

# Use of Remifentanyl for sedo-analgesia in stapedotomy: personal experience

## *Impiego del Remifentanyl per la sedo-analgesia nella stapedotomia: esperienza personale*

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### Key words

Otosclerosis • Stapedotomy • Anaesthesia • Sedo-analgesia • Remifentanyl

### Parole chiave

Otosclerosi • Stapedotomia • Anestesia • Sedo-analgesia • Remifentanyl

### Summary

*Stapedotomy for otosclerosis presents particular anaesthesiology demands as the surgeon has to assess functional results during the operation, work with some bleeding, be ensured the collaboration of the patient, and limit the occurrence of intra- and post-operative symptoms (dizziness, nausea, vomiting and pain). Remifentanyl, a  $\mu$ -opioid selective agonist characterised by short latency and duration, has been used for about 2 years at the Otolaryngological Unit of the "Federico II" University of Naples for patients with otosclerosis undergoing stapedotomy. Aim of the study was, therefore, to assess: efficacy and tolerability of Remifentanyl in combination with a local anaesthetic in surgical procedures for otosclerosis; intra- and post-operative reduction in patient symptoms of dizziness, nausea, vomiting and pain; reduction of intra-operative bleeding; degree of patient collaboration and optimisation of anaesthesiological and vital parameters monitored during surgery. The study was carried out on 92 patients with otosclerosis, (17 M, 75 F), median age 41 years (range 25-56), undergoing stapedotomy. Patients were randomly assigned to one of two groups, which were homogeneous as far as concerns age, sex and pre-operative hearing: i. Group A (50 patients), received Remifentanyl infusion in combination with canal injection for local anaesthesia with Mepivacaine 2% and Adrenalin 1/100,000; ii. Group B (42 patients), received only local anaesthetic by infiltration of the external canal ear. Remifentanyl led to an improvement over the local anaesthetic technique previously used, with a clear decrease in intra- and post-operative neurovegetative symptoms such as dizziness, nausea, vomiting and pain, as well as reduced bleeding.*

### Riassunto

La stapedotomia per otosclerosi presenta particolari esigenze per ciò che concerne la tecnica anestesiológica: vi è, infatti, la necessità da parte del chirurgo di verificare il risultato funzionale nel corso dell'intervento stesso, di lavorare con un modesto sanguinamento, di ottenere una buona collaborazione da parte del paziente, di ridurre l'insorgenza di sintomi intra- e post-operatori (vertigine, nausea, vomito e dolore). Da circa 2 anni presso il Dipartimento Assistenziale di Scienze Mediche Preventive, Sezione Otorinolaringoiatria, dell'Università "Federico II" di Napoli il Remifentanyl, agonista selettivo  $\mu$ -oppiode caratterizzato da una breve latenza e durata d'azione, è stato impiegato nei pazienti sottoposti a stapedotomia. Nello studio ci siamo quindi proposti di verificare: l'efficacia e la tollerabilità del Remifentanyl nella chirurgia dell'otosclerosi in associazione all'anestesia loco-regionale, la riduzione della sintomatologia vertiginosa e del dolore nel corso dell'intervento e nel post-operatorio, la riduzione del sanguinamento intra-operatorio, il grado di collaborazione del paziente e l'ottimizzazione dei parametri anestesiológicos e vitali monitorati nel corso dell'intervento. Lo studio è stato effettuato su 92 pazienti affetti da otosclerosi (17 M, 75 F), di età media 41 anni (range 25-56), sottoposti ad intervento chirurgico di stapedotomia. I pazienti sono stati suddivisi in due gruppi omogenei per età, sesso ed entità del deficit uditivo in modo randomizzato: i. nel gruppo A, (50 pazienti) sono stati inseriti i soggetti ai quali è stata somministrata l'infusione di Remifentanyl associandola all'anestesia locale per infiltrazione del condotto uditivo mediante Mepivacaina al 2% e Adrenalina all'1/100.000; ii. nel gruppo B (42 pazienti) sono stati inclusi i pazienti a cui è stata effettuata esclusivamente l'anestesia locale per infiltrazione del condotto uditivo esterno. Si evince sulla base dei risultati ottenuti che, rispetto agli interventi condotti con la sola anestesia loco-regionale, le crisi chinetosiche, tipiche di alcune fasi chirurgiche, sono praticamente scomparse con l'utilizzo del Remifentanyl; esso ha consentito di migliorare la tecnica anestesiológica precedentemente impiegata, rappresentata dalla sola anestesia locale, con una netta riduzione dei sintomi neurovegetativi intra- e post-operatori quali vertigine, nausea, vomito e dolore e un minore sanguinamento.

