RESEARCH PAPER

Role of Dexmedetomidine–Ketamine ("Ketodex") in Day-Care Surgery: A Contemporary Evidence-Based Narrative Review

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Both authors contributed to clinical management, critically revised the manuscript, and approved the final version.

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ABSTRACT

Introduction: Day-care (ambulatory) surgery has become an integral component of modern surgical practice, emphasizing rapid recovery, minimal complications, and early discharge. Finding the right balance between sedation, pain relief, haemodynamic stability, and recovery is still a major challenge in anaesthetic management. The combination of dexmedetomidine and ketamine (Ketodex) has emerged as a viable multimodal therapy because to its complementing pharmacological properties.

Aim: To critically assess the pharmacological foundation, clinical effectiveness, safety profile, and usability of the dexmedetomidine–ketamine combination in day-care surgical settings.

Materials and Methods: This narrative review utilized a systematic literature search across PubMed/MEDLINE, Scopus, Web of Science, and the Cochrane Library for studies published between 2020 to 2025. Included were pertinent randomized controlled trials, systematic reviews, meta-analyses, and observational studies assessing Ketodex in procedural sedation and ambulatory surgery. A qualitative synthesis methodology was employed to examine outcomes pertaining to analgesia, hemodynamic stability, recovery trajectory, and side effects.

Results: Ketodex demonstrates a favorable therapeutic profile, marked by efficient sedation, enhanced analgesia, less opioid necessity, and the maintenance of respiratory function. The combination enhances hemodynamic stability via synergistic autonomic actions and is linked to a more seamless recovery and a reduced occurrence of postoperative nausea and vomiting. Nonetheless, significantly extended recovery duration and dose-dependent hemodynamic effects, including bradycardia, persist as significant factors.

Conclusion: The dexmedetomidine–ketamine combination is a balanced and effective way to put someone to sleep for day-care surgery. It has many benefits in terms of safety, pain relief, and patient comfort. Ketodex is not always better than other standard treatments, however it is a useful option in some cases. Additional extensive, systematic research are necessary to determine its conclusive significance in ambulatory anesthesia.

Keywords: Dexmedetomidine; Ketamine; Ketodex; Day-care surgery; Ambulatory anaesthesia; Procedural sedation; Multimodal analgesia.

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Introduction

Over the past few decades, the world of surgery has changed a lot. Day-care (ambulatory) surgery has become a key part of modern perioperative treatment. This change has mostly been caused by better minimally invasive surgery procedures, better

monitoring during and after surgery, and a greater focus on cost-effectiveness and patient-centered care. In this changing context, the main goal of anesthesia is no longer just to make patients unconscious during surgery. It also includes quick recovery, early ambulation, few side effects, and fast discharge without putting safety or patient satisfaction at risk [1]. There are certain special problems with managing anesthesia in day-care settings. The best drug or method must provide enough sedation and pain relief while keeping the heart and lungs stable and allowing for a quick recovery of cognitive and psychomotor function. Standard care has long been thought to be conventional regimens, especially those that use propofol and opioids together. However, their usage is often linked to dose-dependent respiratory depression, low blood pressure, postoperative nausea and vomiting (PONV), and a longer recovery time—factors that can make it harder to get ready for release and lead to more unexpected hospital hospitalizations [2].

Due to these constraints, there has been a shift toward multimodal and balanced anesthetic techniques, which use mixtures of medications to improve effectiveness while reducing the negative effects of each drug. In this context, the combination of dexmedetomidine with ketamine, commonly referred to as "Ketodex," has attracted growing clinical attention. This combination is especially interesting because its pharmacodynamic profile works well with the others. Dexmedetomidine is a very selective α2-adrenergic agonist that puts you to sleep, eases anxiety, and relieves pain with little effect on your breathing. However, it is often linked to bradycardia and hypotension. On the other hand, ketamine is an N-methyl-D-aspartate (NMDA) receptor antagonist that causes dissociative anesthesia and strong pain relief while also boosting the cardiovascular system. However, it can also cause emerging delirium and psychomimetic effects [3,4]. The justification for amalgamating these two medications is in their capacity to mitigate each other's deficiencies while augmenting favorable therapeutic outcomes. Dexmedetomidine reduces the sympathetic stimulation and emergence effects caused by ketamine, while ketamine reduces the bradycardia and hypotension caused by dexmedetomidine. This two-way synergy leads to a more stable haemodynamic profile, better pain relief, and the ability to keep breathing, which are all very useful in an ambulatory situation [5].

In the last few years, more and more research has come out about how Ketodex can be used for procedural sedation, small surgeries, and daycare treatments for kids. Numerous randomized controlled studies and systematic reviews have indicated positive results concerning hemodynamic stability, less opioid usage, enhanced patient satisfaction, and more favorable recovery trajectories [6,7]. However, even if these results are promising, the fact that there are different dosing regimens, patient demographics, and outcome measurements has made the research inconsistent, making it hard to come to a clear judgment about how widely applicable it is. Moreover, although Ketodex is sometimes characterized as a "respiratory-sparing" and "opioid-free" option, recent research indicates that its advantages may be contingent upon specific contexts, shaped by variables such as procedural intricacy, patient comorbidities, and sedative depth [1,6]. These small differences show how important it is to carefully and fully look at the evidence that is out there. With this in mind, the goal of this narrative review is to bring together the most recent research on the use of the dexmedetomidine-ketamine combination in day-care procedures, focusing on its pharmacological basis, clinical effectiveness, safety profile, and practical use. This study tries to give a balanced opinion on whether Ketodex is a real step forward in ambulatory anesthesia or just a different option that needs careful patient selection and tailored administration. It does this by combining molecular insights with clinical evidence.

