

Peri-operative and long-term outcomes of patients with severe obstructive sleep apnea after Nissen-Sleeve and matched Sleeve-gastrectomy : a cohort study

Matthias Guillemot

▶ **To cite this version:**

Matthias Guillemot. Peri-operative and long-term outcomes of patients with severe obstructive sleep apnea after Nissen-Sleeve and matched Sleeve-gastrectomy : a cohort study. Human health and pathology. 2021. dumas-03603114

HAL Id: dumas-03603114
https://dumas.ccsd.cnrs.fr/dumas-03603114

Submitted on 9 Mar 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial - ShareAlike| 4.0 International License

UNIVERSITE DE MONTPELLIER
FACULTE DE MEDECINE MONTPELLIER-NIMES

THESE

Pour obtenir le titre de
DOCTEUR EN MEDECINE

Présentée et soutenue publiquement
Par
Matthias GUILLEMOT

le 6/12/2021

Peri-operative and long-term outcomes of patients with severe obstructive sleep apnea after Nissen-Sleeve and matched Sleeve-gastrectomy : a cohort study

Directrice de thèse :
Docteur Audrey DE JONG

Président :
Professeur Samir JABER
PROFESSEUR DES UNIVERSITÉS - Anesthésie réanimation

Assesseurs :
Professeur David NOCCA
PROFESSEUR DES UNIVERSITÉS – Chirurgie Digestive

Professeur Arnaud BOURDIN
PROFESSEUR DES UNIVERSITÉS – Pneumologie

Docteur Audrey DE JONG
MAITRE DE CONFERENCE DES UNIVERSITÉS - Anesthésie réanimation

Université de Montpellier
FACULTÉ de MÉDECINE
Montpellier-Nîmes

ANNEE UNIVERSITAIRE 2020 - 2021

PERSONNEL ENSEIGNANT

Professeurs Honoraires

ALBAT Bernard
ALLIEU Yves
ALRIC Robert
ARNAUD Bernard
ASENCIO Gérard
ASTRUC Jacques
AUSSILLOUX Charles
AVEROUS Michel
AYRAL Guy
BAILLAT Xavier
BALDET Pierre
BALDY-MOULINIER Michel
BALMES Jean-Louis
BANSARD Nicole
BAYLET René
BILLIARD Michel
BLARD Jean-Marie
BLAYAC Jean Pierre
BLOTMAN Francis
BONNEL François
BOURGEOIS Jean-Marie
BOUSQUET Jean
BRUEL Jean Michel
BUREAU Jean-Paul
BRUNEL Michel
CANAUD Bernard
CHAPTAL Paul-André
CIURANA Albert-Jean
CLOT Jacques
COSTA Pierre
D'ATHIS Françoise
DEMAILLE Jacques
DESCOMPS Bernard
DIMEGLIO Alain
DUBOIS Jean Bernard
DUJOLS Pierre
DUMAS Robert
DUMAZER Romain
ECHENNE Bernard
FABRE Serge
FREREBEAU Philippe
GALIFER René Benoît
GODLEWSKI Guilhem
GRASSET Daniel
GUILHOU Jean-Jacques
GUITER Pierre
HEDON berbard
HERTAULT Jean
HUMEAU Claude
JAFFIOL Claude
JANBON Charles
JANBON François
JARRY Daniel
JOURDAN Jacques
KLEIN Bernard
LAFFARGUE François
LALLEMANT Jean Gabriel
LAMARQUE Jean-Louis
LAPEYRIE Henri
LEROUX Jean-Louis
LESBROS Daniel
LOPEZ François Michel
LORIOT Jean
LOUBATIERES Marie Madeleine
MAGNAN DE BORNIER Bernard
MARTY ANE Charles
MARY Henri
MATHIEU-DAUDE Pierre
MEYNADIER Jean
MICHEL François-Bernard
MION Charles
MION Henri
MIRO Luis
NAVARRO Maurice
NAVRATIL Henri
OTHONIEL Jacques
PAGES Michel
PEGURET Claude
PELISSIER Jacques
PETIT Pierre
POUGET Régis
PUJOL Henri
RABISCHONG Pierre
RAMUZ Michel
REBOUL Jean
RIEU Daniel
ROCHEFORT Henri
ROUANET DE VIGNE LAVIT Jean Pierre
SAINT AUBERT Bernard
SANCHO-GARNIER Hélène
SANY Jacques
SEGNARBIEUX François
SENAC Jean-Paul
SERRE Arlette
SOLASSOL Claude
VIDAL Jacques
VISIER Jean Pierre

