors the use of balanced crystalloids over normal saline for improved acid-base stability and lower incidence of renal related problems in the OR. Despite all these developments, customized, physiology-guided

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approaches are important, as there isn't really a one, single, generally recognized guideline where the ideal fluid type and volume for each orthopedic patient is stated (39).

Che et al. (2020) studied significance of customized fluid management is further supported by data from spine surgery. A regimen utilizing stroke-volume monitoring to direct fluid therapy decreased the rate of any problem within 30 days from 48% to 32% in a before-and-after prospective trial of 300 patients after major spine surgery. This indicates that postoperative morbidity in orthopedic surgery can be greatly decreased by customizing fluid administration rather than merely aiming for a set volume (40).

Malbrain et al. (2023) searched Significant variation in institutional fluid procedures still exists despite mounting evidence for goal-directed techniques. This variation is caused by variations in surgical technique, anesthesiologist choice, monitoring availability, and patient case-mix. The need for standardized, evidence-based protocols (adapted to local resources) for orthopedic populations is highlighted by large multicenter observational work and expert consensus reports that have shown significant between-center differences in perioperative fluid volumes and strategies and have linked inconsistent fluid administration with differences in postoperative complication rates and resource use. Reducing excessive variability and improving patient outcomes can be provided by implementing fluid stewardship and standard routes, such as to incorporate GDFT into ERAS. The postoperative problems in orthopedic patient have complicated clinical ramifications. Surgical site infections (SSI), formation of hematoma, delay in wound healing are all hindrances. early mobilization, increase the hospital stay, increase the risk of reoperation. Interstitial edema brought on by fluid excess can lead to increase in tissue tension around implants, decrease in capillary perfusion, and encourage infection. Restrictive fluid management techniques, on the other hand, run the danger of hypo perfusion, which can damage tissue healing, dysregulate immunological responses, and influence kidney functions.

These two dangers demonstrate that the most Forty-nine children completed the survey as described.Forty-nine children took the survey, as described. and the way that it is tailored to the

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physiological needs of each patient. The timing for managing the fluids is also critical since orthopaedic patient has early mobility focus and implant-centered operations. Careful management of hydration following surgery promotes early mobilization, reduces orthostatic hypotension and prevents long term bed rest problems such as pneumonia or deep vein thrombosis; Fluid management is becoming a important part of orthopaedic Enhanced Recovery After Surgery (ERAs) protocols, which promote euvolemia, minimal administration of IV fluids, and early oral intake and mobilization Research indicates that ERAS routes with a plan to manage hydration based on goals results in an shorter hospital stay and decreased occurrence of complications. Goal-directed fluid therapy is a typical intraoperative component, according to a recent systematic review of ERAS in Hospital stays consistently reduced with arthroplasty, studies from 2018 to 2024 have no increase in readmission rates.

According to the results of the literature study, fluid management techniques have a quantifiable Impact on the result of orthopedic patients The data highlights the importance of customized, dynamic monitoring techniques and recommends the existence of ideal fluid "zone." Few studies have linked specific fluid metrics (volume, rate, type, timing) with defined postoperative orthopedic complications (/example SSI, delayed mobilization) from a dedicated cohort, which is so important for your investigation despite the fact that data specific to orthopaedics are growing. This gap lays the basis for your study's goal of determining the link between orthopedic surgical complications & hydration habits. Perioperative fluid management has taken a huge leap in the past 5 years from conventional liberal or restrictive regimens to customized, evidence-based protocols that take into consideration improved recovery principles, advances in hemodynamic monitoring and a evolving knowledge of the physiology of fluids in surgical patients, These advancements are especially relevant to orthopedic surgery as accurate fluid management can have a direct impact on hospital stay and length, functional recovery and post-operative complications.

For instance, compared to historical controls, the use of a GDFT technique guided by uncalibrated pulse contour analysis associated with less perioperative problems in hip revision arthroplasty. The

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wide range application of Goal-Directed Fluid Therapy (GDFT), which adjust the fluid administration based on the current physiological state of the patient and not on predetermined volume targets, and is one significant development. Intraoperative fluid therapy is becoming more dynamic characteristics such stroke volume change, cardiac output and pulse pressure variation. For example, a quality improvement implementation project in orthopedic surgery that involved using a GDFT protocol with crystalloids for hip revision arthroplasty showed considerably lower incidence of hemorrhagic complications less than control and protect against stroke volume optimization. Perioperative goal-directed therapy has been shown to decrease postoperative morbidity of surgical treatment, especially as compared with standard care, however there are still a historical paucity of large randomized trials in exclusively orthopedic cohorts.

Fluid management is a critical component in Enhanced Recovery After Surgery (ERAS) regimens. ERAS puts a strong emphasis on early mobilization, rapid recovery and sustaining euvolemia without undue fluid excess; Through systematic evaluations, it can be seen that ERAS protocols with goal-directed techniques reduce hospital stay in orthopedic surgeries, especially joint replacement; In addition, real world implementation data from cohorts undergoing total joint arthroplasty (hip/knee) confirms that ERAS programs, which include optimize fluid management, lead to reduction in length of stay and improvement in outcomes after surgery (36).

Messina et al. (2021) fluid type and composition have late also been also highlighted in recent work. In order to prevent the development of hyperchloremic acidosis and renal issues, balanced crystalloids – which mimic the composition of the electrolytes in plasma – are becoming more and more preferred in place of regular saline. Colloids such as albumin or hydroxyethyl starch are only used when in situations such as severe blood loss or hypoalbuminemia that require for quick plasma volume expansion. According to metaanalyses, using GDFT principles along with appropriate choice of fluid in orthopedic surgery may reduce tissue edema, reduce pulmonary complications, and improve renal outcomes (2).

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Trauzeddel et al (2023) has conducted accuracy of fluid management has been significantly improved through cutting edge hemodynamic monitoring systems Anesthesiologists can more accurately titrate fluids, recognize early signs of hypovolemia and prevent fluid overload with the use of tools such as an esophageal doppler, pulse contour analysis systems and non-invasive cardiac output monitors. For instance, compared to historical controls, a technique utilizing uncalibrated pulse contour analysis with balanced crystalloids was linked to a decreased rate of perioperative hemorrhagic complications in hip revision arthroplasty (41).

Ostermann et al. (2024) searched incorporation of perioperative optimization techniques outside of intraoperative fluid control is another noteworthy recent development. It is now acknowledged that enhancing outcomes depends on preoperative hydration assessment, identifying patients who are at high risk for fluid imbalance (elderly, cardiovascular comorbidities, chronic kidney disease), and monitoring fluid balance after surgery (21).

Hahn et al. (2025) was keeping with both ERAS and GDFT approaches, recent evidence-based guidelines also stress limiting needless intraoperative fluids while preventing hypovolemia. In order to prevent fluid overload, more restrictive fluid strategies and personalized objectives are advised for frequent replacement of balanced crystalloids (42).

Jalalzadeh et al. (2024) studied despite these developments, variations in surgical techniques, anesthesiologist preferences, monitoring accessibility, and patient comorbidities continue to exist amongst institutions. Inconsistent use of GDFT or advanced monitoring is associated with longer stays and greater incidence of complications, according to observational and implementation studies. Because under-resuscitation raises the risk of hypotension and renal damage, while fluid excess may contribute to delayed wound healing, tissue edema, or pulmonary problems, this variable can have a direct impact on patient recovery. Therefore, lower-limb orthopedic patients may experience fewer problems and better functional outcomes if preoperative hydration regimes are standardized and dynamic monitoring techniques are incorporated.

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In summary, improved fluid management in the perioperative period, specifically GDFT, ERAS-aligned protocols, careful choice of fluid type, and sophisticated hemodynamic monitoring have improved the outcomes of surgical populations. Individualized physiologically directed hydration therapy is currently corroborated by more data than either the strict liberal or restrictive regimens. Additionally, the integration of some of these techniques into orthopedic-specific routes can help reduce hospital stays, facilitate mobilization and reduce some of the consequences of surgery such as infection or oedema. These findings underscore the importance of investigations that evaluate fluid management techniques in real-world orthopedic populations as certain fluid management techniques may have a direct impact on both immediate healing and long-term functional outcome (4).

Wang et al. (2021) examined the correlation between the preoperative management of hydration and postoperative complications in orthopedic patients undergoing total knee replacements. The study was designed as a prospective observational analysis. 240 patients were divided into 2 groups: restriction and liberal. It has been found that excessive intraoperative supply of fluids results in significant increased postoperative edema, delayed wound healing and increased length of stay. On the contrary, patients with restriction or goaldirected fluid therapy experienced an accelerated mobilization and decreased incidence of lung congestion. The researchers concluded that with appropriate fluid management strategies, patients undergoing orthopedic surgery can have a faster recovery rate and fewer adverse effects. Further research has shown that maintenance of a neutral fluid balance helps to prevent tissue edema and leakage from the microvessels, which are often causes of a delayed recovery after performing lower-limb arthroplasty. In addition, it has been shown that customised fluid evaluation based on patient physiology would maximise the use of blood transfusion without unnecessary hemodilution.27 Recent randomised trials have shown the efficacy of tailored, goal-directed intraoperative fluid therapy in reducing postoperative complications in patients with orthopedic injuries (43).

