CASE REPORT

# Postoperative Dexmedetomidine Infusion after Microvascular Free Flap Surgery: A Case Report

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## ABSTRACT

Microvascular free flap surgery requires a delicate balance between optimum patient hemodynamic status and adequate free flap perfusion during the entire perioperative course. A potentially turbulent postoperative course must be appropriately averted as this can lead to flap failure. This paper presents the successful use of postoperative dexmedetomidine infusion to provide a smooth transition after discontinuing general anesthesia while maintaining free flap viability in a 19-year-old male with ameloblastoma who underwent hemimandibulectomy and free fibular osteomyocutaneous microvascular flap surgery.

*Keywords: Dexmedetomidine, microsurgical free flap, ameloblastoma, surgical flap*

## INTRODUCTION

Microvascular surgeries allow the transfer of free vascularized tissue or free flaps. It is a surgical technique only recently utilized in the Philippines for reconstructive head and neck surgeries with no published local data. The postoperative course of these surgeries can be particularly turbulent, leading to flap failure, thus, negating whatever gains accomplished during the complicated procedure.[1,2] According to the American College of Surgeons National Surgical Quality Improvement Program database spanning 2005-2010, surgeries involving the head and neck registered the highest free flap failure rate of 7.7%.[3] Incidences of vascular-related causes of free-flap failure are reported as venous (35%), arterial (28%), and hematoma formation (26%).[4] Uncontrolled hypertension associated with a stormy emergence or post-surgical restlessness could lead to hematoma formation resulting in compression of anastomotic vessels and compromise of flap perfusion.[4] Due to the lack of evidence-based anesthetic recommendations locally, postoperative management is often inspired by theoretical pathophysiological considerations, anecdotal reports, and institutional preference.

Flap success depends on good intraoperative hemodynamics, satisfactory regional blood flow, adequate fluid therapy, and effective analgesia. Conversely, flap failure has been associated with vasospasm, excessive hemodilution, hypovolemia, hypotension, and postoperative patient agitation.[1,2] Commonly employed sedative agents like midazolam and propofol could result in adverse events,

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including prolongation of mechanical ventilation support, delirium, and off-target Richmond Agitation Sedation Scale (RASS) scores.[5,6] Dexmedetomidine can address agitation, stress, and consequent hemodynamic overdrive, but there is pervasive hesitation in its use. Being an alpha-2-agonist, its vasoconstrictive effect may plausibly compromise flap perfusion. The authors share their experience in the utilization of dexmedetomidine infusion at the Intensive Care Unit (ICU) following a fibular osteomyocutaneous free flap.

## CASE PRESENTATION

This is a case of a 19-year-old ASA 1 male who presented with a 1-year history of a slowly enlarging mass on the right mandible found during an incidental dental checkup. He was diagnosed with ameloblastoma and was scheduled for right hemimandibulectomy, mandibulomaxillary fixation, and reconstruction by free fibular osteomyocutaneous flap.

Nasotracheal intubation was done after induction of general anesthesia. Intraoperative vital signs ranged from BP of 100-130/60-80 mmHg, HR of 80-90 bpm, and $SpO_2$ of ≥99%. Estimated blood loss was 1200 mL. A total of 2 units of PRBC and 5 liters of crystalloids were infused with a note of stable vital signs and adequate urine output. Normothermia was achieved using a forced-air warmer and warmed fluid infusion.

With the volatile anesthetic still turned on, hence, offsetting the need for a loading dose, a dexmedetomidine background infusion at 0.3 mcg/kg/hr was started 10 minutes before the end of the operation. Extubation was delayed in anticipation of significant soft tissue swelling and an extremely difficult airway scenario should a re-exploration be warranted later. Utmost care was observed during his transfer from the operating room to the Surgical Intensive Care Unit (SICU) to ensure full immobilization of the flap and the integrity of the airway, IV access lines, drains, monitor cables, and breathing system. The patient stayed at the SICU for 12 days, where his head was deliberately kept in a midline neutral position by pillow bolsters to facilitate better vessel anastomosis (Figure 1).

Postoperative management involved focused monitoring and intensive care. Initially, his respiration was controlled mechanically using pressure-controlled mode, frequency = 12, $FiO_2$ = 0.3, and PEEP = 4 cm $H_20$, later progressing to synchronized intermittent mandatory ventilation mode upon weaning.

