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RESEARCH ARTICLE

Monitored CareAnaesthesia in Minimally Invasive Spine Surgery: A Case Series

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Abstract: The use of minimally invasive spine surgery (MISS) to treat lumbar disc problems has grown in popularity because of its links to less tissue damage, less blood loss, and quicker recovery after surgery. Nonetheless, it is still difficult to control anaesthesia in MISS, especially when the patient is prone. Monitored anaesthesia care (MAC) has piqued the curiosity of several spinal surgeons as a feasible alternative to general anaesthesia. Stable hemodynamics, efficient intraoperative analgesia, and preserved respiratory function are benefits of using dexmedetomidine and ketamine under MAC. The five patients in this case series are having lumbar endoscopic decompression and discectomy, under MAC using intermittent ketamine boluses and dexmedetomidine infusion that is titrated according to clinical response.During surgery, hemodynamic parameters were constantly monitored, and bradycardia or hypotension episodes were managed accordingly. Adequate postoperative pain management was ensured by a multimodal analgesic regimen that included tramadol and paracetamol. None of the patients needed to be switched to GA, and all recovered without any breathing or intraoperative problems. According to these findings, MAC combined with dexmedetomidine and ketamine in MISS is safe and feasible, providing a useful substitute for GA for patient comfort and recovery.

Keywords: Monitored Care Anaesthesia (MAC), Minimally Invasive Spine Surgery (MISS), Ketamine,Dexmedetomidine

INTRODUCTION

MISS offers a paradigm shift in spinal surgery practice, providing less soft tissue damage, less intraoperative blood loss, less postoperative discomfort, and shorter hospitalization than traditional open spine surgery. The growing demand for MISS techniques—particularly endoscopic discectomy and decompression—has simultaneously emphasized the need for anaesthetic strategies that support its minimally invasive ethos while maintaining patient safety and comfort [1, 2].

Traditional GA, though widely used, may not be ideally suited for all MISS cases. GA involves airway instrumentation, positive pressure ventilation, neuromuscular blockade, and often longer postoperative recovery times—factors which may conflict with the goals of day-care or ambulatory spine procedures. Furthermore, GA is associated with risks of nausea and vomiting following surgery (PONV) and opioid-related side effectsand in some patients, exacerbation of underlying cardiorespiratory comorbidities.Thus, MAC has emerged as a viable alternative to GA in selected MISS patients. MAC uses sedation and analgesia while permitting the patient to continue spontaneous breathing and protective airway reflexes. This approach minimizes hemodynamic fluctuations, reduces opioid consumption, and facilitates faster recovery, particularly when used in combination with regional or local anaesthesia techniques. Several studies have reported the success of MAC in neurosurgical and orthopedic contexts, highlighting its safety profile and patient-centered benefits [3, 4].

Among sedative agents used for MAC, dexmedetomidine has garnered significant attention. As a highly selective alpha-2 adrenergic receptor agonist, dexmedetomidine provides dose-dependent sedation, anxiolysis, and modest analgesia without causing respiratory depression, making it ideal for procedures in non-intubated patients. It also offers sympatholytic effects, resulting in intraoperative hemodynamic stability [5]. Ketamine, an NMDA receptor antagonist with potent analgesic and dissociative properties, complements dexmedetomidine by maintaining cardiovascular tone and enhancing analgesia. Its ability to preserve airway reflexes and spontaneous respiration further supports its use in MAC [5, 6]. Many surgical specialties have investigated the synergistic use of ketamine plus dexmedetomidine, also known as "Ketodex." During procedures carried out in the prone position, recent research has shown that Ketodex is safe and effective at preserving sedation and analgesia without sacrificing ventilation or oxygenation [7, 8]. According to current research, Ketodex especially helps MISS achieve high patient satisfaction ratings, less postoperative pain, and adequate anesthetic with no need for conversion to GA [8-11].

Despite these promising findings, literature specifically addressing MAC with Ketodex in MISS remains sparse. This case series seeks to contribute to this growing body of evidence by presenting five cases of lumbar endoscopic discectomy and decompression performed under MAC using dexmedetomidine and ketamine. We aim to document anesthetic management, intraoperative hemodynamic trends, and postoperative outcomes to

support the feasibility and clinical utility of this technique in the MISS setting.