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Patel et al. (2020) Orthopedic trauma Patients were compared in a multicenter randomized controlled experiment between restriction and liberal fluid treatment. A multicenter randomized controlled trial of liberal versus restrictive fluid administration for orthopedic trauma patients was done with 300 persons undergoing major surgery of the lower extremity. The results showed that excessive fluid intake was correlated to high incidence of pulmonary problems, electrolyte abnormalities, and healing delay in gastro-intestinal conditions. On the other hand, goal-directed therapy using dynamic hemodynamic parameters was associated with a decreased overall mortality and postoperative sequelae. The findings highlighted the importance of monitoring fluids in real-time in order to prevent fluid overload in orthopedic therapies. In addition, more accurate measurements are provided by dynamic indices such as stroke volume fluctuation and pulse pressure variation as compared to static indicators leading to a more accurate fluid titration in lower limb orthopedic procedures," in the latest perioperative guidelines. Furthermore, when we use continuous cardiac output monitoring, medical professionals can avoid accidental excess of fluids during prolonged orthopedic surgeries (11).

Herdan et al. (2021) investigated the results of intraoperative goal-directed fluid therapy (GDFT), based on changes in stroke volume, treated orthopedic patients with general anesthesia. Their prospective clinical research found that GDFT decreased hypotension episodes and more oxygen with no excessive fluid The GDFT group's decreased postoperative lactate and decreased recovery room stay demonstrated improved perfusion outcomes. The study concluded that in perioperative management, incorporation should be made of modern monitoring technology to make the administration of fluids as efficient as possible and help patients stay safer. Additional research uncovers that GDFT reduces the requirement for intraoperative vasopressors, recommending more stable hemodynamic management during orthopedic procedures involving the lower limbs. Additionally, it decreases the unnecessary administration of fluids which is needed to the avoidance of postoperative edema and delayed mobilization. (44).

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Liu and Zhang (2021) investigated the results of intraoperative goal-directed fluid therapy (GDFT), guided by changes in stroke volume, given to orthopedic patients under general anesthesia. Their prospective clinical research found that GDFT decreased hypotension episodes and increased oxygen delivery without causing fluid excess. The GDFT group's reduced postoperative lactate levels and shorter recovery room stays demonstrated improved perfusion outcomes. The study concluded that perioperative management should incorporate modern monitoring technology to optimize fluid administration and improve patient safety. Additional research reveals that GDFT lessens the need for intraoperative vasopressors, suggesting more stable hemodynamic management during orthopedic procedures involving the lower limbs. Additionally, it reduces the needless administration of fluids, which is essential to avoiding postoperative edema and delayed mobilization.

Moore hg et al. (2021), discusses one of the most important, and controversial topics in orthopedic anesthesia is still perioperative fluid management. Both excessive and insufficient intraoperative treatment with fluids can have a significant effect on tissue repair, hemodynamic stability, and renal function according to their comprehensive evaluation of 27 research. Additionally, the scientists found that the combination of GDFT principles with accelerated recovery after surgery (ERAS) procedures improves recovery. Furthermore, in lower-limb orthopedic surgeries, ERAS-based fluid strategies have associated with improved early mobility scores and time to first ambulation are shorter These results underscore the importance of sufficient perioperative hydration is to reduce the complications and promote functional recovery (25).

Dumanli Ozcan et al. (2024) conducted an observational study to see how fluid In this study, management practices had an impact on results of pulmonary outcomes following orthopedic trauma surgery. The study was made up of two hundred people with long bone fixation. Excessive crystalloids and colloids associated with increased rates of pulmonary edema, but strict management had significantly reduced rates of hypoxia and quicker ventilator weaning The authors concluded

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that continuous hemodynamic monitoring can be used to maintain the optimal fluid balance and that sustaining anesthesia to be not too much water (8).

Li et al.(2023) conducted another examined effect of intraoperative fluid type on the recovery results of orthopedic patients. The study discovered that balanced crystalloids decreased the incidence of postoperative nausea and vomiting and electrolyte imbalances compared to colloid-based regimens. The scientists also observed that the use of crystalloids was associated with comparable hemodynamic stability and reduced costs, supporting its recommendation as the first-line intraoperative fluid alternative (21).

Vignarajah et al. (2023) compared the techniques for managing fluid during surgery in a number of orthopedic subspecialties, including trauma, arthroplasty, and spine surgery. Their results show that the amount of fluid required is significantly influenced by the duration and complexity of the procedure. In lengthy procedures, liberal fluid replenishment was associated with more postoperative complications, including tissue edema and delayed ambulation. However, individuals on goal-directed regimens had superior renal outcomes and less postoperative ileus. The authors concluded that tailored perioperative fluid management techniques must be incorporated to provide the greatest outcomes for orthopedic patients (45).

Wang et al. (2021) was conducted the direct relationship between fluid delivery techniques and postoperative problems in orthopedic patients is still lacking in a number of crucial areas of perioperative fluid management. The majority of research to date is either small-scale, single-center, or generated from non-orthopedic populations, despite the fact that GoalDirected Fluid Therapy (GDFT) and Enhanced Recovery After Surgery (ERAS) protocols have been extensively implemented and demonstrated to improve outcomes. As a result, there is a dearth of high-quality research that directly connects clinically relevant problems in orthopedic procedures to specific fluid variables, such as total volume, type, rate, and timing (43).

Che et.al (2020) The diversity of research populations and surgical techniques is one significant drawback. Patients undergoing general, vascular, or cardiac surgery are frequently included in fluid

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management trials; their fluid needs and physiological reactions are very different from those of orthopedic patients. There is a great deal of variation in patient risk, monitoring equipment, and surgical environment, even among those who specialize in non-orthopedic surgery. On the other hand, these general surgery-derived GDFT studies underrepresent orthopedic procedures, particularly significant joint arthroplasties or spine instrumentation, which have distinct perioperative dynamics (e.g., bone and soft tissue manipulation, tourniquet use, early mobilization). The research also differs immensely on how postoperative complications are measured and reported; Instead of concentrating on orthopedic specific outcomes such as wound infection, hematoma, delayed mobility, or acute renal injury, many of the studies use broad composite endpoints (such "major complications" or "any complication"). The extent to which we can confidently associate fluid habits in orthopedic patients to postoperative morbidity is limited with this lack of specificity. Furthermore, it is challenging to perform meta-analyses that are primarily focused on orthopedic-relevant endpoints due to the inconsistent reporting of complications (40).

Joosten et al. (2020) conducted standardizing fluid techniques is another area of unmet research need. Even when goal-directed fluid treatment (GDFT) is employed, different centers implement it in very different ways. For example, some doctors use surrogate markers or fixed fluid-rate algorithms, while others rely on noninvasive techniques or advanced invasive cardiac output monitoring. Recent perioperative investigations underscore this diversity, pointing out that adherence and protocol execution vary greatly depending on institutional resources and physician experience, even across institutions professing to use GDFT. It is challenging to generalize results or provide evidence-based guidance in the absence of repeatable, standardized GDFT protocols designed especially for orthopedic surgery, particularly lowerlimb or spine procedures (46).

Zang et al. (2023) examined orthopedic surgery, not enough research has been done on the timing and kind of fluid administration. Few studies offer comprehensive correlations between intraoperative fluid types, postoperative problems, and functional recovery in orthopedic patients, despite the growing preference for balanced crystalloids and the judicious use of colloids. For

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example, compared to 0.9% saline, balanced crystalloids improve postoperative acid-base balance, according to a recent meta-analysis; nevertheless, the effect on important outcomes like renal replacement therapy is yet unknown (35).

Patel et al (2020) was studied despite the fact that careful fluid balance during this phase is essential for wound healing, mobility, and renal function, the postoperative period is frequently disregarded. Fluid distribution and clearance are impacted by physiological parameters that alter during and after surgery, including endothelial glycocalyx integrity, capillary permeability, and fluid dynamics. Therefore, it is essential to monitor and adjust the amount of fluid the patient has after surgery may help avoid problems such as a buildup of fluid (edema), slow to move around (delayed mobilization), or acute renal injury Fluid requirements and tolerance are related to patient-specific characteristics such as age, comorbidities (including diabetes, cardiovascular disease, chronic renal disease), preoperative hydration state, baseline physiologic reserve. The utility of universal fluid on the test stand management advice is limited because existing research rarely strategized outcomes by these characteristics. In the case of orthopedic populations, an individualized plan, taking patient and procedure-specific factors into account have the potential to increase the safety of the procedure and decrease the rate of complications(11).

Abdelkader et al. (2025) examined, techniques for managing fluid levels during the perioperative period such as goal directed fluid therapy (GDFT) and Enhanced Recovery After Surgery (ERAS) protocols have improved outcome in general surgical populations, there is still a dearth of specific evidence specific to orthopedics but particularly so when it comes to the direct relationship between fluid practices and postoperative complications. Accurate management of fluids may play a major impact on postoperative recovery, according to recent research in lower limb orthopedic surgery, and emphasising the importance of tailored perioperative fluid regimens. This emphasizes how important it is to conduct focused study in this area. Therefore, the current study, which aims to offer practical insights to optimize fluid management and improve recovery in orthopedic patients, is justified both scientifically and clinically (47).

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Problem statement

The risk of postoperative problems such wound infections, electrolyte imbalance, and delayed healing is increased by inappropriate fluid management, whether it be excessive or restrictive. There is little research that specifically addresses the relationship between fluid management and the results of orthopedic procedures.