The dexmedetomidine infusion initiated at the OR was continued during postoperative days (POD) 1 to 8 with an average hourly rate of 0.4 mcg/kg/hr. It was titrated within a range of 0.17 mcg/kg/hr to 0.7 mcg/kg/hr, aiming for RASS scores of 0 to -2 to minimize patient motion while ensuring patient comfort and cooperativity. No episodes of hypotension or hypertension were recorded. Heart rate was maintained at 63 to 99 beats per minute. $SpO_2$ was maintained between 97-100%, and body temperature readings were within normal. Urine output remained largely adequate.

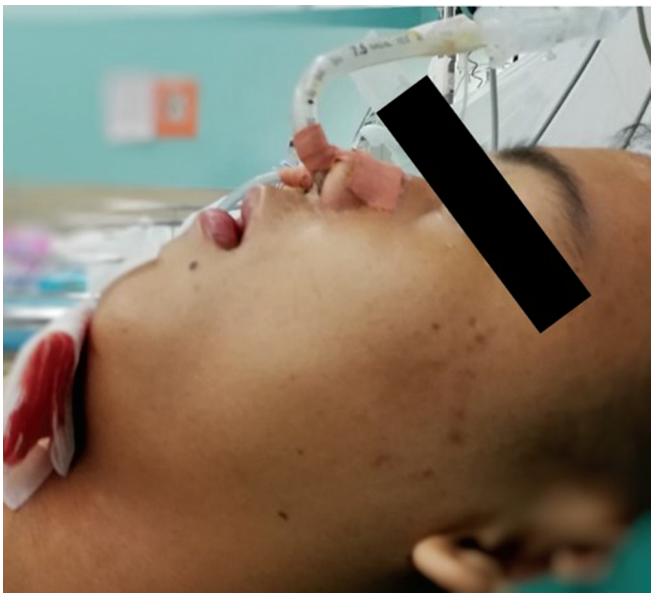

**Figure 1.** Postoperatively, the patient remained intubated with a preformed north nasotracheal tube. His head was kept in a midline neutral position for several days to preserve microvascular anastomoses.

Pain management consisted of round-the-clock intravenous morphine 2-4 mg every 6 hours for the first 48 hours. On day 3, analgesics were revised to round-the-clock intravenous ketorolac 0.5 mg/kg/dose every 8 hours and paracetamol 15 mg/kg/dose every 6 hours. These were given until POD 5. Pain scores obtained during waking hours ranged from 0-3 using the Numerical Pain Rating Scale. Fluid balance was adjusted judiciously to maintain adequate hydration. Hourly flap monitoring consisted of Doppler ultrasound and observance of flap color, turgor, capillary refill time score, and drain output. The flap had brisk bleeding, bright red color, <3 seconds capillary refill time, absence of gross necrotic and color changes, and minimal JP drain output for the entirety of his 12-day stay at the SICU.

On POD 8, the patient was extubated with the dexmedetomidine infusion down titrated at 0.2 mcg/kg/hr. He stayed calm, awake to lightly sedated but easily rousable and responsive. Dexmedetomidine was discontinued on POD 9 until the rest of his SICU stay. The patient was transferred to a regular room without needing any analgesics and eventually discharged home.

Upon follow-up six months postoperatively, the patient had undergone rehabilitation and is fully recovered with no limitation on mandible mobilization, no difficulties with eating or speaking, and no pain on the surgical site (Figure 2). The patient has regained his regular daily routine as a college student.