## Introduction

In otologic surgical procedures, the anaesthetic technique must be adapted to the needs of the surgeon in the different phases of the operation to achieve optimal functional results and to limit the incidence of intra- and post-operative complications.

Stapedotomy for otosclerosis presents particular anaesthesiology demands as the surgeon has to assess the functional result during the operation, work with some bleeding, be ensured the collaboration of the patient, and limit the occurrence of intra- and post-operative symptoms (dizziness, nausea, vomiting and pain).

General anaesthesia, which is mainly indicated for longer-lasting surgical procedures like tympanoplasty and mastoidectomy<sup>1-4</sup> when applied to stapedotomy, on the one hand, guarantees more comfort for both the surgeon and the patient but, on the other, it increases intra-operative bleeding and prevents immediate assessment of hearing recovery.

Instead, in our experience, the use of a local anaesthetic cannot always ensure the comfort or adequate sedation of the patient or guarantee reduced bleeding and prevent the occurrence of neurovegetative problems.

Remifentanyl, a recent introduction to the field of anaesthesiology, is a  $\mu$ -opioid selective agonist characterised by short latency and duration, with a short half-life of 3-10 minutes, and metabolised by aspecific blood and tissue esterases<sup>5,6</sup>.

The pharmacological features afford an immediate response and consequently rapid resolution of respiratory depression and the analgesic effects induced within 5-10 minutes of discontinuation of the infusion.

Remifentanyl has been used in ophthalmological and orthopaedic surgery. In otorhinolaryngological surgery, it has been used in general anaesthesia in nasal surgery<sup>7</sup> and in otological procedure, in combination with anaesthetic gases in tympanoplastic and myringoplastic surgery<sup>4</sup>.

Remifentanyl has been used for about 2 years at the Otolaryngological Unit of the "Federico II" University of Naples for patients with otosclerosis undergoing stapedotomy.

Aim of the study was, therefore, to assess:

- efficacy and tolerability of Remifentanyl in combination with a local anaesthetic in surgical procedures for otosclerosis;
- intra- and post-operative reduction in patient symptoms of dizziness, nausea, vomiting and pain;
- reduction of intra-operative bleeding;
- degree of patient collaboration;
- optimisation of anaesthesiological and vital parameters monitored during surgery ( $O_2$  saturation, heart rate, systolic and diastolic blood pressure).

## Material and methods

The study was carried out on 92 patients (17 male, 75 female) with otosclerosis, median age 41 years (range 25-56), undergoing stapedotomy.

On the basis of the anaesthesiological risk, assessed according to the ASA classification criteria, 38 patients were classified as ASA I and 54 as ASA II.

The study was performed in double blind. Patients were randomly assigned to one of two groups, which were homogeneous for age, sex and pre-operative hearing:

- Group A, comprising 50 patients (9 male, 41 female), received Remifentanyl infusion in combination with canal injection for local anaesthesia with Mepivacaine 2% and Adrenalin 1/100,000;
- Group B, comprising 42 patients (8 male, 34 female), received only local anaesthetic by infiltration of the external canal ear.

