Perioperative Management, Complications, and Outcomes of Shoulder Arthroplasty in Patients with Diabetes Mellitus

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Abstract

» Patients with diabetes mellitus (DM) undergoing shoulder arthroplasty (SA) have a unique risk profile, which must be considered by clinicians.

» The presence of DM as a comorbidity is associated with longer length of stay following SA, greater likelihood of nonhome discharge, and a higher rate of 90-day readmission.

» Though the incidence is low, patients with DM are at an increased risk of serious postoperative cardiovascular complications, such as pulmonary embolism, venous thromboembolism, and myocardial infarction.

» DM has generally been associated with increased risk of postoperative infection. The optimal hemoglobin A1c threshold in patients undergoing SA remains inconclusive. When extrapolating from lower limb arthroplasty, the literature indicates that this threshold is most likely in the range of 7.5% to 8%.

» Patients with DM are more likely to require revision surgery after SA and report lower postoperative satisfaction.

Shoulder arthroplasty (SA) has become an increasingly common intervention for various shoulder pathologies, ranging from osteoarthritis to inflammatory conditions and osteonecrosis[1,2]. However, the presence of comorbidities, particularly diabetes mellitus (DM), can significantly affect postoperative outcomes. With an estimated 400 million adults affected by 2030, this condition represents a growing health concern. Diabetic patients face increased risks following orthopedic surgery, including prolonged hospital stays, higher rates of nonroutine discharges, and a heightened susceptibility to infections[3,4].

As a result of the rising prevalence of both SA and DM, an increasing number of patients with DM are undergoing this procedure. According to a recent analysis of the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database, the incidence of diabetic patients undergoing total shoulder

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arthroplasty (TSA) rose from 12.1% between 2005 and 2010 to 17.8% between 2015 and 2018[1].

Further research using the ACS-NSQIP database demonstrates a higher incidence of diabetes among patients undergoing inpatient TSA compared with outpatient (90.3% vs. 9.7%; n = 22,452)[5]. Diabetes has also been cited as an independent predictor of higher inpatient costs following inpatient reverse shoulder arthroplasty (RSA) and hemiarthroplasty for cuff tear arthropathy ($p = 0.046$ and $p = 0.023$, respectively). These findings illustrate the influence of diabetes on resource allocation and cost burden, emphasizing the importance of clinical decision making and quality improvement efforts in affected patients undergoing SA.

This review explores the existing literature on outcomes and surgical considerations in patients with diabetes undergoing SA, with a particular focus on patient-reported outcomes and satisfaction, perioperative management, length of hospital stay and discharge patterns, postoperative outcomes, and revisions.

Study Inclusion

Retrospective and prospective cohort studies, systematic reviews, and meta-analyses with level of evidence IV and above which investigated SA in a sample of patients with DM were included. Methodology varied as to how authors defined the diagnosis of DM. For studies using the National Inpatient Sample (NIS) database, the diagnosis was based on specific International Classification of Diseases, Ninth Revision and International Classification of Diseases, Tenth Revision codes corresponding to DM. Alternatively, the ACS-NSQIP database defines patients with diabetes as those who have required treatment with insulin or oral antidiabetic medication for longer than 2 weeks. As for institutional cohort studies, the diagnosis was based on whether DM was listed as a comorbid condition within patient medical records. Therefore, while hemoglobin A1c (HbA1c) and blood glucose measurements were not used as metrics for diagnosis, they were incorporated into some studies as variables allowing for differentiation between well and poorly controlled DM.

Functional Outcomes and Patient-Reported Outcome Measures

Evaluating functional outcomes and patient-reported outcome measures following SA is crucial for monitoring procedure success. Levy et al.[6] reviewed data from 230 patients with end-stage arthritis and intact rotator cuffs who underwent TSA and had at least 1 year of follow-up. The purpose was to identify factors influencing postoperative range of motion, and they found that DM was negatively correlated with postoperative internal rotation ($R = -0.196$, $p = 0.003$).

On the other hand, a separate single surgeon's registry study from 2013 to 2016 was unable to come to a similar conclusion[7]. The study excluded patients with intraoperative and postoperative complications and only focused on those with at least 2 years of follow-up. Poor outcomes were defined as being in the bottom 30th percentile of the American Shoulder and Elbow Surgeons (ASES) score. Multivariable logistic regression identified prior shoulder surgery as a significant factor associated with poor improvement (adjusted odds ratio [OR], 2.46) and outcomes (adjusted OR, 4.92). However, DM was not linked to poor outcomes after reverse TSA. Therefore, more studies are needed to evaluate the influence of DM on functional outcomes.