Case Presentation

Case 1: An 18-year-old male weighing 55 kg presented with complaints of severe low back pain and bilateral radiculopathy. MRI revealed disc bulges at L3-L4, L4-L5, and L5-S1 levels. He was classified as ASA-II with no significant comorbidities. Preoperative vitals were stable: HR 85 bpm, BP 122/78 mmHg, and SpO_2 98% on room air. Baseline investigations were within normal limits.An 18G intravenous (IV) cannula was placed in the left hand, and IV fluids were initiated. Premedication was administered with intravenous midazolam 1 mg and glycopyrrolate 0.2 mg. Supplemental oxygen was provided via face mask at 5 L/min, and end-tidal CO_2 ($ETCO_2$) monitoring was used to assess spontaneous ventilation. The patient was then positioned prone with appropriate pillow support to ensure comfort and avoid pressure points. Sedation was initiated with a loading dose of dexmedetomidine at 0.7 mcg/kg over 15 minutes, combined with an initial bolus of ketamine at 2 mg/kg. This was followed by a maintenance infusion of dexmedetomidine at 0.3 mcg/kg/hr, titrated to maintain a Richmond Agitation Sedation Scale (RASS) score of -2. Additional ketamine boluses of 30 mg IV were administered hourly for analgesia. During the procedure, episodes of hypotension and bradycardia were effectively managed with ephedrine 0.1 mg/kg and atropine 0.01 mg/kg, respectively. The dexmedetomidine infusion was discontinued just before skin closure. Throughout the surgery, the patient maintained stable spontaneous respiration, and hemodynamic fluctuations were promptly addressed. The intraoperative course was uneventful, and the patient tolerated the procedure well under MAC using dexmedetomidine and ketamine.Supplemental oxygen was delivered via face mask at 5 L/min.The surgery, which involved lumbar endoscopic decompression, lasted approximately 3.5 hours. The patient maintained spontaneous ventilation throughout. Intraoperatively, he developed mild bradycardia (HR 48 bpm) and hypotension (BP 90/60 mmHg), which were promptly treated with glycopyrrolate and ephedrine. Estimated blood loss was 300 ml. Postoperatively, the patient was awake, oriented, and hemodynamically stable. Pain was managed effectively with IV paracetamol (1g) and tramadol (50mg). He was mobilizedand discharged on postoperative day 2 without any complications.

Case 2: A 38-year-old male with a history of L3-L4 and L4-L5 disc bulge was scheduled for lumbar endoscopic decompression and discectomy at the affected levels. He had no prior surgical history but was a known hypertensive for the past three months, managed with Amlodipine 5 mg daily. He reported no known drug or food allergies but had a history of chronic alcohol consumption (360 ml/week) and smoking. On examination, the patient was hemodynamically stable (BP 150/80 mmHg, PR 75/min, SpO_2 97% on room air), afebrile, and neurologically intact except for reduced power (4/5) and decreased sensation in the left lower limb. Airway evaluation revealed adequate mouth opening, Mallampati class II, and normal dentition with a buck tooth. Preoperative labs, including hemogram and platelet count, were within normal limits, and ECG showed sinus rhythm with evidence of left ventricular hypertrophy. Classified as ASA-II, he was taken to the operating theatre after obtaining informed consent. Standard ASA monitors were applied, and an 18G IV cannula was placed in the left hand. Sedation was initiated with midazolam 1 mg IV and glycopyrrolate 0.2 mg IV, followed by oxygen supplementation at 5 L/min via face mask. After positioning the patient prone with adequate support, a dexmedetomidine infusion was started at 0.7 mcg/kg/hr for 15 minutes along with ketamine 2 mg/kg IV, followed by maintenance dexmedetomidine at 0.3 mcg/kg/hr, titrated to a RASS score of -2. Hourly ketamine boluses (30 mg IV) were administered. Intraoperative hypotension and bradycardia were managed with ephedrine 0.1 mg/kg and atropine 0.01 mg/kg. The dexmedetomidine infusion was stopped before skin closure. Total IV fluids administered were 2400 ml, with a blood loss of 450 ml and urine output of 500 ml during the 4.5-hour procedure. Postoperatively, analgesia was maintained with paracetamol 1 g IV twice daily and tramadol 50 mg IV twice daily. The patient remained stable and comfortable throughout the perioperative period.