All patients were operated on by the same team of surgeons and were previously informed of the surgical and anaesthesiological procedures to be carried out.

The mean operative time was 35 minutes (median 30 minutes, range 25-50).

Excluded from the study were subjects with a history of allergies to drugs and those who had used sedatives.

### ANAESTHESIOLOGICAL TECHNIQUE

Group A patients received local anaesthetic (5 cc Mepivacaine 2% solution and Adrenalin 1/100,000) by infiltration of the ear in combination with Remifentanyl. Patients in Group B received only the local anaesthetic by infiltration.

Patients in both groups were fitted with a nasal tube to supply  $O_2$  at a rate of 2/l/min.

The continuous infusion of Remifentanyl by syringe-pump (s.p.), to reach level 4-3 of the OAA/S, was carried out by the anaesthetist with an initial median speed of infusion of 0.05 mcg/kg/min. After 15 minutes, this was increased to 0.10 mcg/kg/min until an infusion speed of Remifentanyl of 0.15 mcg/kg/min was reached. These doses enabled an optimal sedo-analgesic level to be reached and maintained.

Subjective and objective parameters were evaluated and a comparison made of data from the 2 groups, focusing in particular on:

- a) subjective assessment, by the patient, in relation to the intra- and post-operative occurrence (within 24 hours), of:
  - dizziness,
  - nausea,
  - vomiting,
  - pain or discomfort;
- b) subjective intra-operative assessment, by the surgeon, of:

- bleeding,
- patient collaboration (i.e., a cooperative patient, less nervous and relaxed in all surgical steps);
- c) objective assessment, in relation to monitoring of:
  - partial saturation of oxygen (PsO<sub>2</sub>),
  - heart rate (HR),
  - systolic blood pressure (SBP),
  - diastolic blood pressure (DBP),
  - electrocardiogram (ECG).

These parameters were monitored at time t<sub>0</sub> and every 10 minutes throughout surgery.

The subjective evaluation was made according to the extent of the phenomenon (absent; moderate; severe).

Objective data were evaluated according to 3 categories for each parameter, namely:

- heart rate (HR): HR = 50-70 b/min, HR = 71-100 b/min, HR = 101-114 b/min;
- systolic blood pressure (SBP): SBP = 90-100 mmHg, SBP = 101-130 mmHg, SBP = 131-160 mmHg;
- diastolic blood pressure (DBP): DBP 60-70 mmHg, DBP = 71-90 mmHg, DBP > 91 mmHg;
- partial saturation of oxygen (PsO<sub>2</sub>): PsO<sub>2</sub> = 97-100%, 90-96%, < 90%;
- for the electrocardiogram (ECG) reading: normal, sinus bradycardia, paroxysmic tachycardia.

### STATISTICAL ANALYSIS

Data from the two groups were compared using the  $\chi$ -square test, which was also used to assess differences in subjective parameters within each group, both during and after surgery. Statistical significance was assumed at  $p < 0.01$ .

### Results

A comparison of the results in patients undergoing stapedotomy showed statistically significant differences (Tables I-VII) between those receiving local anaesthetic and Remifentanyl infusion (Group A) and those receiving only local anaesthetic (Group B).

#### INTRA-OPERATIVE FINDINGS (TABLE I)

Group A patients showed intra-operative reduction in symptoms of dizziness, nausea, vomiting and pain with respect to patients in Group B. Statistical comparison of the parameters studied for Groups A and B proved to be significant ( $p < 0.01$ ), except for the data related to vomiting.