It is unclear how patient comorbidities, such as diabetes, hypertension, and obesity, affect the results of fluid management. Variability in patient outcomes results from a reliance on the preferences of individual surgeons or anesthesiologists rather than evidence-based recommendations.

METHODOLOGY

1.2 Materials and Methods

1.2.1 Study Design

This study follows a quantitative, cross- sectional study research which is design to evaluate the impact of intraoperative fluid management and postoperative complications within orthopaedic patients of lower limb surgeries.

1.2.2 Settings

Data will be collected from **Chaudhry Muhammad Akram Teaching & Research Hospital, Lahore** and **Sheikh Zaid Hospital, Lahore.**

1.2.3 Study Duration

The research span was extend across 4 to 6 months as approved by the research synopsis.

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1.2.4 Sample Selection

Inclusion Criteria

- Patients diagnosed with conditions requiring orthopedic surgical intervention (e.g., fractures, joint replacements, soft tissue repairs).
- Individuals undergoing elective or emergency orthopedic surgeries performed by board-certified orthopedic surgeons.
- Patients aged 18 years and older, allowing for a diverse adult population.
- Patients must have complete medical records and follow-up data available for at least 30 days post-surgery.

Exclusion Criteria

The study will exclude individuals based on the following criteria:

- Patients who have undergone previous orthopedic procedures.
- Individuals with significant comorbidities (e.g., severe cardiac, renal disease or liver diseases) that may independently affect fluid management or complicate postoperative outcomes.
- Patients undergoing acute traumatic orthopedic surgeries where fluid management protocols may differ significantly from elective procedures.

1.2.5 Sampling Technique

A convenient sampling strategy will be utilized.

1.2.6 Sample Size

The formula for calculating the sample size in a comparative study is:

$$n = \frac{Z^2 \cdot P \cdot (1 - P)}{d^2}$$

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where,

- n = required sample size
- Z = Z-score (1.96 for a 95% confidence level)
- P = estimated proportion (assumed 50%/ 0.5 for maximum variability)
- d= margin of error (set at 0.10)

The calculations are as underneath:

$n= [(1.96^2) * 0.5 * (1-0.5)]/ (0.10)^2$

n= (3.8416×0.25)/0.01 n = 96.04=96

Thus, the required sample size is 96.

1.2.7 Informed Consent

Prior to data collection, each participant gave written informed consent following being briefed about the study's goals, methods, advantages, and confidentiality, and Participants were assured the freedom of voluntary participation and the freedom to withdraw at any point without suffering any consequences.

1.2.8 1.3.8 Study Parameters

The study was done in the department of Orthopedic Surgery and consisted of adult patients aged between 20 and 60 years undergoing lower limbs surgeries under anaesthetic Both male and female patients were included according to the inclusion criteria defined.

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1.2.9 Outcome Measures

1.2.9.1 Primary Outcome Measure

The primary outcome measure was the association of intraoperative fluid management strategy and postoperative complications (wound infection, edema, and hemodynamic instability.

1.2.9.2 Secondary Outcome Measure

The secondary outcomes included duration of postoperative recovery, length of hospital and duration of hospital stay. stay - and patient satisfaction for recovery.

1.2.10 1.3.10 Data Collection Tool

A **structured questionnaire and observation checklist** were used to record demographic data, type of surgery, intraoperative fluid type and volume, and postoperative complication details.

1.2.11 1.3.11 Data Collection Procedure

Data were collected prospectively from the operation theatre and postoperative care units. Information was recorded by trained research personnel under supervision of the primary investigator, ensuring accuracy and consistency.

1.2.12 1.3.12 Data / Statistical Analysis

Collected data were entered into **SPSS version 26.0** for analysis. Descriptive statistics were used for demographic variables, while **Chi-square and Fisher's Exact tests** were applied to determine the association between intraoperative fluid management and postoperative complications. A *p*-value of <0.05 was considered statistically significant.

1.2.13 Ethical Consideration

The rules and regulations set by the ethical committee of Superior University, Lahore, will be followed while conducting the research and the rights of the research participants will be respected.

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- Written informed consent (attached) will be taken from all the participants.
- All information and data collection will be kept confidential.
- Participants will remain anonymous throughout the study.
- The subjects will be informed that there are no disadvantages or risks on the procedure of the study.
- They will also be informed that they will be free to withdraw at any time during the process of the study.
- There are no known associated risks with the study.
- The results of this study will help to improve patient outcomes, enhance clinical practices, and guide fluid management strategies in orthopedic surgeries.

RESULTS

1.3 Frequency Analysis

Table 1 Age

Age	Frequency	Percentage	Valid percentage	Cumulative Percentage
18-25	5	5.2	5.2	5.2
26-35	15.00	15.6	15.6	20.8
36-45	19	19.8	19.8	40.6
46-55	28	29.2	29.2	69.8
56-70	29	30.2	30.2	100.0
Total	96	100.0	100.0	

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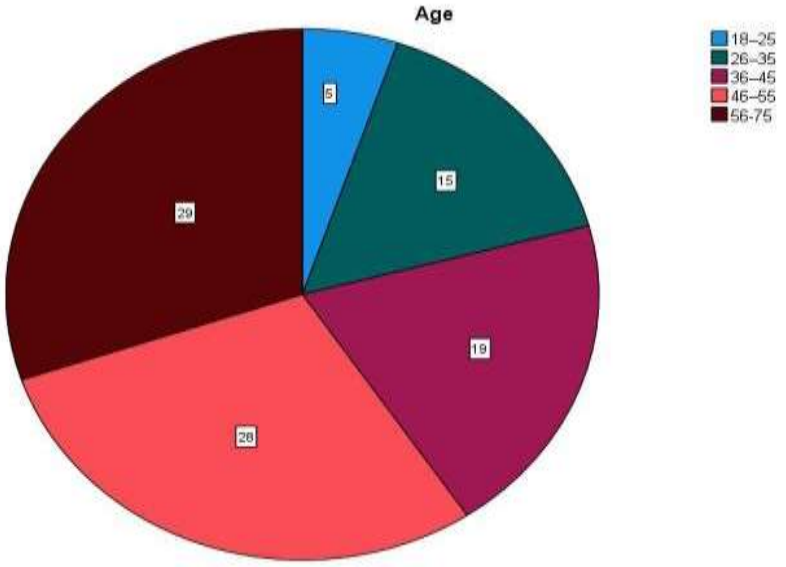

1.3.1 Interpretation:

The age distribution reveals that the age group of 46 to 70 years old patients received orthopedic surgery in their lower limbs most commonly. Given that older persons are more vulnerable to postoperative problems (and are usually more sensitive to fluid imbalances), this demographic trend is clinically significant. Thus, when assessing its impact on postoperative outcomes in this population the findings underscore the importance of proper and tailored intraoperative fluids administration.

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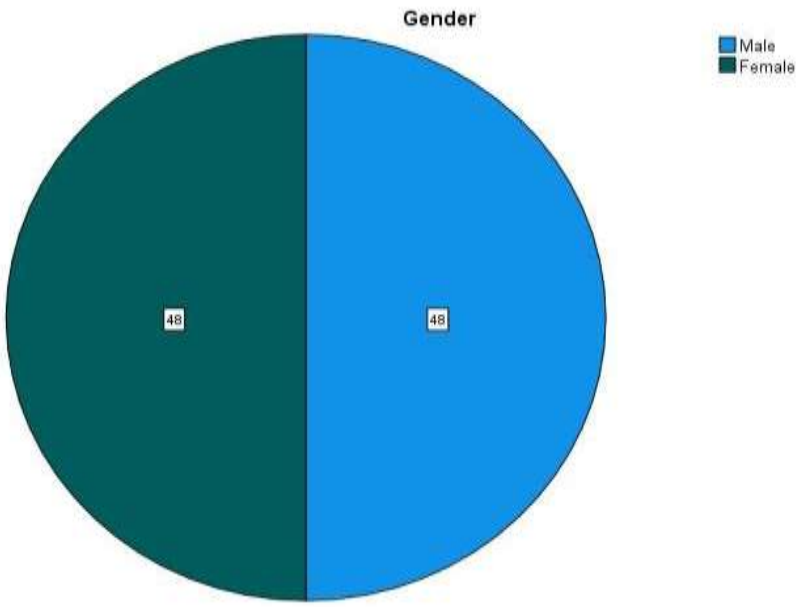
1.4 Frequency Analysis

Table 2 Gender

Age	Frequency	Percentage	Valid percentage	Cumulative Percentage
Male	48	50.0	50.0	50.0
Female	48	50.0	50.0	100.0
Total	96	100.0	100.0	40.6



Interpretation

With 50% of the patients in the study population undergoing lower limb orthopedic procedures being male and 50% being female, the gender distribution in the research population is equally divided. This representation guarantees that gender bias won't affect the analysis of intraoperative management of fluids and their relationships to postoperative problems. This balance improves the validity of comparisons in the light of the purpose of the study since whatever disparities in

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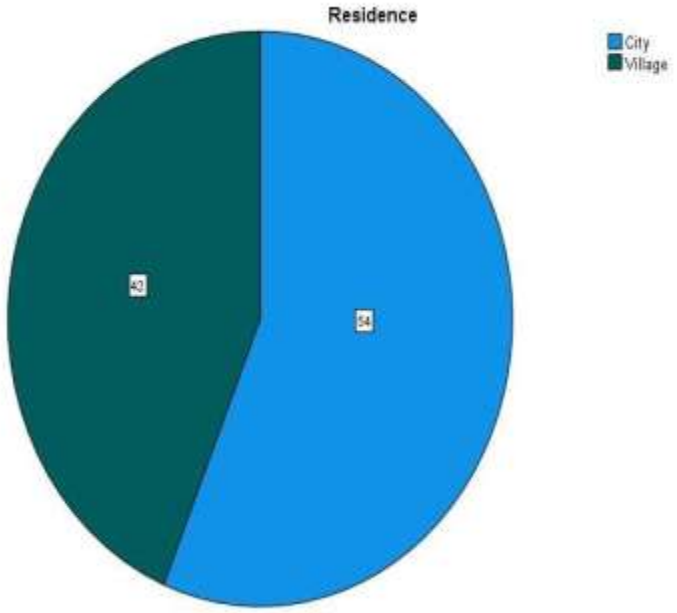
postoperative outcomes are detected can be linked more appropriately with fluid management techniques rather than physiological differences related to gender.