Some studies have analyzed postoperative patient satisfaction after SA. Using data from a prospective multicenter registry, patients who underwent reverse TSA and reported no change or worsening of their condition after a minimum 2-year follow-up were more likely to have DM[8]. In another prospective study of patients who underwent primary TSA, researchers assessed outcome by comparing patients' preoperative ASES scores to future ASES scores within 2-years postoperative[9]. DM was a significant risk factor of procedure failure, which was defined as not reaching the minimal clinically significant difference of 16.1 or requiring revision surgery within 2 years of the index procedure. In a separate retrospective study of 244 patients who underwent reverse TSA and anatomical TSA, it was found that 18.9% of patients reported persistent pain after 2 years postoperatively having a Visual Analog Pain score of >2 ($p = 0.004$)[10]. Using a multivariable logistic regression, DM had a significantly higher incidence among those who reported persistent pain. Therefore, the presence of DM has been incorporated into a machine learning model to predict patient satisfaction at a minimum of 2 years of follow-up after a reverse or anatomical TSA[11].

Hospital Stay and Discharge

Length of Stay

Length of stay (LOS) is an essential metric in assessing the efficiency and effectiveness of surgical interventions, reflecting not only the immediate postoperative recovery but also broader implications for resource utilization and patient outcomes. Several studies have highlighted the impact of DM on LOS following SA. For instance, Basques et al.[12] used ACS-NSQIP to examine patients aged 60 years or older who underwent TSA between 2011 and 2012, identifying DM as a significant risk of extended LOS, defined as more than 3 days (n = 1,505, OR, 2.37; 95% confidence interval [CI], 1.53-3.66; $p < 0.001$). This finding was corroborated by a 2019 retrospective cohort study, which found DM to be a significant risk factor of a LOS of 3 days or more (n = 415, OR, 2.57; 95% CI 1.15-5.71; $p = 0.021$)[13]. Further supporting these results, another ACS-NSQIP study (n = 14,339) lowered the threshold for prolonged stay to 24 hours. The presence of DM proved to be an independent risk factor of prolonged LOS following TSA in this study (OR, 1.7; 95% CI, 1.4-2.0; $p < 0.0001$)[14]. Last, in another retrospective study at a tertiary-care referral center, diabetic patients undergoing TSA had a significantly increased mean LOS of 2.3 nights compared with 1.7 nights in patients without DM (n = 353, OR, 1.4; p = 0.0145)[15]. The proposed explanation is that diabetes may act as a proxy for metabolic syndrome–mediated compromised health status and is associated with higher rates of postoperative complications, such as acute renal failure, which require extended management before discharge[4,15].

Of note, these studies did not distinguish between type 1 or type 2 DM. An additional ACS-NSQIP database study analyzed 17,011 patients who underwent SA from 2007 to 2016[16]. The authors found that compared with the rate of non–same-day discharge, both non–insulin-dependent DM (12.7% vs. 11.3%; p < 0.001) and insulin-dependent DM (6.7% vs. 3.6%; p < 0.001) were associated with a significantly lower rate of same-day discharge. Although not specific to the type of DM, Burns et al.[17] found uncontrolled DM (n = 66), defined as a random glucose of greater than 180 mg/dL or HbA1c >8%, to have a greater mean LOS following SA compared with those with controlled DM (n = 1,042, 2.8 ± 2.8 days vs. 2.3 ± 1.7 days; p = 0.019). Understanding disease type and severity in diabetic patients undergoing SA can provide valuable information regarding patient counseling and risk evaluation.

The influence of diabetes on LOS has been incorporated into prediction models, though findings appear to differ in inpatient vs. outpatient settings. A validated risk assessment tool showed DM was a significant risk factor of extended inpatient LOS following anatomic and reverse TSA (n = 5,410; p = 0.0225)[18]. By contrast, a retrospective cohort study found that diabetes was not associated with an increased risk of unplanned overnight stay after outpatient anatomic or reverse TSA (n = 127, OR, 1.92; 95% CI, 0.32-15.00; p = 0.427)[19]. However, this distinction may be attributed to the inpatient population having more comorbidities than those scheduled to undergo outpatient surgery.