Case 3: A 61-year-old male with L4-L5 disc prolapse and bilateral radiculopathy was scheduled for endoscopic decompression and discectomy at the L4-L5 level. His medical history included hypertension for 10 years, well-controlled on atenolol 50 mg once daily, and a prior appendicectomy under spinal anaesthesia 20 years ago. He reported no known drug or food allergies but had a history of chronic alcohol use and smoking. On preoperative evaluation, the patient was hemodynamically stable (BP 140/80 mmHg, PR 84/min, SpO_2 99% on room air), conscious, and afebrile, with neurological examination revealing decreased sensation and muscle power (4/5) in both lower limbs. Airway assessment was unremarkable, with adequate mouth opening, Mallampati Class II, and normal dentition. Laboratory investigations were within normal limits, and echocardiography revealed concentric LVH, mild tricuspid regurgitation, grade 1 diastolic dysfunction, and an ejection fraction of 64%. After obtaining informed consent, the patient was shifted to the operating room. Standard ASA monitors were applied, and an 18G IV cannula was secured in the right hand. Following premedication with midazolam 1 mg IV and oxygen supplementation via face mask at 5 L/min, sedation was initiated with a dexmedetomidine infusion at 0.7 mcg/kg/hr for 15 minutes, along with ketamine 1 mg/kg IV. This was followed by a maintenance dexmedetomidine infusion at 0.3 mcg/kg/hr, titrated to a RASS score of -2. Intraoperative

hypotension and bradycardia were managed with ephedrine 0.1 mg/kg and glycopyrrolate 0.01 mg/kg. Dexmedetomidine was discontinued before wound closure. The surgery lasted 2 hours and 20 minutes, with a total fluid administration of 1400 ml, blood loss of 280 ml, and urine output of 300 ml. Postoperative analgesia was maintained with IV paracetamol (1 g) and tramadol (50 mg) twice daily. The patient remained stable and comfortable in the recovery period.

Case 4: A 65-year-old hypertensive and diabetic female with L4–L5 disc prolapse and right-sided radiculopathy was scheduled for endoscopic decompression and discectomy. She had a prior history of total abdominal hysterectomy under spinal anaesthesia 20 years ago. Her comorbidities were well controlled with atenolol, amlodipine, and a combination of vildagliptin and metformin. Preoperative examination revealed she was conscious, oriented, hemodynamically stable (BP 140/80 mmHg, PR 84/min), and had motor weakness (power 4/5) and sensory deficit in the right lower limb. Airway assessment showed a Mallampati class III with multiple missing teeth and poor oral hygiene. Blood investigations, including glycemic parameters, were within acceptable limits, and echocardiography revealed concentric LVH with preserved ejection fraction (54%) and grade 1 diastolic dysfunction. In the operation theatre, ASA standard monitors were applied, and IV access was secured. Premedication with IV midazolam (1 mg) was given, and oxygen was administered via face mask at 5 L/min with capnography to monitor spontaneous ventilation. After proper prone positioning, sedation was initiated with dexmedetomidine at 0.7 mcg/kg/hr for the first 15 minutes, along with ketamine 1 mg/kg IV, followed by a maintenance infusion of dexmedetomidine at 0.3 mcg/kg/hr, titrated to a RASS score of -2. Intraoperative hypotension and bradycardia were managed with IV ephedrine (0.1 mg/kg) and glycopyrrolate (0.01 mg/kg). Dexmedetomidine was stopped prior to wound closure. The surgery lasted 2 hours, during which 1200 ml of IV fluids were administered, with a blood loss of 315 ml and urine output of 250 ml. Postoperatively, analgesia was maintained with IV paracetamol and tramadol, and the patient had an uneventful recovery.