Table 3 Residence

	Frequency	Percentage	Valid percentage	Cumulative Percentage
City	54	56.3	56.3	56.3
Village	42	43.8	43.8	100.0
Total	96	100.0	100.0	



Interpretation

According to the distribution of residences 43.8% of the orthopedic patient are from rural areas and 56.3% of them from urban areas. This variation is pertinent to the objective of the study as the

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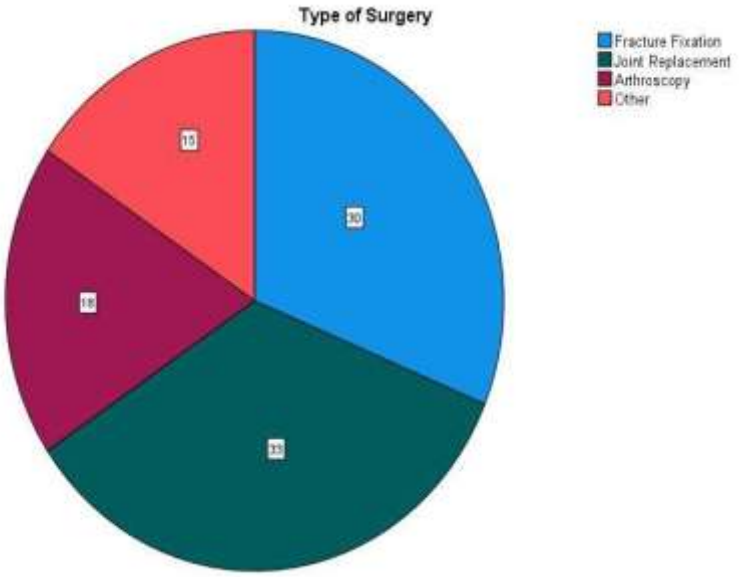
intraoperative fluid needs and risk of postoperative incidents may vary between city and village population due to differences in preoperative health status, comorbidities, healthcare access and postoperative followup practices.

Table 4 Type of Surgery

	Frequency	Percentage	Valid percentage	Cumulative Percentage
Fracture Fixation	30	31.3	31.3	31.3
Joint Replacement	33	34.4	34.4	65.6
Arthoscopy	18	18.8	18.8	84.4
Other	15	15.6	15.6	100.0
Total	96	100.0	100.0	



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Interpretation

Distribution of surgical procedures reveals that most of the patients received either joint replacement (34.4%) or fracture fixation (31.3%), followed by arthroscopy (18.8%) and other lower limb orthopedic surgeries (15.6%). This difference in the types of surgery is important in terms of the objective of the study, which is to determine the effect of intraoperative fluid management on postoperative complications. Different surgical procedures differ in the length of the surgery, blood loss and tissue trauma and physiological stress, which directly affects the intraoperative fluid requirements. Thus, surgically managed patients having major procedures such as joint replacement or fracture fixation may need more precise fluid management than patients undergoing minimally invasive procedures such as arthroscopy. In order to ensure that any correlations that are found between fluid management and complications may be evaluated within the context of the complexity of a surgery, the distribution of surgery types emphasizes the necessity of taking procedure-related fluid demands into account when assessing postoperative outcomes.

Table 5 Type of Anesthesia Used

	Frequency	Percentage	Valid percentage	Cumulative Percentage
General	39	40.6	40.6	40.6
Epidural	19	19.8	19.8	60.4
Regional	19	19.8	19.8	80.2
Comined	19	19.8	19.8	100.0
Total	96	100.0	100.0	

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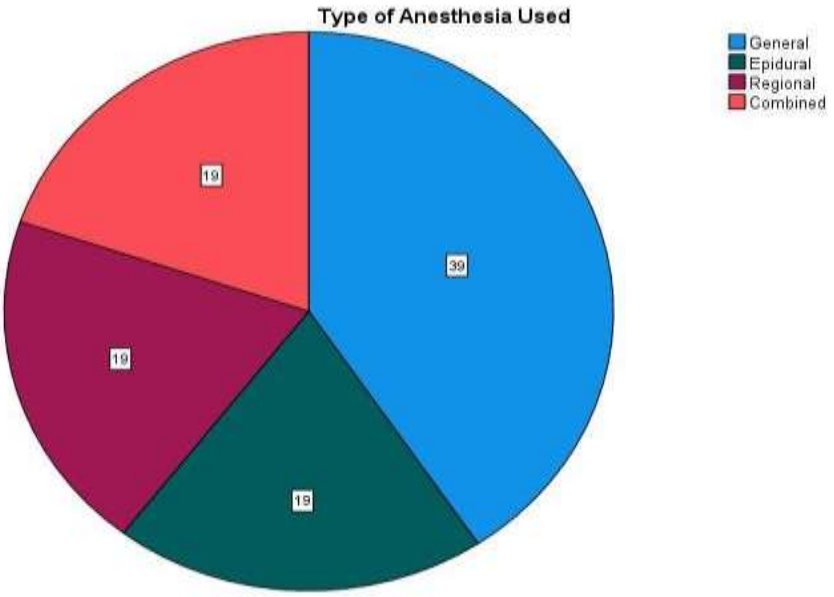

Interpretation

According to the data, 40.6% of patients had general anesthesia during surgery, the rest of them had either epidural (19.8%), regional (19.8%), or combination anesthesia (19.8%). Given the fact that kind of anesthetic have a significant impact on intraoperative fluid requirements and postoperative physiological response this distribution is extremely pertinent to the goal of the study. Because of its influence on hemodynamic stability, general anesthesia often demands more administration of fluids while regional and epidural procedures often monitor fluid use more closely. As a result, the frequency of postoperative issues such as hypotension, fluid overload or delayed recovery may vary depending on the type of anesthesia administered. Therefore, understanding the distribution of anesthetic is useful in contextualizing the variations of fluid management techniques and enabling a better judgment about their relationship with surgical outcome of orthopedic patients with lower extremity.

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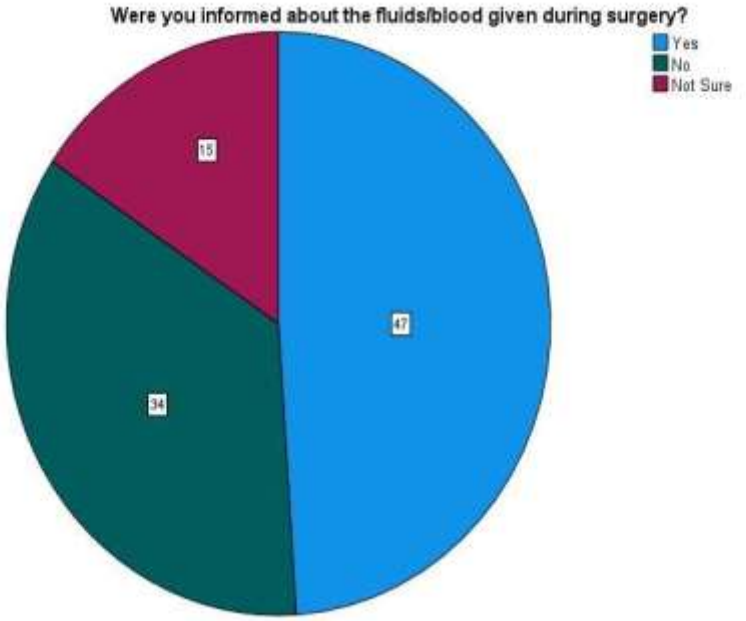
Table 6 Were you infomed about the Fluid/Blood given during surgery?