Several risk assessment models used to stratify patients to inpatient vs. outpatient SA found that the presence of DM was negatively associated with same-day discharge[20,21], emphasizing that careful consideration should be given to these individuals. Furthermore, diabetic patients may not be appropriate candidates for outpatient surgery, though this must be weighed in the context of other associated comorbidities.

Nonhome Discharge

Nonhome discharge after SA refers to transferring patients to rehabilitation centers or skilled nursing facilities after surgery. This decision can affect recovery times, health care costs, and patient satisfaction. A multinomial logistic regression analysis of a NIS review, which included anatomic and reverse TSA procedures, compared postacute facility discharges (n = 14,908) with routine home discharges (n = 65,958). The study found that patients with DM were 1.5 times more likely to be discharged to a postacute care facility (OR, 1.51; 95% CI, 1.30-1.80; p < 0.001)[22]. Notably, this increase was seen in primary arthroplasty cases, as revision surgery was a predictor of decreased risk of discharge to a facility. Similarly, Lopez et al.[23] developed a machine learning model using multivariant binary logistic regression to predict nonhome discharge after elective TSA, identifying significant variables from the ACS-NSQIP. Their findings also indicated that a history of diabetes increased the risk of nonhome discharge by 1.5 times (OR, 1.56; 95% CI, 1.38-1.75; p < 0.001). The greater need for nonhome discharge may be attributed a variety of factors including a more extensive comorbidity profile, higher postoperative complication rate, and slower return to functional mobility[24].

Readmission

DM is also a predictor of 90-day readmission following TSA and reverse TSA. Scott et al.[25] used data from the National Readmission Database of 25,196 patients who underwent reverse TSA in 2014, finding that DM independently predicted 90-day readmission (OR 1.42; 95% CI, 1.14-1.78; p = 0.002). The primary causes of readmission were dislocation (32% of cases) and infection (10%). In addition, a study using Kaiser Permanente Shoulder Arthroplasty Registry (KP SAR) on 8,819 patients reported that patients with severe DM (HbA1c >7%) who underwent both elective and traumatic SA had a higher likelihood of 90-day readmission compared with those without DM (OR, 1.6; 95% CI, 1.2-2.2; p = 0.001 and OR, 1.8; 95% CI, 1.2-2.7; p = 0.005, respectively)[26]. These findings emphasize the significant role DM plays in increasing the likelihood of 90-day readmission following TSA and reverse TSA, highlighting the need for targeted management strategies to address this risk.

Perioperative Factors

Opioids

Although opioids have become standard for postoperative analgesia, their use has raised concerns due to their significant impact on medical and socioeconomic welfare[27,28]. Spencer et al.[29] analyzed opioid use among opioid-naive patients undergoing TSA (n = 17,706) and found that diabetes was a significant risk factor of prolonged opioid use beyond 6 months (OR, 1.35; p < 0.001). However, a retrospective study by Rao et al. assessing preoperative risk factors and the number of opioid prescriptions for 360 days postoperatively in patients undergoing elective SA (n = 4,243) found no association between diabetes and 1-year postoperative opioid use (p = 0.443)[28]. Similarly, another retrospective study using the PearlDiver (PD) database found no significant difference in prolonged opioid use (> 1 month postoperatively) between patients with diabetes (n = 4,961) and without diabetes (n = 9,926) who underwent revision TSA (CI, 0.90-1.06)[30]. Last, Best et al.[27] did not find that diabetes was a significant predictor of prolonged opioid use following TSA, defined as opioid prescriptions of a 120-day or longer supply during the 3 to 12 months postsurgery. While some evidence suggests diabetes as a risk factor, the nuanced relationship between DM and opioid use highlights the need for a more tailored approach to pain management.