#### POST-OPERATIVE FINDINGS (TABLE II)

Group A patients showed a reduction in symptoms of dizziness, nausea, vomiting and pain. No significant difference was found between the intra- and post-

**Table I.** Subjective assessment by patient and surgeon in relation to intra-operative findings.

Parameters	Group A (50 Pts)			Group B (42 Pts)		
	Absent	Moderate	Severe	Absent	Moderate	Severe
Dizziness	44 (88%)	5 (10%)	1 (2%)	20 (48%)	16 (38%)	6 (14%)
Nausea	41 (82%)	8 (16%)	1 (2%)	18 (43%)	18 (43%)	6 (14%)
Vomiting	50 (100%)	0 (0%)	0 (0%)	42 (100%)	0 (0%)	0 (0%)
Pain	46 (92%)	4 (8%)	0 (0%)	10 (24%)	22 (52%)	10 (24%)
Bleeding	46 (92%)	4 (8%)	0 (%)	8 (19%)	29 (69%)	5 (12%)
Patient collaboration	0 (0%)	1 (2%)	49 (98%)	8 (19%)	31 (74%)	3 (7%)

**Table II.** Subjective assessment by patient in relation to post-operative findings.

Parameters	Group A (50 Pts)			Group B (42 Pts)		
	Absent	Moderate	Severe	Absent	Moderate	Severe
Dizziness	46 (92%)	4 (8%)	0 (0%)	18 (43%)	20 (48%)	4 (9%)
Nausea	45 (90%)	5 (10%)	0 (0%)	15 (36%)	23 (55%)	4 (9%)
Vomiting	50 (100%)	0 (0%)	0 (0%)	42 (100%)	0 (0%)	0 (0%)
Pain	50 (100%)	0 (0%)	0 (0%)	42 (100%)	0 (0%)	0 (0%)

**Table III.** Mean values of Heart Rate (HR) evaluated according to 3 categories.

Group	HR = 50-70 b/min	HR = 71-100 b/min	HR = 101-140 b/min
A	46 (92%)	4 (8%)	0 (0%)
B	8 (19%)	29 (69%)	5 (12%)

**Table IV.** Mean value of systolic blood pressure evaluated according to 3 categories.

Group	PAS = 90-100 mmHg	PAS = 101-130 mmHg	PAS = 131-160 mmHg
A	46 (92%)	4 (8%)	0 (0%)
B	8 (19%)	29 (69%)	5 (12%)

operative parameters for Group A (dizziness  $p = 0.5$ , nausea  $p = 0.3$ , vomiting and pain  $p = 1$ ). In Group B, this comparison was significant only for pain ( $p < 0.01$ ), but not for dizziness ( $p = 0.6$ ), nausea ( $p = 0.5$ ), or vomiting ( $p = 1$ ).

#### HAEMODYNAMIC PARAMETERS (TABLES III-VII)

Group A patients showed optimisation of the anaesthesiological and vital parameters monitored during surgery compared to those in Group B. A statistical comparison of the parameters studied for Groups A and B proved significant ( $p < 0.01$ ), except for the data regarding  $O_2$  saturation.

#### SURGICAL POST-OPERATIVE RESULTS

The post-operative success of the operation was measured by analysing the mean post-operative air-bone gap for the speech frequencies (500, 1000 and 2000 Hz). In the 80 operated patients (86%), closure of the cochlear reserve was within 5 dB, in 12 cases (14%) the cochlear reserve was between 10 and 20 dB. No statistical difference was found between groups A and B.

#### Discussion

Stapedotomy requires an anaesthetic technique that will respond to the needs of the surgeon operating, to guarantee a bloodless field, and reduce, if not prevent, the occurrence of intra- and post-operative symptoms such as dizziness, nausea, vomiting and pain.