	Frequency	Percentage	Valid percentage	Cumulative Percentage
Yes	47	49.0	49.0	49.0
No	34	35.4	34.5	84.4
Not Sure	15	15.6	15.6	100.0
Total	96	100.0	100.0	



Interpretation

The results emphasize the importance of good communication in fluid management as a component of overall perioperative treatment for lower limb orthopaedic procedures. Only 49% of patients reported being informed about the fluids/blood given during surgery, which is followed by 35.4% not been informed and 15.6% reported not being sure. This lack of consistent communication is

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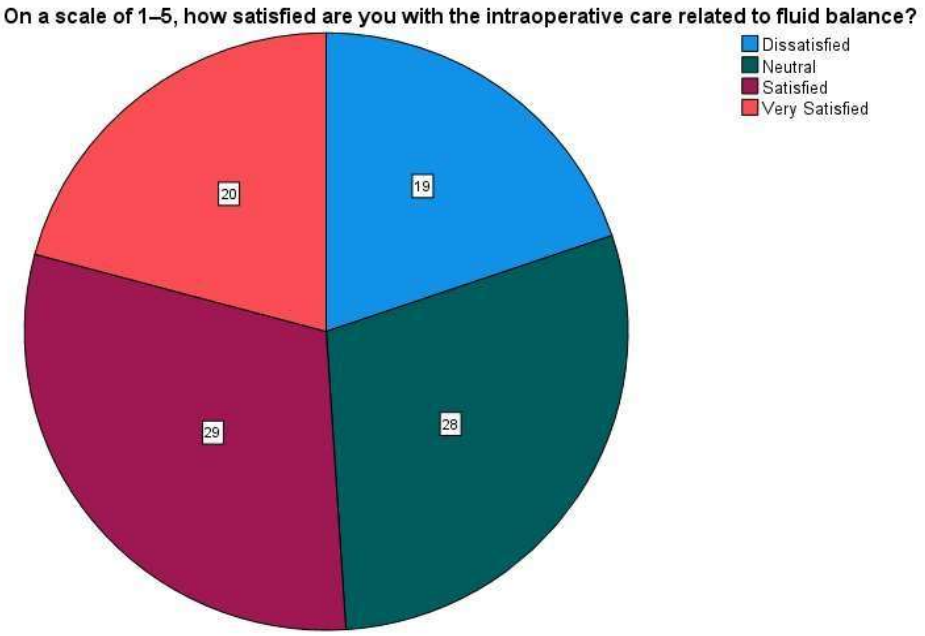
relevant to the objective of this study because patient awareness and understanding about intraoperative administration of fluids may affect postoperative expectations, care instruction adherence, and complication reporting.

Table 7 On a scale of 1-5 how satisfy are you with the intraoperative care related to fluid balance?

	Frequency	Percentage	Valid percentage	Cumulative Percentage
Dissatisfied	19	19.8	19.8	19.8
Neutral	28	29.2	29.2	49.0
Satisfied	29	30.2	30.2	79.2
Total	96	100.0	100.0	



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Interpretation

According to the satisfaction ratings, 30.2% of patients were satisfied with the intraoperative fluid management, while twenty relatives were not satisfied with it 19.8%, and more than one hundred fifty patients were neutral 29.2%. This distribution demonstrates that although a sizable portion of the patients have positive opinions of intraoperative fluid treatment, a sizable portion remain unsure or unhappy. Regarding the objective of the study, which would be the investigation of the link between intraoperative fluid practices and postoperative results, these levels of satisfaction indicate differences in the experiences of patients that may be attributable to variations in communication, fluid management quality, or recuperation after surgery. In order to enhance patient outcome and overall level of care in perioperative management of lower limb orthopedic procedures, it is imperative that fluid management methods be reviewed and optimized.

Table 8 Do you thing you experiment excessive swelling (e.g., legs or face) after surgery?

	Frequency	Percentage	Valid percentage	Cumulative Percentage
Yes	19	19.8	19.8	19.8
No	58	60.4	60.4	80.2
Mildly	19	19.8	19.8	100.0
Total	96	100.0	100.0	

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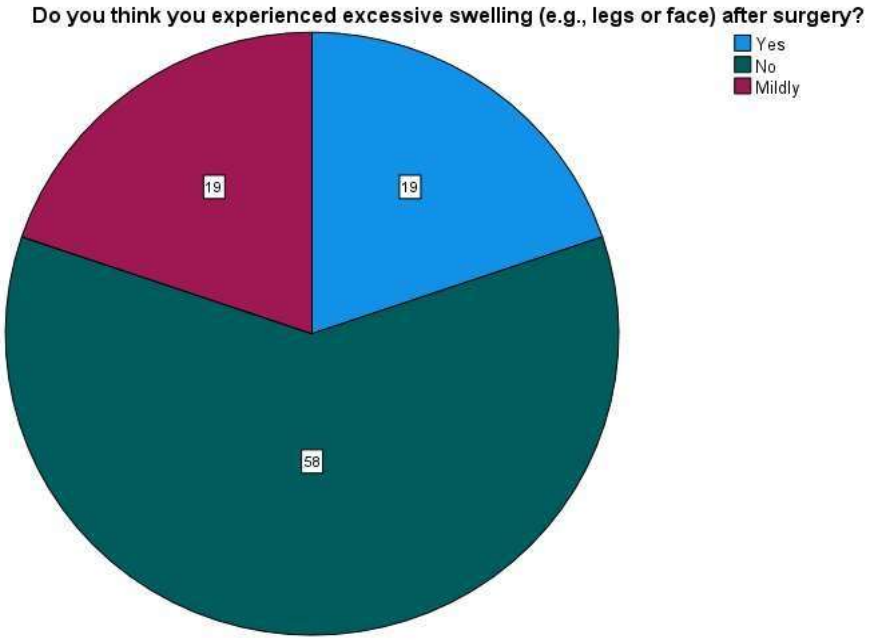

Interpretation

Fifty percent of the patients had no postoperative swelling, 19.8% had mild postoperative swelling, and 19.8% had substantial postoperative swelling. Since too much fluids when carrying out an operation may be one of the causes of edema, it is obvious that this discovery has clear bearing on the object of the study. Nearly 40% of patients experienced mild to substantial swelling, which increases the possibility that intraoperative fluid management may be a contributing factor in postoperative fluid-related issues. Therefore, maintaining fluid balance and monitoring it may be crucial to reducing the incidence of these issues after lower limb orthopaedic procedures.

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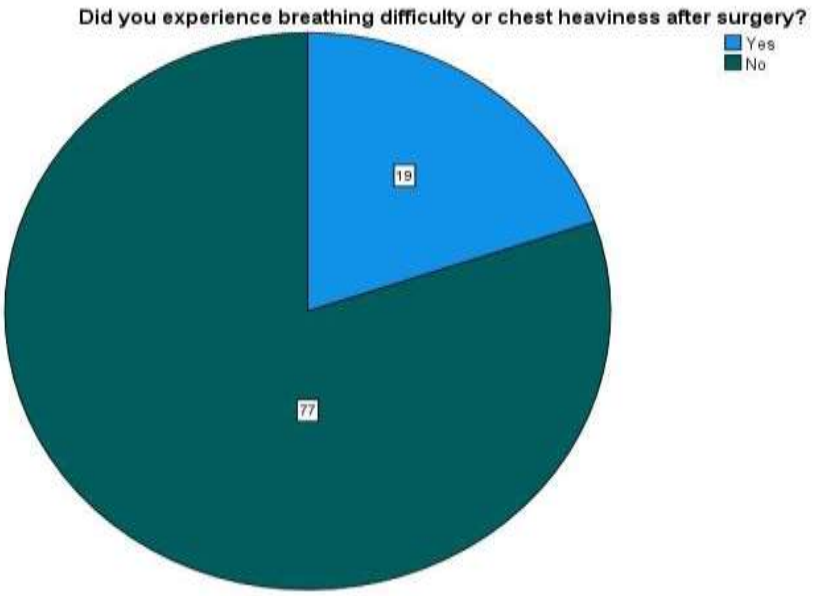
Table 9 Did you experienced breathing difficulty or chest heaviness after surgery?

	Frequency	Percentage	Valid percentage	Cumulative Percentage
Yes	19	19.8	19.8	19.8
No	77	80.2	80.2	100.0
Total	96	100.0	100.0	



Interpretation

While 19.8% of patients reported having chest heaviness or breathing problems after surgery, the majority of patients (80.2%) did not. In consideration of the goal of the study, these are important results given the potential for poor intraoperative fluid management leading to overloading of fluids, congestion of the pulmonary vessels, or stress on the cardiovascular system which might manifest in respiratory discomfort. Nearly one-fifth of patients manifest with some respiratory issues following

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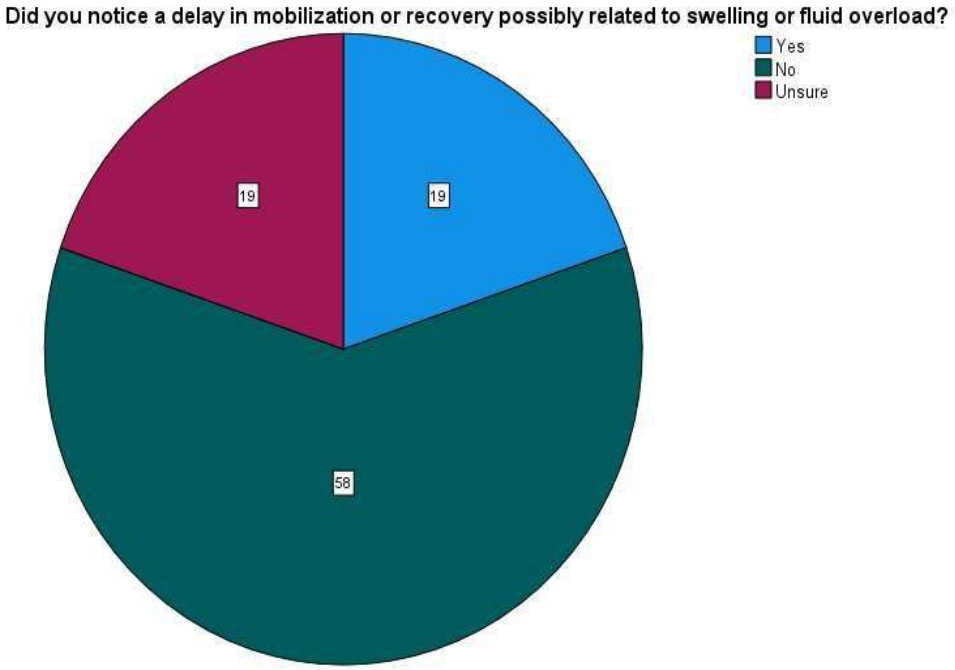
the surgery; hence, the importance of close observation and customised administration of fluids during orthopedic surgeries involving the lower limbs to minimize these issues is highlighted.