Blood Transfusions

Blood transfusion can cause adverse outcomes, including allergic reactions, delayed immune medication reactions, iron overload, and cardiopulmonary effects[2,31]. While the routine intraoperative use of tranexamic acid has decreased the likelihood of blood transfusions following TSA, blood transfusions may still be required. Identifying patients at high risk of transfusion is essential for optimizing perioperative management and enhancing patient counseling. In a retrospective cohort study, DM was associated with significantly greater odds of postoperative transfusion after revision TSA (OR, 2.3; 95% CI, 1.2-4.4; $p = 0.01$)[31]. Larger retrospective studies using the ACS-NSQIP to compare patients who received blood transfusions (n = 305) following reverse or anatomic TSA with those who did not (n = 18,124) identified insulin-dependent DM as a significant risk factor (OR, 2.045; 95% CI, 1.33-3.14; $p = 0.001$)[2]. Furthermore, in diabetic patients who underwent TSA between 2015 and 2020, other independent risk factors of postoperative transfusion included female sex (OR, 2.43; 95% CI, 1.52-3.89; $p < 0.001$), American Society of Anesthesiologist score ≥3 (OR, 2.46; 95% CI, 1.10-5.48; $p = 0.028$), bleeding disorder (OR, 2.94; 95% CI, 1.50-5.76; $p = 0.002$), transfusion before surgery (OR, 12.19; 95% CI, 4.25-35.00; $p < 0.001$), preoperative anemia (OR, 8.76; 95% CI, 5.47-14.03; $p < 0.001$), and an operative duration ≥129 minutes (OR, 4.05; 95% CI, 2.58-6.36; $p < 0.001$)[32]. These studies highlight diabetes as a significant risk factor of postoperative blood transfusion after SA. Recognizing this risk and other contributing variables is crucial for improving perioperative management and patient outcomes.

Postoperative Outcomes and Complications

Tools such as the modified fragility index (mFI) can assess complication risk. The mFI has proved to be a strong predictor of serious medical complications, such as cardiac arrest, myocardial infarction (MI), septic shock, pulmonary embolism (PE), postoperative dialysis, reintubation, and prolonged ventilator requirement, as well as discharge to a facility and readmission (OR ≥ 1.309; $p < 0.001$)[33].

The mFI score includes the presence of comorbidities such as DM, which significantly contributes to the risk of postoperative complications. Although mFI is an important clinical tool for identifying high-risk patients, informing preoperative counseling, and directing perioperative care, it does not distinguish between the severity or type of diabetes. Fu et al.[34] conducted another NSQIP database study of 5,918 TSA cases, categorizing them into insulin-dependent DM (n = 295), non-insulin-dependent DM (n = 691), and no DM (n = 4,932) to compare 30-day postoperative complication rates. Patients with insulin-dependent DM had significantly increased odds of experiencing 1 or more postoperative complications, including cardiac arrest, MI, pulmonary complications, and renal insufficiency, among others, relative to non–insulin-dependent and nondiabetic patients (OR, 1.53; 95% CI 1.04-2.26; $p < 0.033$)[34].

More specifically, multiple studies have identified DM to be associated with PE or deep vein thrombosis (DVT) after SA[35-37]. Using NIS, 422,372 patients who underwent SA over a 10-year period had a 0.25% rate of in-hospital perioperative PE (n = 10,559)[35]. The multivariable logistical regression model determined that the PE cohort presented with a significantly higher incidence of uncomplicated DM than those who did not experience a PE (22.2% vs. 17.4%; $p < 0.001$). In another retrospective study of 533 postoperative patients with SA, DM was identified as a significant risk factor ($p < 0.05$) of postoperative venous thromboembolism (VTE), including PE (n = 12) and DVT (n = 5)[36]. In addition, a systematic review of 9 studies came to a similar conclusion, finding DM to be a significant risk factor of VTE[37]. Another significant cardiovascular complication associated with morbidity and mortality is MI. An analysis of patients from the NIS who underwent TSA or hemiarthroplasty between 1988 and 2011 revealed a cumulative perioperative MI incidence of 0.28% (n = 1,174). Though the overall incidence was low, complicated diabetes was 1 of the top 4 predictors for acute MI (OR, 1.96; 95% CI, 1.49-2.57; $p < 0.001$)[38].

Complication incidence appears to be further elevated following revision surgery, particularly in diabetic patients. In comparison with primary TSA, DM has been associated with a greater risk of all adverse postoperative outcomes after revision TSA (OR, 1.4) including death, pulmonary complications, DVT, PE, stroke or cerebrovascular accident, sepsis, return to the operating room, wound infections, urinary tract infection, blood transfusion, and readmission within 30 days of procedure[39].