In addition, the anaesthesiological technique for stapedotomy should allow certain conditions in relation to:

- manipulation of the stapes and, in particular, of the footplate, and micro-aspiration of small quantities of endolabyrinthine fluid that might readily provoke dizziness and vagal reactions such as hypotension, sweating and bradycardia;
- the need to ensure good patient collaboration with the surgeon throughout the operation, and especially when the incudo-stapedial prosthesis has been inserted in the oval window so that recovery of hearing function can be immediately ascertained during surgery;
- unforeseeable anatomic variations (tympano-

**Table V.** Mean values of diastolic blood pressure evaluated according to 3 categories.

Group	PAD = 60-70 mmHg	PAD = 71-90 mmHg	PAD = > 90 mmHg
A	46 (92%)	4 (8%)	0 (0%)
B	8 (19%)	29 (69%)	5 (12%)

**Table VI.** Mean value of  $O_2$  saturation monitored throughout surgery.

Group	$SpO_2 = 97-100\%$	$SpO_2 = 90-96\%$	$SpO_2 = < 90\%$
A	46 (92%)	0 (0%)	4 (8%)
B	42 (100%)	0 (0%)	0 (0%)

Table VII. Type of electrocardiogram during surgery.

Group	Normal	Sinusal bradycardia	Paroxystic tachycardia
A	46 (92%)	4 (8%)	0 (0%)
B	37 (88%)	0 (0%)	5 (12%)

squamous spine particularly prominent, presence of scar tissue covering the incus or the stapes, unprotected facial nerve), conditions that expose the patient and, therefore, the surgeon to a greater risk of complications<sup>3</sup>.

In our experience, the local anaesthetic technique, based on infiltration of the external ear with a solution of Mepivacaine 2% and adrenalin 1/100,000, does not always ensure the comfort and sedation of the patient, guarantee reduced bleeding in the operative field or prevent dizziness and nausea (Tables I, II).

We, therefore, considered it useful to employ a new anaesthetic technique for stapedotomy procedures that involves administration, by syringe-pump (s.p.), of Remifentanyl.

This  $\mu$ -opioid agonist, employed to blunt or reduce the response to pain triggered by surgical manipulation and to reduce the need for volatile hypnotic and anaesthetic drugs offers certain advantages with respect to the commonly used anaesthetics.

Indeed, due to its molecular structure, the duration of the effect of Remifentanyl is very short and independent of the dose and rate of infusion<sup>2,5</sup>. In particular, with this drug, sedation can be regulated according to the emotional state of the patient, to the duration of the operation and to bleeding and dizziness.

Indeed, Remifentanyl guarantees superficial sedative levels suitable for stapes surgery. Total recovery from sedation, induced by the analgesic, was rapid and occurred in all cases within 10 minutes of discontinuation of the drug.

The use of the Remifentanyl offers important advantages compared to local anaesthetic infiltration alone; in fact, it allowed the anaesthetic to be delivered according to the needs not only of the surgeon, but also the surgical steps, and to avoid high and superfluous dosage with reduction in the collateral symptoms (nausea, dizziness) of the patients, typical of opioids.

Remifentanyl allowed the operation to be carried out rapidly, with reduced complications thanks to good patient collaboration which results in a shorter hospitalisation period, with obvious positive effects on the patient and, in turn, a reduction in social and medical costs.

## Conclusions

In conclusion, to guarantee good functional results, especially in surgery for otosclerosis, the anaesthesiological technique should be optimised to respond to the needs of the surgeon and to be well tolerated by the patient. Of fundamental importance to achieving an optimal end result is the collaboration between the anaesthesiologist and the surgeon.

Remifentanyl, an opioid analgesic, has been used in combination with a local anaesthetic for the past two years at our Institute; this has led to an improvement with respect to the local anaesthetic technique previously used, with a clear decrease in intra- and post-operative neurovegetative symptoms such as dizziness, nausea, vomiting and pain, as well as reduced bleeding.

In addition, Remifentanyl has:

- made it possible to assess the patient's reaction during surgical manipulation near the cochlea due to good collaboration on the part of the patient;
- resulted in early ambulation of the patient since the effect is short-lived after the infusion is stopped;
- allowed the anaesthetic to be delivered according to the needs of the surgeon (speed and duration of surgery).

Therefore, Remifentanyl may, in our opinion, be successfully employed in stapedotomy procedures, for levels of consciousness in combination with a local anaesthetic.

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