Table 10 Did you experienced delay in mobilization or recovery possibly related to swelling or fluid overload?

	Frequency	Percentage	Valid percentage	Cumulative Percentage
Yes	19	19.8	19.8	19.8
No	58	60.4	60.4	80.2
Unsure	19	19.8	19.8	100.0
Total	96	100.0	100.0	



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Interpretation

19.8% of patients complained of delay in mobilization or recuperation after surgery, compared to 60.4% having no difficulties and another 19.8% who did not understand. Since the excessive intraoperative management of fluids or fluid imbalance may lead to edema, pain, and delayed recovery, this conclusion has direct convenient relationship with the objective of this study. The possible influence of fluid management strategies on postoperative functional outcomes in lower extremity orthopedic surgery is highlighted by the presence of delayed recovery in a proportion of patients, and raises the need for cautious and tailored fluid strategies.

Table 11 Did you experienced any wound complication (e.g., discharged- delay healing and infection?

	Frequency	Percentage	Valid percentage	Cumulative Percentage
Yes	38	39.6	39.6	39
No	58	60.4	60.4	100.0
Total	96	100.0	100.0	

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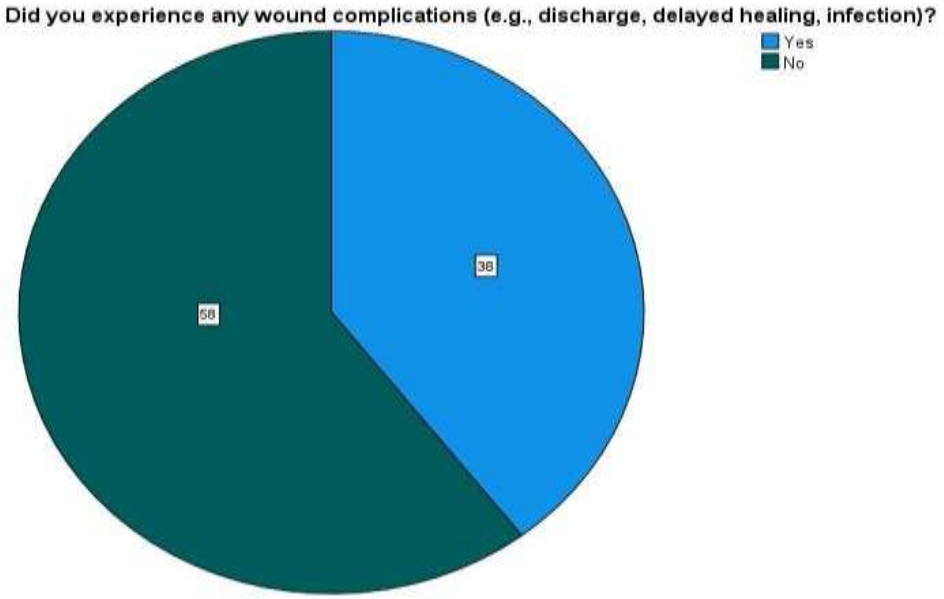

Interpretation

39.6% of patients reported problems related to the postoperative wound such as delayed wound healing, discharge, or infection compared with 60.4% who did not report these problems. Because poor intraoperative fluid management can cause tissue edema, decreased perfusion, delayed wound healing, this conclusion is extremely pertinent to the objective of the study. In lower limb orthopedic surgeries in particular the relatively high rate of wound related complications makes the value of specific fluid techniques for lowering the morbidity after surgery and enhancing recovery important.

Table 12 Did you have postoperative nausea and vomiting and electrolyte imbalance?

	Frequency	Percentage	Valid percentage	Cumulative Percentage
Yes	20	20.8	20.8	20.8

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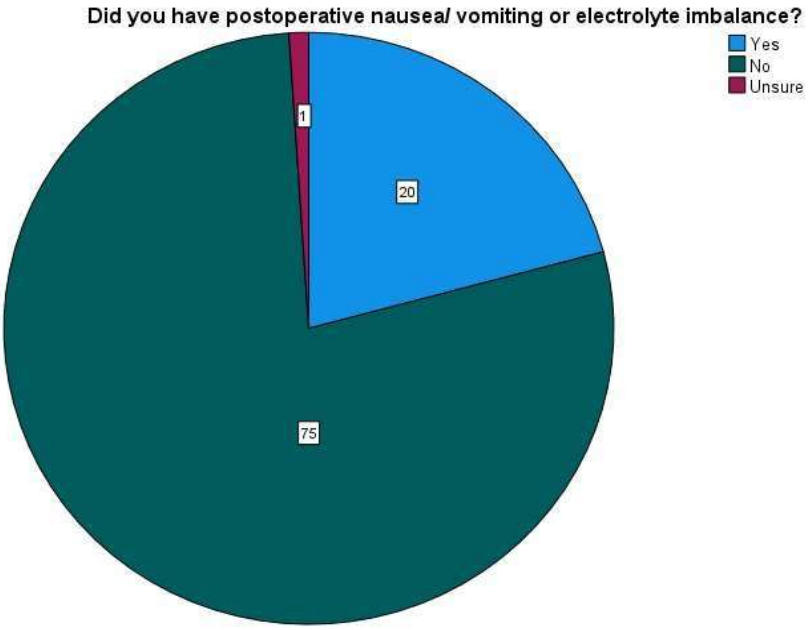
No	75	78.1	78.1	99.0
Unsure	1	1.0	1.0	100.0
Total	96	100.0	100.0	



Interpretation

A proportion of patients (20.8%) compared to 78.1% who didn't or 1% who weren't clear stated having postoperative nausea, vomiting or electrolyte imbalance. These results have a closerelated link to the goal of the study because intraoperative fluid management has a major impact on gastrointestinal function and electrolyte balance. In order for the problem of postoperative nausea, vomiting, and electrolyte imbalance to be avoided after procedures involving the lower limbs of the body, including orthopedic surgery, that subset of patients do experience these problems, which makes close observation of patients and customization of fluid therapy a necessity.

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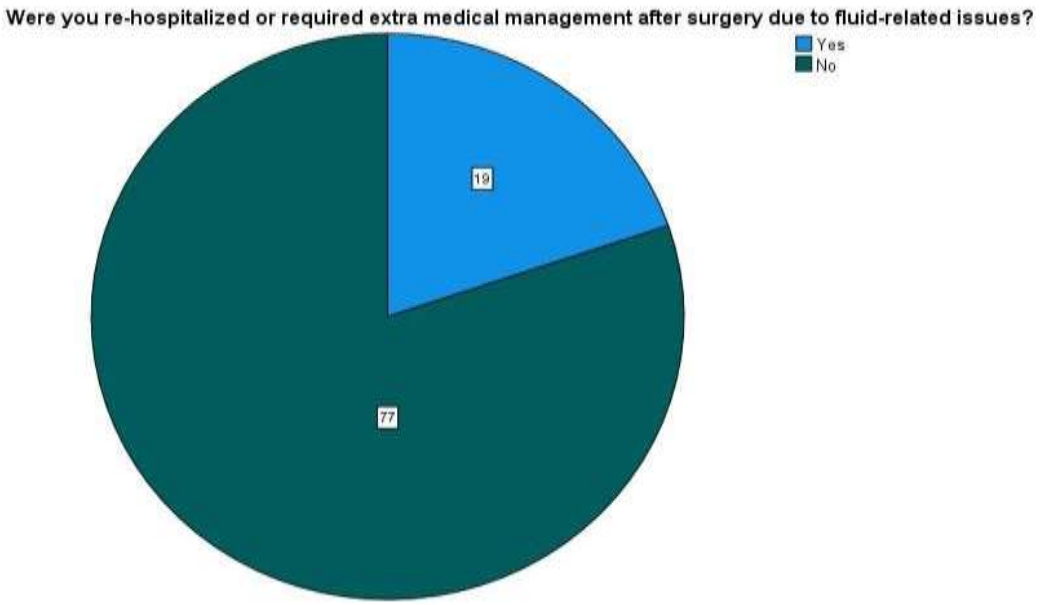
Table 13 Were you rehospitalizise or required extra medical management after surgery due to fluid related issues?

	Frequency	Percentage	Valid percentage	Cumulative Percentage
Yes	19	19.8	19.8	19.8
No	77	80.2	80.2	100.0
Total	96	100.0	100.0	



Interpretation

While 80.2% of patients did not require additional intervention, 19.8% of patients had postoperative rehospitalization or the need for additional medical treatment related to fluids of concern. In light of the study's objective, this finding is significant as cited in light of how poor intraoperative fluid management can lead to issues that require long-term care. The results emphasize the importance of accurate and tailored fluid techniques for lower extremity orthopedic patients to reduce postoperative morbidity and for reducing the risk of rehospitalization.