Several studies have also examined risk factors of dislocation and fracture following RSA. A study of 30,670 patients from the Medicare Standard Analytical Files identified DM to be a risk factor for postoperative dislocation within 2 years of primary RSA ($p < 0.0001$)[40]. In addition, a separate database study found that DM increased the risk of aseptic glenoid loosening postoperatively (OR, 184)[41]. Interestingly, a multicenter sample of 9,079 patients undergoing RSA found that those who suffered acromion or scapula fractures following the procedure (n = 138; 1.52%) were less likely to have DM[42]. However, it is important to note that these 3 studies did not account for preoperative diagnoses, which may exaggerate the influence of diabetes on postoperative complications.

A recent study of 6,621 patients across 15 institutions by the ASES complications of RSA multicenter research group aimed to identify the strongest patient-related factors associated with dislocation, while stratifying by preoperative diagnoses[43]. Notably, DM was not identified as a predictor for dislocation any model. In addition, RSAs for primary glenohumeral osteoarthritis (GHOA) with intact rotator cuffs had significantly lower rates of dislocation than those performed for cuff tear arthropathy (CTA) (0.8% vs. 2.5%; $p < 0.001$). While it may be postulated that diabetics more commonly undergo RSA for CTA rather than primary GHOA, this has not been substantiated. Nonetheless, this underscores the importance of considering a patient's preoperative diagnosis when evaluating their complication risk. Similarly, the multicenter research group did not find DM to be a predictor for acromial or scapular spine stress fractures ($n = 4,764$), once again demonstrating that preoperative diagnosis of GHOA vs. CTA is the more reliable metric for risk prediction[44].

Infection

Infection is a critical postoperative complication following SA, significantly affecting patient outcomes, recovery time, and overall health care costs. Despite low infection rates overall (1%-4%) after SA, infections can lead to substantial morbidity, with 50% to 78% of infected cases requiring revision surgery[45]. Patients with DM are particularly vulnerable to infections due to compromised immune function, poor glycemic control, and impaired wound healing. In general, while *Cutibacterium acnes* remains the most common infecting pathogen after SA in both diabetic and nondiabetic patients[46], it is important to recognize that skin and soft tissue infections in patients with DM may be attributed to more aggressive pathogens, such as *Staphylococcus aureus*, which are associated with a fivefold greater risk of complications[47,48]. This has implications for treatment, as infections with more virulent organisms often necessitate 2-stage revision arthroplasty (as opposed to single stage) and carry higher rates of recurrent infection[49].

The risk of infection in diabetic patients undergoing SA is still not clearly defined. A meta-analysis of 6 studies demonstrated that DM was a risk factor of periprosthetic joint infection (PJI) following SA, with an OR of 1.32[50]. An additional retrospective cohort study using the Mariner Database examined 46,223 male patients who underwent TSA from 2010 to 2020 with a minimum 2-year follow-up and found DM to be an independent predictor of infection (OR, 1.26; 95% CI, 1.10-1.44; $p < 0.001$)[51]. Using data from a single orthopaedic specialty center, Rao et al.[52] found that a preoperative diagnosis of DM had significant associations with postoperative infection following TSA and reverse TSA ($p = 0.01$). This retrospective study analyzed 1,104 patients who underwent TSA or reverse TSA with a minimum follow-up of 90 days, including surgical site infections and PJI. In addition, an elevated initial in-hospital blood glucose level in a patient with DM was associated with greater risk of infection ($p = 0.01$), but this trend did not persist with second or third blood glucose measurements ($p = 0.16$, $p = 0.39$)[52].

However, other studies have failed to find an association between DM and postoperative SA infection. A retrospective study using Medicare Part A and B Standard Analytical Files compared patients who acquired PJI within 2 years of reverse TSA ($n = 879$) with those who did not ($n = 50,945$). DM did not present a significantly greater risk of PJI when groups were adjusted for comorbidities ($p = 0.862$)[53]. Richards et al.[54] showed DM was not associated with postoperative primary SA deep infection risk ($p = 0.679$), defined as revision surgery for infection, supported clinically by purulent drainage from the incision, fever, localized pain or tenderness, a positive deep culture, or a diagnosis of deep infection by the operating surgeon based on intraoperative findings. In 2 single-surgeon retrospective studies ($n = 137$ and $n = 501$, respectively), DM was also not associated with deep infection after reverse TSA ($p = 0.22$ and $p = 0.87$) with a minimum 1-year follow-up[55,56]. A third single surgeon study had similar findings, though at just 3 months of follow-up ($p = 0.95$)[57]. However, it is important to note these studies[55-57] are limited by smaller sample sizes and shorter follow-up periods compared with those reporting a significantly higher incidence of infection in diabetic patients undergoing RSA, which may suggest a temporal influence of diabetes on infection risk. Furthermore, patients with poorly controlled diabetes are unlikely to undergo this elective procedure in the first place, and therefore, infection rates may not significantly differ between nondiabetics and well-controlled diabetics.