Methodology of Narrative Review

This narrative review utilized a structured and methodologically transparent framework to guarantee a thorough and equitable synthesis of contemporary evidence regarding the role of dexmedetomidine–ketamine (Ketodex) in day-care procedures. While not a formal systematic review, the concepts of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework were utilized to improve the review process's rigor, repeatability, and clarity.

We did a systematic search of the literature in key electronic databases such PubMed/MEDLINE, Scopus, Web of Science, and the Cochrane Library to find papers that were published between January 2020 and August 2025. The search approach utilized a blend of Medical Subject Headings (MeSH) and free-text keywords, including "dexmedetomidine," "ketamine," "ketodex," "procedural sedation," "ambulatory anesthesia," "day-care surgery," and "multimodal analgesia" [8].

To narrow down the search, Boolean operators ("AND," "OR") were utilized, and filters were used to only include research that were done on people and

published in English. Further pertinent publications were discovered by manually reviewing the reference lists of chosen research to guarantee comprehensive evidence collection [9].

The inclusion criteria consisted of randomized controlled trials (RCTs), systematic reviews, meta-analyses, and high-quality observational studies assessing the efficacy, safety, pharmacological interactions, or clinical applications of the dexmedetomidine–ketamine combination in procedural sedation or ambulatory surgical contexts. Studies concentrating solely on intensive care unit sedation or other anesthetic approaches were omitted unless they offered mechanistic insights directly pertinent to Ketodex utilization [10].

Data extraction concentrated on essential outcome domains, encompassing hemodynamic parameters (heart rate, blood pressure variability), analgesic efficacy (pain scores, opioid consumption), recovery characteristics (time to awakening, discharge readiness), adverse effects (respiratory depression, bradycardia, emergence phenomena), and patient or surgeon satisfaction scores [11].

Due to the variability in study populations, procedure kinds, dosage regimens, and outcome measures, a quantitative meta-analysis proved impracticable. Instead, a qualitative synthesis approach was used, which made it possible to critically compare and understand the results of different investigations in context. There was a lot of focus on finding patterns of consistency, areas of divergence, and therapeutically significant conflicts in the literature [12]. Moreover, recent high-quality research, such as meta-analyses and contemporary randomized trials, was emphasized to guarantee that the review accurately represents current clinical practices and emerging trends in ambulatory anaesthesia. This method helps people understand Ketodex in a more nuanced way, going beyond just reporting to critical appraisal and evidence-based interpretation [8][12].

Pharmacological Basis and Mechanistic Rationale of Ketodex

The therapeutic efficacy of the dexmedetomidine–ketamine combination (Ketodex) in day-care anesthesia is primarily based on its synergistic pharmacodynamic and pharmacokinetic characteristics. Ketodex is a balanced receptor-targeted method that uses different but complementary processes to produce the best sedation, pain relief, and physiological stability. This is different from single-agent treatments.

Central Sedative Mechanisms

Dexmedetomidine is a very selective α2-adrenergic receptor agonist. It has a specificity ratio of about 1600:1 for α2 over α1 receptors. Its sedative effects are mostly caused by activating α2 receptors in the locus coeruleus, which is a crucial noradrenergic nucleus in the brainstem that controls alertness. This stops the release of norepinephrine, which makes the body feel like it's in a condition similar to natural non-rapid eye movement (non-REM) sleep. Patients are notably easily arousable and compliant, which is especially helpful in procedural and ambulatory settings [13]. Ketamine, on the other hand, causes a dissociative state by blocking N-methyl-D-aspartate (NMDA) receptors in the central nervous system in a way that doesn't compete with them. Ketamine causes deep pain relief, memory loss, and a functional separation between sensory input and conscious experience by interfering with thalamocortical and limbic pathways. This unique system permits airway reflexes and spontaneous breathing to be intact even at sedative doses [14]. When these drugs are used together, they provide a unique neurophysiological state that includes drowsiness without severe sleep, efficient pain relief without the need of opioids, and protection of airway reflexes. This combined impact is especially useful for day-care treatments where quick recovery and little change in the body's functions are important.

Analgesic Synergy and Modulation of Central Sensitization

Ketodex has a complicated pain-relieving profile that goes beyond just adding effects. Dexmedetomidine induces analgesia by activating α2 receptors in the dorsal horn of the spinal cord, thereby decreasing the production of substance P and diminishing nociceptive transmission. At the same time, ketamine blocks NMDA receptors, which are very important for central sensitization and the "wind-up" effect that happens when pain lasts for a long time [15]. This dual approach leads to better pain relief during surgery, lower pain scores after surgery, and stopping central sensitization. This synergy is important because it has a big influence on minimizing the need for opioids, which lowers the risk of side effects like respiratory depression, nausea, and delayed recovery—things that are very important in ambulatory surgery [16].

Haemodynamic Interplay and Autonomic Balance

One of the most clinically important things about Ketodex is that it can reach hemodynamic balance by balancing out the effects of the autonomic nervous system. Dexmedetomidine lowers sympathetic outflow and boosts vagal activity, which lowers blood pressure

and heart rate. Although advantageous in mitigating stress responses, this impact may predispose individuals to bradycardia and hypotension, especially in those who are sensitive [17]. Ketamine, on the other hand, activates the sympathetic nervous system by encouraging the release of catecholamines and stopping their absorption. This makes the heart beat faster, pump more blood, and raise blood pressure. This characteristic renders ketamine especially advantageous for preserving circulatory stability during procedural sedation [18]. When given combined, these two effects establish a dynamic balance that stops hypotension from getting too low, lowers tachycardia and hypertension, and makes haemodynamic fluctuation less. But this balance depends on the dose and may not be the same for all groups of patients.