Case 5: A 61-year-old hypertensive male with a diagnosis of L4–L5 disc prolapse and bilateral radiculopathy was planned for endoscopic L4–L5 decompression and discectomy. He had no prior history of surgery and was on atenolol 50 mg once daily. He was a smoker but denied alcohol use and there were no reported medications or food-related allergies.. On preoperative evaluation, the patient was conscious, oriented, afebrile, and hemodynamically stable (BP 140/80 mmHg, PR 84/min, SpO_2 99% on room air). Neurological examination revealed motor power of 4/5 and decreased sensation in both lower limbs. Airway assessment showed a Mallampati Class II with adequate mouth opening and normal dentition. Preoperative investigations were within normal limits, including Hb 13.8 g/dL and platelet count of 274,000/mm^3. Echocardiography revealed concentric LVH, grade 1 diastolic dysfunction, mild aortic regurgitation, and an ejection fraction of 64%, placing him in ASA Physical Status Class II with intermediate cardiac risk. After obtaining informed consent, the patient was shifted to the operation theatre where ASA standard monitors were applied and an 18G IV line secured in the right hand. Premedication included IV midazolam 1 mg and oxygen supplementation via face mask at 5 L/min with capnography to monitor spontaneous ventilation. Following prone positioning with adequate support, sedation was initiated using dexmedetomidine infusion at 0.7 mcg/kg/hr for the initial 15 minutes, along with IV ketamine 1–2 mg/kg, followed by a maintenance dose of dexmedetomidine at 0.3 mcg/kg/hr titrated to a RASS score of -2. Intraoperative episodes of hypotension and bradycardia were managed with IV ephedrine 0.1 mg/kg and glycopyrrolate 0.01 mg/kg. Dexmedetomidine infusion was discontinued prior to skin closure. The 2-hour and 20-minute procedure was uneventful, with a total IV fluid administration of 1400 ml, blood loss of 280 ml, and urine output of 300 ml. Postoperatively, the patient was managed with IV paracetamol 1 g BD and IV tramadol 50 mg BD for pain relief, and recovery was stable.

DISCUSSION

Dexmedetomidine, an alpha-2 adrenergic agonist, is commonly used in settings requiring sedation without compromising respiratory function. It provides sedation that closely resembles natural sleep, allowing patients to remain responsive, which is crucial in procedures like MISS where intraoperative positioning and neuromonitoring may require patient awareness. However, its use is not without potential drawbacks. Dexmedetomidine can cause bradycardia and hypotension, which were observed in several of our cases, particularly at higher doses or during the loading phase. These hemodynamic changes are well-documented in the literature; therefore, monitoring is necessary while taking dexmedetomidine, especially in individuals with pre-existing cardiovascular problems..

This emphasizes the significance of individualized dosing regimens based on the patient's clinical situation [12, 13]. While, Ketamine is a well-established NMDA receptor antagonist, it complements dexmedetomidine by providing strong analgesic effects. It also helps to maintain cardiovascular stability. This is particularly important in patients undergoing procedures like MISS, where hemodynamic fluctuations can complicate patient management. In our series, ketamine played a pivotal role in reducing opioid use postoperatively, which is consistent with emerging practices aimed at minimizing opioid-related side effects. Moreover, ketamine's ability to preserve cardiovascular function, counteracting the potential hypotension associated with

dexmedetomidine, is well-documented in other studies [14, 15].

This case series demonstrates the efficacy of combining dexmedetomidine and ketamine for MAC in MISS, with considerable benefits in hemodynamic stability, analgesia, and smooth recovery. The approach of using these agents in tandem aligns with evolving trends in Anaesthesia for spine surgeries, particularly as alternatives to GA in select patient populations. Here, the combination of dexmedetomidine and ketamine is increasingly being investigated in various surgical contexts, particularly for its benefits in multimodal analgesia and enhanced recovery after surgery (ERAS) protocols. Studies have found that MAC with these drugs can provide equal, if not greater, outcomes in terms of pain control, postoperative recovery, and patient satisfaction when compared to general anaesthesia. In a similar cohort of patients undergoing spine surgery, a recent study demonstrated that this combination provides stable intraoperative conditions and helpsreduce the incidence of nausea and vomiting following surgery which are common complications following general Anaesthesia. However, it is important to note that the successful implementation of MAC requires careful patient selection. For instance, patients with significant cardiovascular or pulmonary comorbidities may not be ideal candidates for dexmedetomidine, given its potential to exacerbate bradycardia and hypotension. Using common pharmacologic treatments like glycopyrrolate and ephedrine, the incidence of bradycardia was successfully controlled in our case series. To reduce problems, however, such management necessitates cautious drug titration. Furthermore, even though the combination of ketamine and dexmedetomidine worked well for us, more research is necessary to improve dosage guidelines and evaluate the long-term effects of using these medications in MAC for MISS. To provide more solid proof of MAC's clinical benefits, larger, randomized controlled trials contrasting its safety and effectiveness with GA for spine procedures are required [16–20].