Several studies have investigated the utility of the HbA1c level in predicting infection risk following SA, as elevated HbA1c has been associated with postoperative infections and wound complications in hip and knee arthroplasty[58]. One study using the PD Database observed that in diabetic patients undergoing anatomic TSA, reverse TSA, and shoulder hemiarthroplasty, the risk of wound complications and deep infections rose with higher HbA1c levels[59]. While the overall risk of wound complications was relatively low at 1.4%, the authors suggest that a perioperative HbA1c level of >8% should raise concern for increased risk of infection.

Alternatively, a retrospective comparison of TSA outcomes between 1995 and 2013 in diabetic patients with an HbA1c greater than 7% ($n = 104$) vs. less than 7% ($n = 302$) revealed no significant difference in complication rates (16.4% vs. 16.6%; $p = 0.9603$)[58]. These mixed findings demonstrate that even though elevated HbA1c levels may be associated with an increased risk of wound complications, there is no definitive HbA1c cutoff value to predict this. Nevertheless, elevated HbA1c still warrants a more careful approach to perioperative management.

Revision

Revision rates are critical indicators of SA's long-term success. Understanding the impact of DM is essential for optimizing patient outcomes and guiding preoperative counseling, as multiple studies have identified DM as a significant risk factor of revision[60-64].

Ramamurti et al.[60] used the PD database and found that type 1 DM was associated with greater risk of revision for reverse TSA, with an OR of 1.44. Another study using a national private insurance database (n = 509) demonstrated that type II DM was a significant risk factor of revision TSA, specifically in patients aged 50 years or younger ($p = 0.043$)[61]. Similarly, Lu et al.[62] compared demographics, comorbidities, and 30-day complication and revision rates for patients after primary TSA in both the NSQIP (n = 10,080) and PD (n = 17,016) databases. They performed separate analyses for each database, finding that DM increased the risk of 30-day revision following TSA in patients aged 65 years and older (OR, 1.46; 95% CI 1.19-1.19; $p < 0.001$). However, their regression analysis of the NSQIP database did not detect DM as a significant risk factor of revision surgery among patients of the same age group (OR, 1.34; 95% CI 0.86-2.11; $p = 0.20$). The authors attribute this discrepancy to differences in data collection practices. While NSQIP is a prospective surgical outcomes registry, PD is a claims-based private database, and the coding definitions regarding comorbidities may vary between the 2. Furthermore, the PD sample of diabetic patients (n = 6,050) was more than 3 times that of NSQIP (n = 1,855), which may have affected the analysis.

In addition, using the PD database (n = 824), Leong et al.[63] reviewed patients who underwent revision SA for various indications, including postoperative infection, instability, and stiffness. They found that while diabetes was a significant risk factor of revision surgery (OR, 1.9; $p = 0.05$), it was not associated with a greater likelihood of a second revision. However, a cohort study from the KP SAR evaluated patients who underwent revision SA (n = 510) for aseptic loosening and found that diabetes was a significant risk factor of needing multiple revisions[64]. The results of these 2 studies indicate that DM may predispose patients to subsequent revision surgeries in the case of aseptic failure, but not in the setting of infection. This finding may help surgeons better understand the prognosis of their diabetic patients and the likelihood of requiring multiple operations.

Conclusion

- Evidence from the literature suggests that an ideal HbA1c range for patients undergoing SA is below 7.5%, though specific thresholds vary across studies.
- Patients with poor glycemic control (e.g., HbA1c >8%) should be counseled to optimize their glucose levels before surgery. Postoperative complications, including infection, readmission, and revision, are more common in these patients, emphasizing the need for vigilant monitoring. In addition, these patients may have poorer functional outcomes and higher rates of persistent pain, highlighting the importance of personalized rehabilitation and pain management.
- The current literature lacks robust data distinguishing type 1 from type 2 DM. As such, overall glycemic control should be the primary metric used by clinicians.
- The unique set of risks and challenges associated with DM in patients undergoing SA necessitates a comprehensive approach to perioperative planning, surgical technique, and postoperative care.

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