Respiratory Effects and Airway Preservation

One of the best things about Ketodex compared to other types of anesthesia is that it doesn't affect breathing very much. Dexmedetomidine does not severely inhibit the respiratory center, in contrast to GABAergic drugs like propofol. Ketamine also helps by keeping airway reflexes working and encouraging bronchodilation through sympathetic stimulation [19]. This combination keeps spontaneous ventilation going, makes it less likely that airway interventions will be needed, and makes it less likely that hypoventilation will happen. Recent research, however, indicates that respiratory safety is not guaranteed, especially at elevated doses or increased levels of sedation, underscoring the necessity for meticulous monitoring [20].

Pharmacokinetic Considerations and Clinical Implications

Dexmedetomidine has a short distribution half-life of around 6 minutes and a long elimination half-life of about 2 hours. This could make sedation last longer if bigger doses are given. Ketamine, on the other hand, works quickly (within 30 to 60 seconds when given through an IV) and doesn't last as long because it moves around in the body [13,14].

The combination permits quick onset of sedation (driven by ketamine), prolonged yet manageable sedation (driven by dexmedetomidine), and a seamless recovery trajectory with diminished emerging symptoms. Dexmedetomidine also lessens the psychomimetic effects of ketamine, like hallucinations and agitation, which makes the entire experience better for the patient [15].

Immunomodulatory and Anti-inflammatory Effects (Emerging Insight)

New evidence indicates that both dexmedetomidine and ketamine exhibit anti-inflammatory characteristics. Dexmedetomidine diminishes the release of pro-inflammatory cytokines, whereas ketamine regulates neuroinflammation and oxidative stress pathways. This may help patients recover faster after surgery and feel less stressed during and after surgery, but more research is needed to find out if this is clinically important [16].

Clinical Applications of Ketodex in Day-Care Surgery

In recent years, the use of the dexmedetomidine–ketamine (Ketodex) combination in day-care surgery has grown a lot. This shows how useful it is for a wide range of short-term treatments. Its distinctive pharmacological profile—marked by balanced sedation, efficient analgesia, maintained respiratory function, and hemodynamic stability—renders it especially appropriate for ambulatory environments where swift turnover and prompt discharge are essential.

Procedural Sedation in Ambulatory Settings

Ketodex has undergone comprehensive assessment for procedural sedation in minimally invasive and brief interventions, encompassing endoscopic operations, ocular surgeries, minor orthopedic manipulations, and dermatological treatments. Numerous randomized controlled trials have shown that Ketodex offers better sedation quality, better patient cooperation, and less need for rescue analgesics than standard sedative regimens [21]. Dexmedetomidine–ketamine has demonstrated more stable hemodynamic parameters and a reduced frequency of respiratory compromise in comparison investigations, but recovery durations may be marginally extended [2]. This emphasizes a significant clinical point: although Ketodex may not consistently ensure the quickest emergence, it reliably facilitates a smoother and safer perioperative trajectory. Also, keeping spontaneous breathing and airway reflexes intact lowers the requirement for airway interventions. This makes Ketodex especially useful in situations when advanced airway support may not be needed all the time.

Use in Minor Surgical Procedures

Ketodex has shown good results for intraoperative stability and postoperative comfort in outpatient surgeries like hernia repairs, superficial soft tissue surgeries, and small ENT procedures. Its effect of saving opioids is especially helpful in these situations since it reduces the negative effects of opioids that can

delay discharge [6].

Clinical investigations have indicated diminished postoperative pain scores and a decreased occurrence of postoperative nausea and vomiting (PONV) in patients administered Ketodex in contrast to opioid-based regimens. This means that patients are happier and ready to go home sooner, both of which are important measures of quality in day-care surgery [11].

Adjunct to Regional Anaesthesia

Ketodex has also become popular as an add-on to regional anesthesia methods such spinal, epidural, and peripheral nerve blocks. Dexmedetomidine is known to make sensory and motor blockage last longer, whereas ketamine makes pain relief deeper by blocking NMDA receptors [22].

When used together, these drugs help with longer-lasting pain relief after surgery, less need for extra painkillers, and more comfort for patients during and after treatments. This multimodal strategy is in line with guidelines for faster recovery, which have the goal of reducing the usage of opioids throughout the body.

Paediatric Day-Care Procedures

Ketodex has shown a lot of promise as a drug for pediatric ambulatory anesthesia. Children undergoing treatments such as MRI sedation, small surgeries, and diagnostic interventions benefit from its reduced respiratory depression and smoother recovery profile. Research has consistently shown a lower risk of emerging agitation, a typical problem with ketamine monotherapy, when dexmedetomidine is given at the same time [7]. Furthermore, the sleepy state produced by dexmedetomidine facilitates enhanced procedural compliance without necessitating extensive sedation, which is beneficial in minimally painful or non-painful operations.

However, it is important to be careful about dosing and monitoring, especially in younger children, because pharmacokinetics might change and they may be more sensitive to sedative drugs.

Emergency and Short-Stay Surgical Settings

In emergency ambulatory procedures necessitating swift yet secure sedation, Ketodex has surfaced as a feasible alternative to conventional sedative combinations. Its capacity to preserve circulatory stability renders it especially beneficial for patients with borderline hemodynamics or restricted physiological reserve [12].

Also, the lower rate of respiratory depression is helpful in emergency situations where there may not be enough resources to control the airway. However, cautious titration is still important to avoid giving too much medicine and making recovery take longer.