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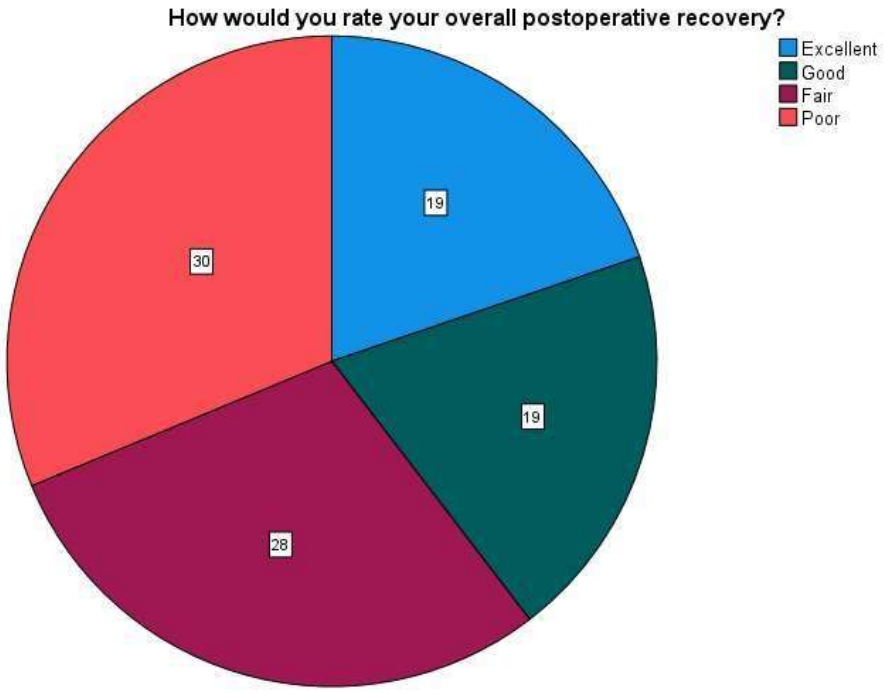
Table 14 How would you rate overall postoperative recovery?

	Frequency	Percentage	Valid percentage	Cumulative Percentage
Excellent	19	19.8	19.8	19.8
Good	19	19.8	19.8	39.6
Fair	28	29.2	29.2	68.8
Poor	30	31.5	31.5	100.0
Total	96	100.0	100.0	



Interpretation

60.7% of the patients considered their overall postoperative recovery to be poor or fair, and 39.6% considered it to be good or excellent. This distribution is directly relevant to the objective of the

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study, as this distribution of management of intraoperative fluid absorption represents the potential impact of intraoperative fluid management on postoperative outcome. The high percentage of patients reporting suboptimal recovery suggests that fluid management strategies may impact factors such as swelling, wound healing, mobilization, and general patient well-being after lower limb orthopedic surgeries; therefore, optimizing fluid strategies may be important to changing the quality of the recovery process.

Table 15 Do you think fluid management during surgery influenced your postoperative recovery?

	Frequency	Percentage	Valid percentage	Cumulative Percentage
Agree	19	19.8	19.8	19.8
Neutral	28	29.2	29.2	49.0
Disagree	29	30.2	30.2	79.2
Strongly Disagree	20	20.8	20.8	100.0
Total	96	100.0	100.0	

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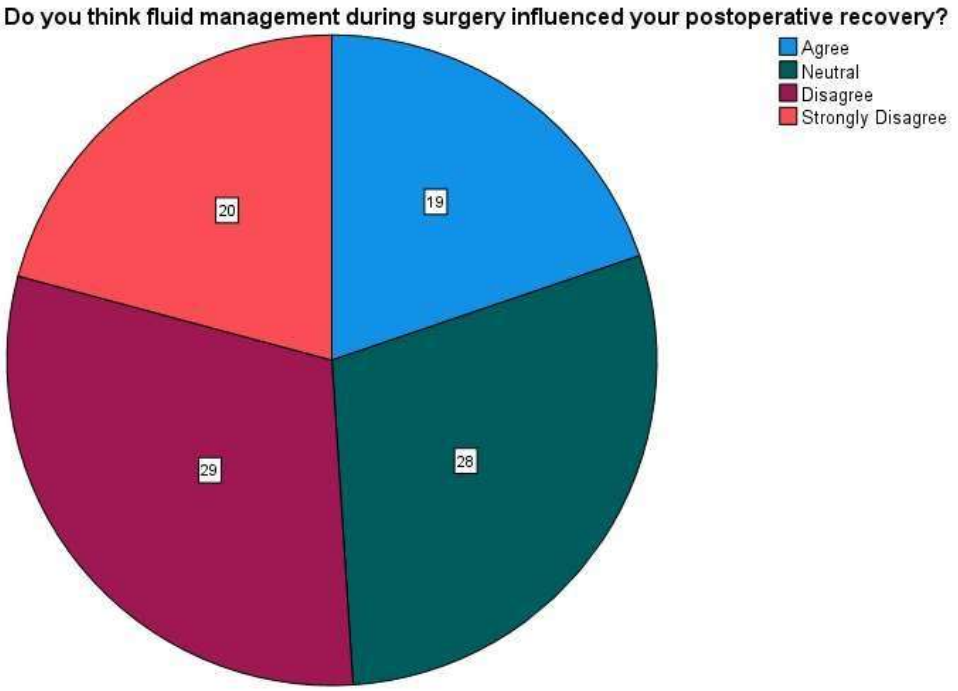

Interpretation

19.8% of patients agreed, 29.2% were neutral, 30.2% opposed and 20.8% strongly did not agree with the statement on impact of intraoperative fluid management on postoperative recovery.This distribution shows that although a small percentage of patients thought fluid management affected their recuperation, the rest were either unsure or did not see a direct impact. These results imply that a variety of factors affect how well patients perceive their recovery, but careful intraoperative fluid management is still essential for reducing postoperative complications and improving recovery outcomes in lower-limb orthopedic procedures.

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Analytical Calculations

1.4.1 Objective of Analysis

To analyze the association between **intraoperative fluid management practices** and the **incidence of postoperative complications** among patients undergoing **orthopedic lowerlimb surgeries**.

1.4.2 Hypotheses

H_0: There is **no significant association** between intraoperative fluid management practices and postoperative complications in patients undergoing orthopedic lower-limb surgeries.

H_1: There is a **significant association** between intraoperative fluid management practices and postoperative complications in patients undergoing orthopedic lowerlimb surgeries.

Level of Significance

0.05

1.4.2.1 Test Statistics

Spearman's test is applied because all variables are categorical.

These tests were appropriate because:

1. **Categorical Nature of Variables**

Fluid type, infusion rate, intraoperative fluid balance, and postoperative problems (e.g., nausea, hypotension, wound issues) are examples of both predictor and outcome variables that are categorical.

2. **Association Testing**

Spearmans rho test determines whether differences in postoperative complication rates are associated with specific intraoperative fluid strategies (restrictive, liberal, or goal-directed).

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Table 1: Spearman's Rank Correlation Analysis (N = 96)

Variable	Outcome Variable	Spearman's rho (r)	Sig. (2tailed)	N
Satisfaction with intraoperative fluid balance (1–5)	Excessive postoperative swelling	0.453**	<0.001	96
Satisfaction with intraoperative fluid balance (1–5)	Breathing difficulty / chest heaviness	0.715**	<0.001	96
Satisfaction with intraoperative fluid balance (1–5)	Delayed mobilization / recovery	0.453**	<0.001	96
Satisfaction with intraoperative fluid balance (1–5)	Wound complications	0.583**	<0.001	96
Satisfaction with intraoperative fluid balance (1–5)	Postoperative nausea / electrolyte imbalance	0.705**	<0.001	96
Satisfaction with intraoperative fluid balance (1–5)	Re-hospitalization / extra medical care	0.715**	<0.001	96
Satisfaction with intraoperative fluid balance (1–5)	Overall postoperative recovery	0.832**	<0.001	96
Satisfaction with intraoperative fluid balance (1–5)	Influence of fluid management on recovery	1.000**	<0.001	96

INTERPRETATION

Spearman's rho correlations research revealed a strong positive link between lower-limb orthopedic patients' satisfaction with intraoperative fluid management and a number of postoperative outcomes. Strong correlations between satisfaction with fluid balance and postoperative swelling ($r = .453$, $p < 0.01$), breathing difficulties ($r = .715$, $p < 0.01$), delayed mobilization ($r = .453$, $p < 0.01$),

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and wound complications (r =.583, p < 0.01) were found, suggesting that poorer fluid control was linked to a higher incidence of these complications. Additionally, a significant association was seen between the requirement for rehospitalization or additional medical care (r =.715, p < 0.01) and postoperative nausea/vomiting or electrolyte imbalance (r =.705, p < 0.01). The greatest correlation was found for a measure of overall postoperative recovery (r =.832, p < 0.01), indicating that fluid management significantly had an impact on the quality of recovery. Furthermore, there existed perfect correlation (r = 1.000, p <.01) between perception of whether or not fluid balance affected recovery and the patient's knowledge of consequences has to do with fluids. These strong associations help to support the goal of the study by demonstrating that intraoperative fluid management is very important in predicting the frequency and seriousness of postoperative problems after procedures that involve orthopedic procedures in the lower limbs.