Université de Montpellier
FACULTÉ de MÉDECINE
Montpellier-Nîmes

Professeurs Emérites

ARTUS Jean-Claude
BLANC François
BONAFE Alain
BOULENGER Jean-Philippe
BOURREL Gérard
BRINGER Jacques
CLAUSTRES Mireille
DAURES Jean-Pierre
DAUZAT Michel
DAVY Jean-Marc
DEDET Jean-Pierre
ELEDJAM Jean-Jacques
GROLLEAU RAOUX Robert
GUERRIER Bernard
GUILLOT Bernard
JONQUET Olivuer
LANDAIS Paul
LARREY Dominique
LE QUELLEC Alain
MARES Pierre
MAUDELONDE Thierry
MAURY Michèle
MESSNER Patrick
MILLAT Bertrand
MONNIER Louis
MOURAD Georges
PREFAUT Christian
PUJOL Rémy
RIBSTEIN Jean
SCHVED Jean-François
SULTAN Charles
TOUCHON Jacques
UZIEL Alain
VOISIN Michel
ZANCA Michel

Docteurs Emérites

PRAT Dominique
PUJOL Joseph

Université de Montpellier
FACULTÉ de MÉDECINE
Montpellier-Nîmes

ANNEE UNIVERSITAIRE 2020 - 2021

PERSONNEL ENSEIGNANT

Professeurs des Universités - Praticiens Hospitaliers

PU-PH de classe exceptionnelle

ALRIC Pierre	Chirurgie vasculaire ; médecine vasculaire (option chirurgie vasculaire)
BACCINO Eric	Médecine légale et droit de la santé
BASTIEN Patrick	Parasitologie et mycologie
BEREGI Jean-Paul	Radiologie et imagerie médicale
BLAIN Hubert	Médecine interne ; gériatrie et biologie du vieillissement, médecine générale, addictologie
BOULOT Pierre	Gynécologie-obstétrique ; gynécologie médicale
CAPDEVILA Xavier	Anesthésiologie-réanimation et médecine péri-opératoire
CHAMMAS Michel	Chirurgie orthopédique et traumatologique
COLSON Pascal	Anesthésiologie-réanimation et médecine péri-opératoire
COMBE Bernard	Rhumatologie
COSTES Valérie	Anatomie et cytologie pathologiques
COTTALORDA Jérôme	Chirurgie infantile
COUBES Philippe	Neurochirurgie
COURTET Philippe	Psychiatrie d'adultes ; addictologie
CRAMPETTE Louis	Oto-rhino-laryngologie
CRISTOL Jean Paul	Biochimie et biologie moléculaire
CYTEVAL Catherine	Radiologie et imagerie médicale
DE LA COUSSAYE Jean Emmanuel	Médecine d'urgence
DE WAZIERES Benoît	Médecine interne ; gériatrie et biologie du vieillissement, médecine générale, addictologie
DELAPORTE Eric	Maladies infectieuses ; maladies tropicales
DEMOLY Pascal	Pneumologie ; addictologie
DOMERGUE Jacques	Chirurgie viscérale et digestive

DUFFAU Hugues	Neurochirurgie
ELIAOU Jean François	Immunologie
FABRE Jean Michel	Chirurgie viscérale et digestive
FRAPIER Jean-Marc	Chirurgie thoracique et cardiovasculaire
HAMAMAH Samir	Biologie et Médecine du développement et de la reproduction ; gynécologie médicale
HERISSON Christian	Médecine physique et de réadaptation
JABER Samir	Anesthésiologie-réanimation et médecine péri-opératoire
JEANDEL Claude	Médecine interne ; gériatrie et biologie du vieillissement, médecine générale, addictologie
JORGENSEN Christian	Thérapeutique ; médecine d'urgence ; addictologie
KOTZKI Pierre Olivier	Biophysique et médecine nucléaire
LABAUGE Pierre	Neurologie
LEFRANT Jean-Yves	Anesthésiologie-réanimation et médecine péri-opératoire
LEHMANN Sylvain	Biochimie et biologie moléculaire
LUMBROSO Serge	Biochimie et Biologie moléculaire
MERCIER Jacques	Physiologie
MEUNIER Laurent	Dermato-vénéréologie
MONDAIN Michel	Oto-rhino-laryngologie
MORIN Denis	Pédiatrie
PAGEAUX Georges-Philippe	Gastroentérologie ; hépatologie ; addictologie
PUJOL Pascal	Biologie cellulaire
QUERE Isabelle	Chirurgie vasculaire ; médecine vasculaire (option médecine vasculaire)
RENARD Eric	Endocrinologie, diabète et maladies métaboliques ; gynécologie médicale
REYNES Jacques	Maladies infectieuses, maladies tropicales
RIPART Jacques	Anesthésiologie-réanimation et médecine péri-opératoire
ROUANET Philippe	Cancérologie ; radiothérapie
SOTTO Albert	Maladies infectieuses ; maladies tropicales
TAOUREL Patrice	Radiologie et imagerie médicale