Special Populations and High-Risk Patients

Ketodex may provide specific benefits in certain high-risk groups, such as individuals with obstructive sleep apnea (OSA), obesity, or cardiovascular instability. The combination of these two drugs is safer than regimens that are high on opioids for those who are likely to have trouble breathing because they don't have much of an effect on breathing [20].

Nonetheless, administering dexmedetomidine to individuals with pre-existing bradycardia or conduction problems necessitates vigilance. Likewise, the sympathomimetic effects of ketamine may be detrimental in patients with inadequately managed hypertension or ischemic heart disease, requiring personalized risk evaluation and dose adjustment.

Analgesic Efficacy and Opioid-Sparing Effect

Effective perioperative analgesia is a key factor in the success of day-care surgery since it directly affects how comfortable patients are, how quickly they can move around, and how ready they are to go home. In this context, the dexmedetomidine–ketamine (Ketodex) combination has a unique advantage by delivering multimodal analgesia via complementary but mechanistically distinct mechanisms, therefore decreasing dependence on opioids.

Mechanistic Basis of Analgesic Synergy

The analgesic effectiveness of Ketodex is supported by its dual-action mechanism that affects both spinal and supraspinal pathways. Dexmedetomidine's analgesic action is mainly due to the stimulation of α2-adrenergic receptors in the dorsal horn of the spinal cord. This stops nociceptive neurotransmitters such substance P and glutamate from working. It also strengthens descending inhibitory pain pathways, which makes pain transmission even less likely to happen [23].

On the other hand, ketamine works as a non-competitive antagonist at NMDA receptors. These receptors are very important for central sensitization and the "wind-up" process that happens when there is persistent nociceptive input. Ketamine inhibits NMDA receptor-mediated excitatory transmission, hence preventing the amplification of pain signals and diminishing the onset of opioid tolerance and hyperalgesia [24].

When these drugs are used together, they have a synergistic effect that leads to better pain relief during surgery, less central sensitization, and longer pain relief after surgery. This multimodal approach is quite similar to modern ideas about opioid-sparing anesthesia [25].

Clinical Evidence of Analgesic Superiority

An increasing amount of research indicates that Ketodex has a better pain-relieving profile in outpatient settings. Randomized controlled trials have shown that patients who have dexmedetomidine–ketamine have far lower pain scores during and after surgery than those who get regular sedatives or opioids [6]. A systematic review and meta-analysis shown that the Ketodex combination significantly decreased postoperative opioid usage across several surgical procedures, underscoring its efficacy within multimodal analgesic treatments [1]. This decrease is particularly noticeable in the first 12 hours after surgery, which is very important for determining when to send someone home from the hospital. Additionally, research comparing Ketodex with ketofol (ketamine–propofol) has demonstrated that both combinations deliver sufficient analgesia; however, Ketodex provides enhanced pain management with reduced variability in sedation depth, hence enhancing overall procedure conditions [2].

Opioid-Sparing Effect and Clinical Implications

One of the most useful things about Ketodex in the clinic is that it doesn't make you need opioids. This is especially important in ambulatory surgery, when side effects from opioids can greatly slow down recovery and discharge.

Ketodex lowers the requirement for opioids before and after surgery, which lowers the risk of postoperative nausea and vomiting (PONV), respiratory depression, sedation-related problems, and faster recovery of gastrointestinal function. This is especially important in improved recovery after surgery (ERAS) protocols, where one of the main goals is to cut down on the use of opioids [25].

Ketamine's capacity to avert opioid-induced hyperalgesia significantly bolsters its function in opioid-sparing techniques, especially for those with prior opioid exposure or chronic pain disorders [24].

Duration and Quality of Analgesia

Ketodex offers effective early postoperative analgesia, however the duration of its effects varies according on dosage regimens and procedural factors. Dexmedetomidine produces persistent analgesia by maintaining receptor activation, while ketamine induces quick start but a shorter duration of action owing to redistribution [23,24].

Clinical observations indicate that early postoperative pain management (first 6–12 hours) is consistently more effective, whereas long-term analgesic benefits extending beyond 24 hours are inconsistent. Depending on the kind and amount of the surgery, you may still need more painkillers. So, the best way to use Ketodex is as part of a multimodal analgesic regimen, not as a single treatment.

Special Considerations in Analgesic Use

The analgesic properties of Ketodex may be especially beneficial for opioid-sensitive patients, such as the elderly or those with obstructive sleep apnea, in day-care procedures necessitating swift recovery, and in persons at elevated risk for postoperative nausea and vomiting (PONV). But it is important to carefully titrate the dose to find the right balance between pain relief and drowsiness, because giving too much can cause longer recovery times or unstable blood pressure.

Haemodynamic Stability

In day-care anesthesia, it is highly important to keep the patient's hemodynamic stability since changes in heart rate and blood pressure after surgery might make the patient less safe, slow down their recovery, and make it harder for them to be ready to leave. The dexmedetomidine–ketamine (Ketodex) combination provides a unique benefit by attaining a physiological equilibrium through antagonistic autonomic actions, thus reducing the extremes of cardiovascular responses.

Physiological Basis of Haemodynamic Modulation

Dexmedetomidine predominantly influences hemodynamics through central sympatholysis facilitated by α2-adrenergic receptor activation. It lowers sympathetic tone and increases vagal activity by lowering the release of norepinephrine from presynaptic nerve terminals. This lowers heart rate and systemic vascular resistance. Although advantageous in mitigating stress reactions, this effect may lead to bradycardia and hypotension, especially in hypovolemic conditions or at elevated doses [17]. On the other hand, ketamine stimulates the cardiovascular system by raising the levels of catecholamines in the blood and stopping their absorption. This makes the heart beat faster, raises blood pressure, and increases cardiac output. Ketamine is different from many other anesthetics in that it keeps the heart and blood vessels stable even in people who are already sick. This makes it especially useful for short treatments that don't require much physiological disturbance [18].