In summary, our case series indicates that dexmedetomidine and ketamine for MAC in minimally invasive spine operations present a viable substitute for general anaesthesia, particularly for patients receiving outpatient procedures or those who are more susceptible to problems. This method improves the overall surgical experience and recovery process by limiting opioid use, preserving stable hemodynamics, and providing appropriate analgesia. But like with any anesthetic method, the key to getting the best results is careful patient selection, close observation, and customized dosage guidelines.

CONCLUSION

Patients undergoing MISS have shown that MAC, which uses a mix of ketamine and dexmedetomidine, is a safe and efficient substitute for GA. This method minimizes the need for airway manipulation and lowers perioperative problems by maintaining spontaneous respiration, ensuring hemodynamic stability, and providing appropriate analgesia. Dexmedetomidine's sedative qualities combined with ketamine's analgesic and sympathomimetic effects produce a well-balanced anesthetic state that is perfect for operations involving prone positioning. Furthermore, less dependence on opioids lowers the likelihood of related side effects and promotes better postoperative recovery. The use of this approach in appropriate clinical settings is further supported by patient comfort, a quicker return to baseline function, and possible cost-effectiveness.In light of these results, MAC ought to be incorporated more widely into MISS anesthetic planning, particularly for patients who have comorbid conditions or are at higher risk for anaesthesia. To provide standardized procedures and confirm long-term benefits across a range of patient populations, future prospective trials are crucial.

Declarations

Patient Consent:All of the patients in this case series gave their informed agreement for their clinical information to be published.

Conflict of Interest:The authors declare no conflicts of interest.

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Authorship Contribution Statement

R.Naveen Prasad: experimentation and Writing-original draft,S.A. Namasivayam: Review and editing,Are Tejaswi &Akshay Rajkumar: Review and editing, K.Gokul Krishnan: Conceptualization and supervision

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REFERENCES

1. Smith, Z. A., Fessler, R. G., 2012, Paradigm changes in spine surgery—evolution of minimally invasive techniques. Nature Reviews Neurology, 8(8): 443-450. https://doi.org/10.1038/nrneurol.2012.110
2. Lohre, R., Wang, J. C., Lewandrowski, K. U., Goel, D. P., 2020, Virtual reality in spinal endoscopy: a paradigm shift in education to support spine surgeons. Journal of Spine Surgery, 6 (Suppl 1): S208. https://jss.amegroups.org/article/view/4849/html
3. Chun, E. H., Han, M. J., Baik, H. J., et al., 2015, Dexmedetomidine-ketamine versus Dexmedetomidine-midazolam-fentanyl for monitored anesthesia care during chemoport insertion: a Prospective Randomized Study. BMC

Anesthesiology, 16(1): 49. https://bmcanesthesiol.biomedcentral.com/articles/10.1186/s12871-016-0211-4