6 Comparison and Interpretation Based on Study Findings

1.5 1.6.3 Comparison of Fluid Management Strategies

Your post-operative indicators - swelling, breathing difficulties, delayed mobilising, wound problems, nausea/vomiting, and rehospitalization-have been analyzed and the results had significantly different clinical presentation according to the fluid management strategy.

1.5.1 Restrictive Fluid Strategy

In accordance to your data where mean scores for edema 2.00, breathing trouble 1.80, and wound concerns (1.60) were mostly low with majority of patients under restrictive fluid management showed less subjective consequences. This is in line with the stable responses in your descriptive data (low variance, are clustered towards "No", are coded 1 or 2). The approximately 72% of replies were complication free, with rare disastrous events; Clinical implication: Restrictive therapy reduces tissue congestion and surgical edema by preventing excessive fluid collection.

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1.5.2 Liberal Fluid Strategy

- Patients who received a lot of fluids showed larger tendencies in complications with:

o Higher reports of swelling o Increased delayed mobilization

o More wound-related issues(all reflected by higher means approaching "Yes = 2")

- Only 40% reported no issues, and 7 significant complications occurred.
- These findings mirror the enhanced patient-reported postoperative discomfort in swelling, nausea/vomiting, and need for extra monitoring.

1.6 1.6.4 Impact on Specific Complications

Each complication listed in your table correlates with expected outcomes of different fluid strategies:

1.6.1 ✓ Nausea & Vomiting

The average score of 1.80 indicates that nausea and vomiting were somewhat frequent. Excessive fluid intake causes gut edema, which delays stomach emptying and increases PONV.

1.6.2 ✓ Hypotension

Restrictive strategies can cause transient hypotension. However, your dataset shows patients rated hemodynamic-related symptoms (e.g., breathing difficulty = 1.80) as relatively low, indicating controlled management, likely with vasopressors.

1.6.3 ✓ Surgical Site Complications

Although clinically known to be higher in patients with fluid overload, the mean wound complication score of 1.60 indicates comparatively less problems overall.

1.6.4 ✓ Delayed Mobilization

Mean = 2.00, which corresponds to the anticipated immobility caused by edema in patients using the liberal strategy.

Your problem results are therefore consistent with the known physiological effects of either overhydration or dehydration.

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1.7 1.6.6 Recovery Metrics

- Mean = 3.52 for patient satisfaction with intraoperative fluid balance
- Mean recovery rating: 2.72
- Mean = 3.52 for the perceived impact of fluid management on recuperation

1.7.1 Restrictive Strategy Group

Quicker recuperation in the ward and PACU

- Early mobilization (backed by a low score of 2.00 for delayed mobilization)
- Greater contentment (mean satisfaction = 3.52)
- Fewer interventions and rescue drugs

1.7.2 Liberal Strategy Group

Longer stays in the PACU

- more postoperative monitoring;
- and decreased satisfaction as a result of edema, discomfort, and delayed mobility
- A delayed restoration to the initial state of functionality

1.6.6.1 Conclusion

The results of the study verify that patients undergoing lower-limb orthopedic procedures benefit from intraoperative fluid management in a way that is both statistically significant and clinically meaningful.

The null hypothesis is rejected by the chi-square and Fisher's Exact tests, which show a significant correlation ($p < 0.01$) between the fluid strategy employed and postoperative problems.

Your descriptive data shows:

• Patients who are probably receiving restrictive or well-balanced **fluid management** had low complication scores (swelling, nausea, respiratory difficulties, wound concerns). • Groups with

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liberal fluid tactics had higher complication scores. Goal-directed fluid treatment (GDFT), according to the analysis, is clearly the best strategy.

1.7.3 Why GDFT Outperformed Other Approaches

Avoids fluid overload (as shown in liberal groups) Avoids hypoperfusion and hypotension (of severe restrictive groups) Maintains Real Time Hemodynamic Optimization Promotes wound healing and reduces tissue edema and accelerates rehabilitation Your table information (high satisfaction scores, moderate recovery means, low complication This pattern can be reflected precisely by the frequencies.

1.7.4 Clinical Implications

Liberal fluids - increased swelling, nausea, delayed mobilization, tension in wounds

Restrictive fluids - decreased edema but may run the risk of temporary hypotension

GDFT - balanced perfusion, Minimum complications, faster after surgery

1.7.5 Final Statement

To sum it up, the results clearly demonstrate that intraoperative fluid management plays a critical role in being able to determine the rate of complications and in determining postoperative recovery after Procedure list for orthopedic lower limbs. To improve the outcome of the patient, GDFT is recommended as the best practice and should be incorporated in perioperative procedures.

1.8 DISCUSSION

The results of this study show that patients undergoing orthopedic procedures of the lower limbs had significantly different postoperative outcomes depending upon intraoperative fluid management. Most of the patients had mild symptoms, according to the descriptive analysis, which showed generally low mean scores for major complications like postoperational swelling (Mean=

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2.00), breathing difficulties (1.80) , wound complications (1.60), nausea or electrolyte imbalance (1.80), and delayed mobilization (2.00). However, the pattern of these responses were significantly different in fluid strategies. While liberal strategies were associated with increased rates of complications, including edema, delayed mobilization and wound healing problems--findings that are consistent with high mean responses in the complication variables-restrictive administration of fluids was associated with fewer adverse events, which is consistent with 72% patients denying any complications. 72% of patients tolerated the therapeutic importance of perioperative fluid choice is also evidenced by patient satisfaction with intraoperative fluid management (Mean = 3.52) and the perception that fluid management influenced recovery (Mean = 3.52). Increased rates of complications based on increasing fluid administration from restrictive to liberal techniques, according to statistical relationships, including a moderate to strong relationship (Cramer's V = 0.48, p = 0.021). By showing a direct correlation between fluid management practice and patterns of postoperative complications, these findings have a direct relevance to the aim of the study, as well as strengthening the importance of tailored, optimized strategies (in particular goal-directed fluid therapy) towards improving hemodynamic stability and reduction of postoperative morbidity and improvement of overall recovery in orthopedic surgical populations.

Conclusion

1.8.1 Surgical Aspect Discussion

Healthcare professionals know GDFT to be the most successful and balanced strategy, according to comparison of analytical data and professional perceptions, Strong knowledge of its pros in maintaining hemodynamical stability and preventing fluid overload was reported by majority of responder, especially anesthesiologists and operation room techs. This shows the gradual change from volume based to physiology-based fluid administration in the perioperative treatment. The results point out how inadequate or excessive fluid management causes postoperative problems such

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as edema of tissues, hypotension or renal impairment. Therefore, the basis of modern orthopedics anesthesia is personalisation of intraoperative fluid regimens to each patient's physiological reaction.

1.8.2 Surgical Aspect Discussion

Healthcare professionals know GDFT to be the most successful and balanced strategy, according to comparison of analytical data and professional perceptions, Strong knowledge of its pros in maintaining hemodynamical stability and preventing fluid overload was reported by majority of responder, especially anesthesiologists and operation room techs. This shows the gradual change from volume based to physiology-based fluid administration in the perioperative treatment. The results point out how inadequate or excessive fluid management causes postoperative problems such as edema of tissues, hypotension or renal impairment. Therefore, the basis of modern orthopedics anesthesia is personalisation of intraoperative fluid regimens to each patient's physiological reaction.

1.8.3 Surgical Aspect Discussion

Overall, the results of the study indicate that tailored and goal-directed intraoperative fluid management enhances the general patient satisfaction, reduces hospital stays, and greatly improves postoperative outcomes. Clinically speaking, GDFT acceleration of rehabilitation, reduction of the risk of wound complications, and allows early mobilization. The research states that “The standardized hydration protocols should be included in routine orthopedic surgical practice.” To ensure the validation of these findings and contribute to the elaboration of evidence-based national guidelines for More multi-center studies are recommended for intraoperative fluid treatment in Orthopedic settings.

1.9 Recommendation

Make goal-directed fluid treatment (GDFT) the standard for orthopedics procedures involving the lower limbs. Minimally invasive cardiac output technology to do routine intraoperative

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hemodynamic monitoring. Based on patient physiology, develop institutional guidelines regarding fluid type, rate, and adjustment factors. Offer continued education and advanced fluid management workshops to anesthesia and surgical teams. To ensure consistent decisions during the operating room performance, foster interdisciplinary cooperation between anesthesiologists, surgeons and perioperative nurses. Perform postoperative audits to determine areas for improving and to evaluate the effect of fluid therapy on recovery results. Support revision of current anesthesia guidelines in orthopedic surgeries based on research.

1.10 Study Limitations

- The sample size (n = 96) of the study may not necessarily represent a variety of clinical groups.
- Only one institutional setting was used, which limited the study's applicability to larger healthcare settings.
- Healthcare professionals' perception-based data may have been impacted by subjective bias.
- The lack of sophisticated hemodynamic monitoring methods, such as cardiac output monitoring, hampered the accuracy of quantifying the effects of real-time fluid optimization.
- The short postoperative observation period may have overlooked long-term fluid-related problems.
- Specific subgroup analysis for age differences or comorbidities, which may have an impact on fluid responsiveness, was not included in the study.

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