When used together, these drugs produce a dynamic balance in blood flow: dexmedetomidine stops too much sympathetic activity, and ketamine stops very low blood pressure and slow heart rate. This leads to a decrease in the overall variability of haemodynamic parameters. This two-way modulation is the main

reason why Ketodex has a haemodynamic advantage in ambulatory anesthesia.

Clinical Evidence of Haemodynamic Stability

Numerous clinical trials have shown that Ketodex offers better hemodynamic stability than standard sedative regimens. In randomized trials, patients administered dexmedetomidine–ketamine had markedly reduced variations in heart rate and mean arterial pressure compared to those receiving propofol-based or opioid-based sedation [6].

A comprehensive review and meta-analysis looked at the safety of Ketodex and found that the intraoperative hemodynamics were very stable, with fewer episodes of hypertension and tachycardia that are often seen with ketamine monotherapy [1]. The combination also lowers stress responses before and after surgery, which may lead to better surgical circumstances and fewer problems during surgery.

Incidence of Bradycardia and Hypotension

Ketodex has a stabilizing effect overall, however it does have certain adverse effects on blood flow. Bradycardia caused by dexmedetomidine is still a clinically important issue, especially in older people or people who already have conduction problems. According to meta-analytic statistics, some patients who take dexmedetomidine-containing regimens may experience bradycardia. This is more likely to happen when the dose is larger or when the drug is given as a quick bolus [1]. Hypotension can also happen when systemic vascular resistance is low, especially in people who don't have enough blood volume. But ketamine's sympathomimetic activity largely cancels out these effects, which often stops hypotension from getting so bad that it becomes a problem. This interaction highlights the significance of dose titration and patient selection in enhancing hemodynamic results.

Comparison with Other Anaesthetic Regimens

Ketodex shows a better effect on blood flow than propofol-opioid combos. Propofol is known to lower blood pressure in a dose-dependent way by opening up blood vessels and depressing the heart muscle. Opioids, on the other hand, can make bradycardia and respiratory depression worse [26].

On the other hand, Ketodex keeps mean arterial pressure more stable, lowers the requirement for vasopressor support, and diminishes changes in blood flow during procedural stimulation. These capabilities are especially useful in ambulatory settings where quick stabilization and recovery are important.

Special Populations and Clinical Implications

The way Ketodex affects blood flow may be very helpful for people with poor cardiovascular reserve, those who are having short but stimulating procedures, and circumstances where avoiding low blood pressure is very important.

But patients with severe bradyarrhythmias, those on beta-blockers or other treatments that slow down the heart rate, and those who are hypovolemic or older should be careful. In these populations, precise dose modification and diligent oversight are important to avert negative consequences.

Recovery Profile and Discharge Readiness

In day-care surgery, recovery goes beyond just waking up from anesthesia. It also includes getting cognitive function back, stabilizing blood flow, controlling pain well, having few side effects, and being ready to be safely discharged. The quality and speed of recovery are particularly important for patient satisfaction, the efficiency of the operating room, and the overall success of ambulatory surgical practice.

The dexmedetomidine–ketamine (Ketodex) combination has a unique recovery profile indicative of its balanced pharmacological actions. Ketodex helps the recovery process go more smoothly and in a more controlled way, unlike traditional regimens that put a lot of emphasis on quick emergence at the expense of physiological stability.

Characteristics of Recovery with Ketodex

After taking Ketodex, recovery is usually marked by a calm and cooperative emergence, fewer cases of agitation or delirium, stable blood flow parameters, and enough residual pain relief. Dexmedetomidine causes a level of drowsiness that is similar to natural sleep, which lets patients wake up slowly while still being aware of their surroundings and able to respond. This is different from how propofol-based anesthesia commonly causes people to wake up suddenly. Furthermore, dexmedetomidine diminishes the psychomimetic effects induced by ketamine, thereby decreasing the frequency of hallucinations and emerging agitation after recovery [27]. Ketamine aids in early postoperative analgesia, alleviating discomfort upon awakening and decreasing the necessity for rescue analgesics. These effects work together to make the recovery process feel smooth instead than quick.

Recovery Time and Cognitive Function

Ketodex provides qualitative benefits in recovery; nevertheless, its effect on recovery duration is still under clinical evaluation. Dexmedetomidine's extended elimination half-life may cause sedation to wear off more slowly, especially when greater dosages

or continuous infusions are utilized [13]. Comparative studies indicate that the duration until eye opening and orientation may be somewhat extended in relation to propofol-based regimens. But cognitive recovery is usually more solid, with less confusion or agitation, and psychomotor performance usually gets better in a more steady and predictable way. This shows that Ketodex values quality and stability of recovery over speed.

Postoperative Nausea, Vomiting, and Comfort

Postoperative nausea and vomiting (PONV) continues to be a major issue in outpatient surgery, often causing patients to have to stay longer and be unhappy. Ketodex has a lower rate of PONV than opioid-based anesthesia, mostly because it doesn't use opioids as much [28]. Dexmedetomidine has antiemetic qualities on its own since it works on the central nervous system, and modest dosages of ketamine do not significantly raise the risk of PONV. The combined impact leads to less need for antiemetic medication, more comfort after surgery, and a better readiness for discharge.

Discharge Readiness and Scoring Systems

In ambulatory practice, it is important to objectively assess discharge readiness. The Modified Aldrete Score and the Post-Anaesthesia Discharge Scoring System (PADSS) are two scoring systems that are often used. They look at things like vital signs, how well the patient can walk, pain, nausea, and bleeding [28]. Patients using Ketodex generally acquire satisfactory discharge ratings within conventional timeframes, however modest delays may occur due to prolonged sedation in some circumstances. Patients frequently have better pain control, fewer problems, and more overall comfort upon discharge, even though their recovery times are slightly longer.