4. Na, H. S., Song, I. A., Park, H. S., Hwang, J. W., Do, S. H., Kim, C. S., 2011, Dexmedetomidine is effective for monitored anesthesia care in outpatients undergoing cataract surgery. Korean Journal of Anesthesiology, 61(6): 453-459. https://pmc.ncbi.nlm.nih.gov/articles/PMC3249565/
5. Luscri, N., Tobias, J. D., 2006, Monitored anesthesia care with a combination of ketamine and dexmedetomidine during magnetic resonance imaging in three children with trisomy 21 and obstructive sleep apnea. PediatricAnesthesia, 16(7): 782-786. https://doi.org/10.1111/j.1460-9592.2006.01857.x
6. Goyal, R., Hasnain, S., Mittal, S., Shreevastava, S., 2016, A randomized, controlled trial to compare the efficacy and safety profile of a dexmedetomidine-ketamine combination with a propofol-fentanyl combination for ERCP. Gastrointestinal Endoscopy, 83(5): 928-933. https://pubmed.ncbi.nlm.nih.gov/26364968/
7. Kim, K. H., 2014, Safe Sedation and Hypnosis using Dexmedetomidine for Minimally Invasive Spine Surgery in a Prone Position. Korean Journal of Pain, 27(4): 313-320. https://pubmed.ncbi.nlm.nih.gov/25317279/
8. Amornyotin, S., 2020, Use of a combination of ketamine and dexmedetomidine (Ketodex) in different clinical cases. Journal of Addiction Medicine and Therapeutic Science, 6(1): 041-044. https://www.neuroscigroup.us/articles/JAMTS-6-136.pdf
9. Kim, H. J., Park, S., Lim, Y., Bang, S. R., 2023, Monitored Anesthesia Care in Minimally Invasive Spine Surgery—A Retrospective Case Series Study. Medicina, 60(1): 43. https://pubmed.ncbi.nlm.nih.gov/38256304/
10. [10]. Ghosh, M. K., Kumar, S., Begam, S., Ghosh, S., Basu, M., 2024, GBM immunotherapy: Exploring molecular and clinical frontiers. Life Sciences, 323: 123018. https://pubmed.ncbi.nlm.nih.gov/39214286/
11. [11]. Kumar, S., Basu, M., Ghosh, M. K., 2024, E3 ubiquitin ligases and deubiquitinases in colorectal cancer: Emerging molecular insights and therapeutic opportunities. Biochimica et Biophysica Acta - Molecular Cell Research, 1871(8): 119827. https://pubmed.ncbi.nlm.nih.gov/39187067/
12. Giovannitti Jr, J. A., Thoms, S. M., Crawford, J. J., 2015, Alpha-2 adrenergic receptor agonists: a review of current clinical applications. Anesthesia Progress, 62(1): 31-39. https://pmc.ncbi.nlm.nih.gov/articles/PMC4389556/
13. Murthy, T., Singh, R., 2009, Alpha 2 adrenoceptor agonist-dexmedetomidine role in anaesthesia and intensive care: A clinical review. Journal of Anaesthesiology Clinical Pharmacology, 25(3): 267-272. https://pmc.ncbi.nlm.nih.gov/articles/PMC4173414/
14. Panzer, O., Moitra, V., Sladen, R. N., 2009, Pharmacology of sedative-analgesic agents: dexmedetomidine, remifentanil, ketamine, volatile anesthetics, and the role of peripheral mu antagonists. Critical Care Clinics, 25(3): 451-469. https://pubmed.ncbi.nlm.nih.gov/19576524/
15. Sleigh, J., Harvey, M., Voss, L., Denny, B., 2014, Ketamine–More mechanisms of action than just NMDA blockade. Trends in Anaesthesia and Critical Care, 4(2-3): 76-81. https://pmc.ncbi.nlm.nih.gov/articles/PMC11017467/
16. Dhanya, A., Yadav, S., Thomas, C., et al., 2024, Monitored Anesthesia Care (MAC) as an Alternative to General Anesthesia (GA): Prospective Double-Blinded Randomized Controlled Study Comparing Efficacy and Safety of Dexmedetomidine and Ketamine Infusions with Ultrasonography (USG) Guided Pectoral Nerve Block (PECs) for Postoperative Analgesia in Breast Surgery. Maedica, 19(2): 283. https://pubmed.ncbi.nlm.nih.gov/39188822/
17. Rioja, E., Santos, M., Martínez, F., Tendillo, F., 2005, Dexmedetomidine and midazolam interaction is synergistic with isoflurane and additive with halothane in terms of MAC reduction. Veterinary Anaesthesia and Analgesia, 32(4): 10-11. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-2995.2005.00232a_21.x
18. Ebner, L. S., Lerche, P., Bednarski, R. M., Hubbell, J. A., 2013, Effect of dexmedetomidine, morphine-lidocaine-ketamine, and dexmedetomidine-morphine-lidocaine-ketamine constant rate infusions on the minimum alveolar concentration of isoflurane and bispectral index in dogs. American Journal of Veterinary Research, 74(7): 963-970. https://pubmed.ncbi.nlm.nih.gov/23802667/
19. Vaishnav, A.S. Othman, Y.A.; Virk, S.S.; Gang, C.H.; Qureshi, S.A. Current state of minimally invasive spine surgery. J Spine Surg 2019;5(Suppl 1): S2-S10 https://pmc.ncbi.nlm.nih.gov/articles/PMC6626758/
20. Kumar, S., Basu, M., Ghosh, M. K., 2022, Chaperone-assisted E3 ligase CHIP: A double agent in cancer. Genes & Diseases, 9(6): 1521-1555. https://doi.org/10.1016/j.gendis.2021.08.003