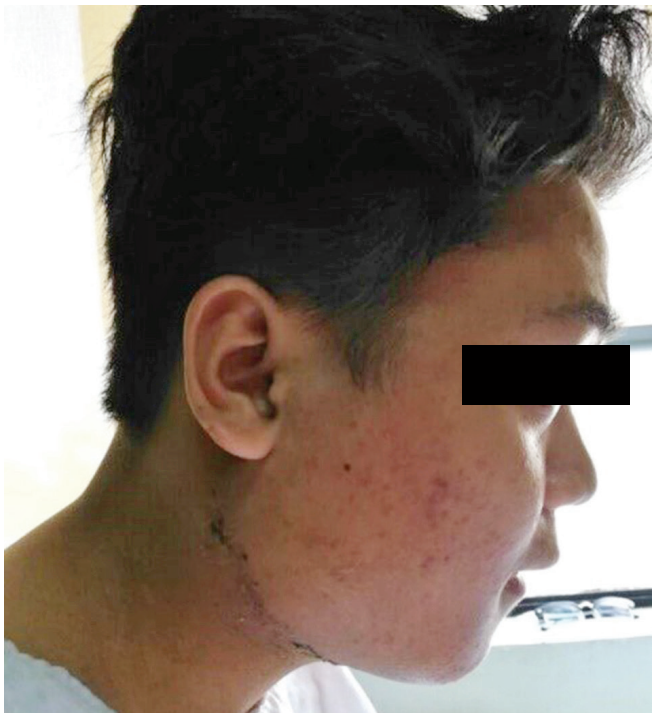

**Figure 2.** Fully functional and healthy-looking free flap on patient's follow-up consult.

## DISCUSSION

A microvascular-free flap is an attractive option for head and neck reconstructive surgery as this provides better functional outcomes and improved aesthetics.[7] This involves the transfer of free tissue from the skin, muscle, and bones or a combination of these to fill in the large surgical defect left. After surgery, the viability of the free flap depends on many postoperative goals such as prevention of turbulent emergence from anesthesia, reduction of pain and agitation, maintenance of stable patient hemodynamics to optimize flap perfusion, and prevention of flap edema and hematoma.[1,2,7]

Postoperative agitation has been reported in 65% of patients after flap reconstruction, and the rate of postoperative delirium can occur as high as 70% after flap surgery.[8] A period of deep sedation is recommended following major reconstructive plastic surgery in the face and neck regions to avoid possible mechanical strain to the transplanted tissues caused by spontaneous movements.[9] To prevent severe traction on anastomosed vessels, movement of their heads should be restricted for around 3-5 days, and large pressure variations from coughing and bucking from agitation should be circumvented as well.[1,10]

The ideal sedative in the postoperative setting should possess the following properties: rapid onset and recovery, low accumulation profile, absence of withdrawal effects, easy titratability, and ability to safeguard hemodynamic stability.[11] Propofol and midazolam are commonly employed sedatives in various critical care setups. Although proven safe and effective for short-term sedation, it has been shown to exert negative effects when used long-term.[12] Midazolam can cause acute withdrawal syndrome and delayed recovery from drug accumulation, while propofol can result in hypertriglyceridemia, cardiovascular depression, and propofol infusion syndrome.[13] Additionally, oversedation and dose-dependent ventilatory depression were considered inevitable complications when both agents were used for long-time sedation.[14,15]

Dexmedetomidine, a more recently developed alternative, is a highly specific alpha-2-adrenoreceptor agonist designed as a sedation and co-analgesic drug. It targets the alpha-2-receptors located in the locus coeruleus, producing sedation and a 60-80% reduction of tonic levels of sympathetic outflow and catecholamines.[10]

In a study by Paul et al. comparing midazolam, propofol, and dexmedetomidine among patients requiring postoperative mechanical ventilation, dexmedetomidine yielded more constant targeted RASS scores compared to the midazolam group, had the easiest reusability, best tolerance for ICU procedures (e.g., suctioning, physiotherapy), had the lowest incidence of post-extubation delirium and had the least requirement for supplementary analgesia.[16] This corroborated the findings of MIDEX and PRODEX trials which showed patients receiving dexmedetomidine were significantly more rousable, cooperative, better able to communicate, and had better pain scores than patients receiving either midazolam and propofol.[5]

Unaddressed pain can lead to agitation, triggering catecholamine release and hyperdynamic circulation. Apart from sedation, dexmedetomidine also acts within the spinal cord to modulate pain pathways resulting in analgesia.[17] It has been shown to reduce the need for rescue midazolam, propofol for sedation, and morphine dose for analgesia.[18,19] Furthermore, a prospective study reported that dexmedetomidine alleviated subjective pain in oral, maxillofacial, and fibular areas.[20]

Even after major surgery involving bone work, the patient necessitated only 48 hours of round-the-clock morphine (2-4 mg every 6 hours) to achieve pain scores of 0 to 3. No agitation was observed even while the patient was kept intubated and the head uncomfortably strapped for several days. In an interview a month after discharge, he said he had surprisingly minimal pain despite his extensive surgery.