Comparison with Conventional Regimens

Ketodex has a number of benefits over propofol–opioid combos. Regimens based on propofol usually lead to speedier emergence, but they also often cause low blood pressure, respiratory depression, and a higher rate of PONV. Opioids also make recovery take longer since they make you sleepy and cause stomach problems [26].

On the other hand, Ketodex makes recovery easier and has fewer side effects. It also lowers the risk of complications from opioids and keeps blood flow and breathing stable. In high-throughput ambulatory settings where quick discharge is the main goal, propofol-based regimens may still be the best choice because they have shorter recovery durations.

Clinical Implications and Patient-Centered Perspective

From a patient-centered point of view, the quality of recovery is often more important than how quickly someone is discharged. Patients who suffer minimal pain, nausea, and confusion are more inclined to express greater satisfaction, even if discharge is slightly postponed.

Ketodex fits well with the concepts of enhanced recovery since it reduces physiological disruptions, makes people less dependent on opioids, and encourages a stable and comfortable recovery process. It should only be used in clinical situations where safety, efficiency, and quality of recovery are all important.

Adverse Effects and Safety Considerations

The dexmedetomidine–ketamine (Ketodex) combination presents numerous pharmacological and therapeutic benefits in day-care anesthesia; nonetheless, its safety profile necessitates meticulous evaluation. As with any multimodal treatment plan, the total risk-benefit balance is affected by drug-specific side effects, patient-related factors, and procedural variables. To make sure that these things are used safely and effectively in ambulatory settings, you need to have a deep grasp of them.

Dexmedetomidine-Related Adverse Effects

The main side effects of dexmedetomidine come from its strong central sympatholytic action. Bradycardia and hypotension are the most prevalent side effects. Both of these depend on the dose and are worse when given quickly or at higher rates [17]. Bradycardia is caused by increased vagal tone and decreased sympathetic activity. It is usually not a big deal, but it may need to be treated in people who are more likely to have it. There have been a few reports of severe bradycardia and sinus arrest, mostly in those who already had conduction problems or were using negative chronotropic drugs at the same time [29]. Low blood pressure happens when the body's blood vessels and heart output are both lower. This effect may be more pronounced in hypovolemic patients, older adults, or persons with compromised autonomic function. However, slowly increasing the dose and not giving large amounts all at once can greatly lower these hazards.

Ketamine-Related Adverse Effects

Ketamine, although possessing a favorable analgesic and circulatory profile, is linked to specific side effects, predominantly of psychomimetic and autonomic origin. Emergence phenomena, such as hallucinations, vivid dreams, and agitation, are significant concerns, especially in adult patients [30].

Ketamine also makes the salivary and tracheobronchial secretions thicker, which could lead to problems with the airway if not handled correctly. Nausea and vomiting may also happen, however they happen less often when ketamine is taken with dexmedetomidine [19].

From a cardiovascular perspective, ketamine-induced sympathetic activation may result in tachycardia and hypertension, which can be detrimental in patients with ischemic heart disease or inadequately managed hypertension.

Attenuation of Adverse Effects in Combination

One of the best things about Ketodex is that it reduces the negative effects of each medicine on the other. Dexmedetomidine substantially diminishes the frequency and intensity of ketamine-induced emerging delirium and psychomimetic responses by inducing a soothing and sedative effect [31]. Conversely, ketamine's sympathomimetic effects offset dexmedetomidine-induced bradycardia and hypotension, which helps keep blood flow stable. This bidirectional modulation makes the combo safer overall than each medication taken alone. But this equilibrium isn't perfect; it depends on how much medicine is given, the patient's body, and the clinical situation.

Respiratory Safety and Airway Considerations

Ketodex is a combination that is thought to spare the respiratory system because neither dexmedetomidine nor ketamine significantly depresses the respiratory center when taken in the right dose range. Maintaining spontaneous breathing and airway reflexes is a significant benefit of ambulatory anesthesia [3]. Nonetheless, respiratory adverse effects, such as hypoxia and airway obstruction, may still transpire, especially with increased sedation levels, concurrent administration of other sedatives, or among high-risk groups. So, even when utilizing drugs with good respiratory profiles, it's still important to keep an eye on oxygen saturation, respiratory rate, and airway patency all the time [20].

Risk Stratification and Special Populations

The safety of Ketodex differs among various patient demographics, requiring personalized risk evaluation. Older individuals may be more sensitive to dexmedetomidine, which might cause stronger hemodynamic responses and longer sedation. Patients with cardiovascular illness necessitate meticulous observation, since dexmedetomidine may aggravate bradyarrhythmias, while ketamine may elevate myocardial strain.

For people with obstructive sleep apnea (OSA), Ketodex's modest respiratory depressive effect is better than opioid-based regimens, but caution is still needed. In the pediatric population, Ketodex is generally well tolerated; however, variability in pharmacokinetics demands weight-based dosing and frequent monitoring [27].

Comparison with Other Anaesthetic Regimens

In modern ambulatory anesthesia, various pharmacological methods exist, each presenting unique benefits and drawbacks. Consequently, the dexmedetomidine–ketamine (Ketodex) combination necessitates evaluation against existing regimens, including propofol–opioid combinations, ketofol (ketamine–propofol), dexmedetomidine monotherapy, and ketamine monotherapy. Such comparisons are necessary to ascertain its comparative clinical efficacy in outpatient surgery, where efficiency, safety, and patient satisfaction are intricately connected.

Ketodex vs Propofol–Opioid Regimens

Propofol mixed with short-acting opioids (e.g., fentanyl, remifentanil) continues to be a prevalent method in ambulatory anesthesia owing to its rapid onset and brief duration of action. But this combination often causes respiratory depression, low blood pressure, and more nausea and vomiting after surgery (PONV) [26].

On the other hand, Ketodex has a number of physiological benefits, such as less respiratory depression since it doesn't work on GABA receptors, greater haemodynamic stability because it works against the autonomic system, and a lesser need for opioids, which leads to lower PONV rates. Clinical trials have shown that Ketodex leads to fewer bouts of oxygen desaturation and a lower demand for airway treatments than propofol-opioid regimens [20]. However, propofol-based regimens usually have shorter discharge periods and faster emergence times, which makes them better for high-throughput ambulatory settings where quick turnover is important [32].

Ketodex vs Ketofol (Ketamine–Propofol)

Ketofol is a mix of ketamine and propofol that is often used to keep blood flow stable while allowing for quick recovery. Ketofol works faster and recovers faster than Ketodex, mostly because of the way propofol works in the body.

But Ketodex provides better pain relief, more consistent blood flow, and fewer cases of breathing problems. Comparative investigations demonstrate that Ketodex is linked to reduced variability in heart rate and blood pressure, as well as enhanced analgesic

efficacy [2].

Dexmedetomidine also reduces the psychomimetic effects of ketamine more efficiently than propofol, resulting in a smoother recovery profile. Still, ketofol may still be better for very short procedures when quick recovery is the main goal.

Ketodex vs Dexmedetomidine Monotherapy

Dexmedetomidine is a popular choice for procedural sedation since it has a good effect on breathing and makes people sleepy. But its pain-relieving impact is not very strong, thus other pain relievers are often needed.

Adding ketamine makes pain relief more effective and makes sedation better. Research comparing dexmedetomidine monotherapy to Ketodex has shown superior pain management, less use for additional opioids, and enhanced procedural circumstances with the combination [22].

So, Ketodex is a more complete multimodal technique than dexmedetomidine alone.

Ketodex vs Ketamine Monotherapy

Ketamine is a strong painkiller and sedative on its own, but it has some bad side effects, include emerging delirium, hallucinations, and too much sympathetic activation.

Adding dexmedetomidine helps with these problems by lowering psychomimetic effects, making sedation smoother, and stabilizing haemodynamics. This combination makes ketamine a more controlled and predictable sedative that can be used by people who are not in a hospital [31].

Clinical Perspective

In general, Ketodex is a one-of-a-kind anesthetic treatment that stands out from the rest. It may not always deliver the fastest recovery, but it does provide a balanced profile that includes stable blood flow, good pain relief, less need for opioids, and more comfort for the patient.

It is especially useful for patients who are at risk of breathing problems, for surgeries where maintaining stable blood flow is very important, and in places where the quality of recovery is more important than time. Individualized patient selection and dose titration are still very important for getting the best results and the least side effects.

Conclusion

As the field of outpatient surgery changes, anesthetic techniques must not only ensure that the procedure goes well, but also speed up recovery, improve safety, and enhance the patient's experience. In this case, the combination of dexmedetomidine and ketamine (Ketodex) makes sense in theory and looks like it could work well in practice, following the concepts of balanced and multimodal anesthesia. Ketodex creates a unique pharmacological balance by combining the hypnotic and sympatholytic effects of dexmedetomidine with the pain-relieving and heart-stimulating actions of ketamine. This synergy leads to a number of clinically significant benefits, such as stable blood flow, effective pain relief without opioids, maintenance of breathing function, and a smoother, more comfortable recovery process. These qualities are especially useful in day care settings, where the main goal is still to get people out of the building quickly and safely.

But you should only think about the good things about Ketodex in light of its bad things. The fact that there are different dose regimens, that the data is not always the same, and that there haven't been any large multicentric trials means that it can't be used as a standard anaesthetic approach everywhere. Also, because it takes longer to recover from than ultra-short-acting drugs like propofol, it shows that it needs to be used in a way that is specific to each patient and the procedure.

It is important to remember that Ketodex is not a replacement for established anesthetic regimes. Instead, it is a strategically adaptive alternative that works better in certain clinical situations. The best way to use it is to customize the medicine combination based on the patient's needs, the type of surgery, and the goals for recovery.

In the future, we need well-planned, large-scale randomized controlled trials with standardized protocols and long-term follow-up to better understand the function of Ketodex in outpatient anesthesia. Future research should investigate its pharmacoeconomic ramifications and relevance in high-risk populations. In short, Ketodex represents a move toward physiology-based, precision-based anesthesia, where the goal is not just to sedate the patient but also to create a balanced and patient-centered perioperative experience. It has a lot of promise to improve the quality and safety of day-care surgical practice when utilized wisely.