Another keystone in managing microvascular flap surgery is the maintenance of circulatory hemodynamics while ensuring the adequacy of perfusion of the microvascular anastomoses. Intraoperatively, one aims for controlled hypertension with hemodilution to facilitate adequate flap perfusion. Postoperatively, while avoiding hypotension following free flap surgeries is essential, uncontrolled hypertension is equally risky. High blood pressure could lead to increased bleeding from the surgical site. The resulting hematoma can affect extrinsic compression, progressing

rapidly to arterial thrombosis, anastomotic disruption, and flap failure.[21] Hematoma and edema formation forebear flap re-exploration and catastrophe. Sources of postoperative hypertension that should be addressed include inadequate analgesia, hypothermia, and agitation. In the earlier mentioned study by Srivastava et al., more stable mean arterial pressures were reported as compared to a propofol infusion, further supporting our use of dexmedetomidine.[22]

The alpha receptors acted upon by dexmedetomidine are also located on sympathetic terminals, mediating vasoconstriction and inhibiting noradrenaline release.[23,24] Some would advocate administering dexmedetomidine before the completion of major surgical procedures, as this was associated with better hemodynamic stability in the postoperative period.[25] This was duly performed in this case, where maintenance infusion of dexmedetomidine was started 10 minutes before turning off the volatile agent. Its infusion during the anesthetic transition, bed transfers, and the entirety of the SICU stay may be responsible for safeguarding against hypertensive episodes. Due to the reduction of norepinephrine outflow within the CNS and resulting sympatholysis, bradycardia can ensue. Since hypotension and bradycardia may be related to increasing dexmedetomidine concentration, maintenance of a low dose infusion in this patient could explain why bradycardia was not observed despite prolonged use.

The circulation of a free flap is through microvascular anastomoses; thus, adequate perfusion is vital to maintain viability. The vasoconstrictive effect of dexmedetomidine is a contentious matter in terms of possible harmful effects on flap perfusion. However, in vitro studies revealed that dexmedetomidine use, even in doses for deep sedation, did not affect the perfusion in denervated musculocutaneous flaps.[23] Moreover, the drug's direct effect on the peripheral vascular smooth muscle is of short duration (<10 min) and can be attenuated by a slow and low dose infusion, as was done in this case.[26]

Rather than being detrimental, dexmedetomidine has even been suggested to exert protective effects on the survival of random flaps.[27] Key factors cited to improve flap success rates were improvement of local circulation, inhibition of inflammatory mediators, alleviation of ischemia-reperfusion injury, inhibition of oxidative stress of skin flap tissue cells, and promotion of angiogenesis by upregulating vascular endothelial growth factor expression.[28-31]

Current guidelines recommend that dexmedetomidine infusion be limited to 24 hours due to possible withdrawal effects. However, some investigators have confirmed prolonged infusion's safety in surgical and medical ICU patients.[32] In these studies, the maximum duration of dexmedetomidine treatment was 14 and 20 days, which were longer than the 8-day duration of the infusion administered to this patient.

The success of this case demonstrates the multi-pronged beneficial postoperative effects of dexmedetomidine in flap reconstruction surgeries.

## CONCLUSION

Dexmedetomidine has sedative, anxiolytic, analgesic, and hemodynamic stabilizing properties, making it an exemplary drug to address the management goals following microvascular flap surgery. Although there have been reservations regarding a possible compromise of flap perfusion due to its vasoconstrictive effects, this case report described the success of a transplanted free flap following a 9-day postoperative use of dexmedetomidine infusion in a young ASA 1 patient.

## PATIENT'S PERSPECTIVE

*"Prior to my surgery, I was in training to become a full-time missionary at my church – and all this was put to a stop because of my diagnosis. I knew that the only way to pursue my dreams was to prevent my tumor from spreading, and that was through this major operation. My recovery in the SICU was one of the most difficult twelve days of my life, not because of the pain but due to the loneliness of not being able to see my family and the physical restrictions imposed on me to achieve proper wound healing. I recovered fast, and I was finally able to go home. I underwent physical therapy at home to be able to walk with the leg which was operated on. Eventually, I was unrestricted with all my physical activities with minimal to no pain at all. I feel happy and blessed with the outcome of my operation and recovery – and now, I can pursue my dreams of becoming a missionary at my church."*

### Declaration of Patient Consent

The authors certify that they have obtained appropriate patient consent forms granting the use of the patient's images and clinical information for publication. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

### Statement of Authorship

PLOC and ALHG participated in writing both the original and final manuscript, while MECP and ARP reviewed and approved the final submitted case report.

### Author Disclosure

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