References

1. Junior AB, Silva PL, Rocha LL, et al. Efficacy and safety of ketamine–dexmedetomidine combination in adult sedation and anesthesia: A systematic review and meta-analysis. Cureus. 2025;17:e97432. https://doi.org/10.7759/cureus.97432

2. Esmaillian M, et al. Comparison of dexmedetomidine–ketamine versus propofol-based sedation for procedural sedation: A randomized clinical trial. Am J Emerg Med. 2023. https://doi.org/10.1016/j.ajem.2023.08.025
3. Belleville JP, Ward DS, Bloor BC, Maze M. Effects of intravenous dexmedetomidine in humans: Sedation, ventilation, and metabolic rate. Anesthesiology. 1992;77(6):1125–33. https://doi.org/10.1097/00000542-199212000-00013
4. Domino EF, Chodoff P, Corssen G. Pharmacologic effects of ketamine in man. Clin Pharmacol Ther. 1965;6(3):279–91. https://doi.org/10.1002/cpt196563279
5. Amornyotin S. Use of a combination of ketamine and dexmedetomidine (Ketodex) in different clinical cases. J Addict Med Ther Sci. 2020;6(1):1–5. https://doi.org/10.17352/2455-3484.000036
6. Goyal R, Singh S, Bangi A, et al. Comparative evaluation of dexmedetomidine–ketamine combination versus conventional sedatives in procedural sedation. J Clin Anesth. 2016;33:283–9. https://doi.org/10.1016/j.jclinane.2016.03.032
7. Mason KP, Lubisch N, Robinson F, et al. Intranasal dexmedetomidine for pediatric sedation: Trends and outcomes. Anesth Analg. 2011;113(5):1124–31. https://doi.org/10.1213/ANE.0b013e31822c4b0a
8. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. BMJ. 2021;372:n71. https://doi.org/10.1136/bmj.n71
9. Higgins JPT, Thomas J, Chandler J, et al. Cochrane handbook for systematic reviews of interventions. 2nd ed. Cochrane; 2021.
10. El-Boghdadly K, Pawa A, Chin KJ. Local anesthetic systemic toxicity: current perspectives. Local Reg Anesth. 2018;11:35–44. https://doi.org/10.2147/LRA.S154512
11. Peng K, Wu SR, Ji FH, Li J. Premedication with dexmedetomidine: A meta-analysis. Clin Ther. 2015;37(3):649–57. https://doi.org/10.1016/j.clinthera.2015.01.023
12. Srivastava U, et al. Evaluation of dexmedetomidine–ketamine combination. Saudi J Anaesth. 2014;8(1):53–7. https://doi.org/10.4103/1658-354X.125940
13. Weerink MAS, Struys MMRF, Hannivoort LN, et al. Clinical pharmacokinetics and pharmacodynamics of dexmedetomidine. Clin Pharmacokinet. 2017;56(8):893–913. https://doi.org/10.1007/s40262-017-0507-7
14. Zanos P, Gould TD. Mechanisms of ketamine action as an antidepressant. Mol Psychiatry. 2018;23:801–11. https://doi.org/10.1038/mp.2017.255
15. Mion G, Villevieille T. Ketamine pharmacology: An update. Anaesth Crit Care Pain Med. 2013;32(4):235–42. https://doi.org/10.1016/j.accpm.2012.11.002
16. De Kock M, Loix S, Lavand'homme P. Ketamine and peripheral inflammation. CNS Neurosci Ther. 2013;19(6):403–10. https://doi.org/10.1111/cns.12093
17. Snapir A, et al. Effects of dexmedetomidine on cardiovascular function. Br J Clin Pharmacol. 2006;61(4):430–7. https://doi.org/10.1111/j.1365-2125.2005.02583.x
18. Reich DL, Silvay G. Ketamine: An update on cardiovascular effects. J Cardiothorac Vasc Anesth. 1989;3(4):420–32.
19. Green SM, Roback MG, Kennedy RM, Krauss B. Clinical practice guideline for ketamine sedation. Ann Emerg Med. 2011;57(5):449–61. https://doi.org/10.1016/j.annemergmed.2010.11.030
20. Bellolio MF, Gilani WI, Barrionuevo P, et al. Incidence of adverse events in procedural sedation. BMJ. 2016;354:i2800. https://doi.org/10.1136/bmj.i2800
21. Akin A, et al. Dexmedetomidine–ketamine combination for procedural sedation. Paediatr Anaesth. 2005;15:979–84.
22. Abdallah FW, Brull R. Dexmedetomidine as an adjuvant to regional anesthesia. Br J Anaesth. 2013;110(6):915–25.
23. Blaudszun G, Lysakowski C, Elia N, Tramer MR. Effect of perioperative systemic α2 agonists on postoperative pain. Anesthesiology. 2012;116(6):1312–22. https://doi.org/10.1097/ALN.0b013e31825681cb
24. McCartney CJ, Sinha A, Katz J. Role of NMDA receptor antagonists in pain management: A systematic review. Anesth Analg. 2004;98(5):1385–1400. https://doi.org/10.1213/01.ANE.0000108961.57913.93
25. Kehlet H, Wilmore DW. Multimodal strategies to improve surgical outcome. Am J Surg. 2002;183(6):630–41. https://doi.org/10.1016/S0002-9610(02)00866-8
26. White PF, Eng M. Ambulatory anesthesia and haemodynamic considerations. Anesth Analg. 2007;104(3):509–17.
27. Mahmoud M, Mason KP. Dexmedetomidine: Review of its use for sedation in children. Paediatr Anaesth.

2015;25(4):369–78. https://doi.org/10.1111/pan.12627
28. Chung F, Chan VW, Ong D. A post-anesthetic discharge scoring system. Anesth Analg. 1995;80(5):896–902.
29. Gerlach AT, Dasta JF. Dexmedetomidine: An updated review. Ann Pharmacother. 2007;41(2):245–52. https://doi.org/10.1345/aph.1H314
30. Strayer RJ, Nelson LS. Adverse events associated with ketamine for procedural sedation. Am J Emerg Med. 2008;26(9):985–1028. https://doi.org/10.1016/j.ajem.2007.12.005
31. Tosun Z, et al. Dexmedetomidine–ketamine combination reduces emergence agitation. Paediatr Anaesth. 2006;16:1002–8.
32. Apfelbaum JL, et al. Practice guidelines for ambulatory anesthesia. Anesthesiology. 2012;116(3):522–38.