TOUITOU Isabelle	Génétique
VANDE PERRE Philippe	Bactériologie-virologie ; hygiène hospitalière
YCHOU Marc	Cancérologie ; radiothérapie

PU-PH de 1re classe

AGUILAR MARTINEZ Patricia	Hématologie ; transfusion
ASSENAT Éric	Gastroentérologie ; hépatologie ; addictologie
AVIGNON Antoine	Nutrition
AZRIA David	Cancérologie ; radiothérapie
BAGHDADLI Amaria	Pédopsychiatrie ; addictologie
BLANC Pierre	Gastroentérologie ; hépatologie ; addictologie
BORIE Frédéric	Chirurgie viscérale et digestive
BOURDIN Arnaud	Pneumologie ; addictologie
CAMBONIE Gilles	Pédiatrie
CAMU William	Neurologie
CANOVAS François	Anatomie
CAPTIER Guillaume	Anatomie
CARTRON Guillaume	Hématologie ; transfusion
CAYLA Guillaume	Cardiologie
CHANQUES Gérald	Anesthésiologie-réanimation et médecine péri-opératoire
CORBEAU Pierre	Immunologie
COULET Bertrand	Chirurgie orthopédique et traumatologique
CUVILLON Philippe	Anesthésiologie-réanimation et médecine péri-opératoire
DADURE Christophe	Anesthésiologie-réanimation et médecine péri-opératoire
DAUVILLIERS Yves	Physiologie
DE TAYRAC Renaud	Gynécologie-obstétrique, gynécologie médicale
DE VOS John	Histologie, embryologie et cytogénétique

DEMARIA Roland	Chirurgie thoracique et cardio-vasculaire
DEREURE Olivier	Dermatologie - vénéréologie
DROUPY Stéphane	Urologie
DUCROS Anne	Neurologie
DUPEYRON Arnaud	Médecine physique et de réadaptation
FESLER Pierre	Médecine interne ; gériatrie et biologie du vieillissement, médecine générale, addictologie
GARREL Renaud	Oto-rhino-laryngologie
GENEVIEVE David	Génétique
GUILLAUME Sébastien	Psychiatrie d'adultes ; addictologie
GUIU Boris	Radiologie et imagerie médicale
HAYOT Maurice	Physiologie
HOUEDE Nadine	Cancérologie ; radiothérapie
KLOUCHE Kada	Médecine intensive-réanimation
KOENIG Michel	Génétique
KOUYOUMDJIAN Pascal	Chirurgie orthopédique et traumatologique
LAFFONT Isabelle	Médecine physique et de réadaptation
LAVABRE-BERTRAND Thierry	Histologie, embryologie et cytogénétique
LAVIGNE Jean-Philippe	Bactériologie-virologie ; hygiène hospitalière
LE MOING Vincent	Maladies infectieuses ; maladies tropicales
LECLERCQ Florence	Cardiologie
MARIANO-GOULART Denis	Biophysique et médecine nucléaire
MATECKI Stéfan	Physiologie
MORANNE Olivier	Néphrologie
MOREL Jacques	Rhumatologie
NAVARRO Francis	Chirurgie viscérale et digestive
NOCCA David	Chirurgie viscérale et digestive
PASQUIE Jean-Luc	Cardiologie

PERNEY Pascal	Médecine interne ; gériatrie et biologie du vieillissement, médecine générale, addictologie
PRUDHOMME Michel	Anatomie
PUJOL Jean Louis	Pneumologie ; addictologie
PURPER-OUAKIL Diane	Pédopsychiatrie ; addictologie
ROGER Pascal	Anatomie et cytologie pathologiques
TRAN Tu-Anh	Pédiatrie
VERNHET Hélène	Radiologie et imagerie médicale

PU-PH de 2ème classe

BOURGIER Céline	Cancérologie; radiothérapie
CANAUD Ludovic	Chirurgie vasculaire ; médecine vasculaire (option chirurgie vasculaire)
CAPDEVIELLE Delphine	Psychiatrie d'Adultes ; addictologie
CLARET Pierre-Géraud	Médecine d'urgence
COLOMBO Pierre-Emmanuel	Cancérologie ; radiothérapie
COSTALAT Vincent	Radiologie et imagerie médicale
DAIEN Vincent	Ophtalmologie
DORANDEU Anne	Médecine légale et droit de la santé
FAILLIE Jean-Luc	Pharmacologie fondamentale ; pharmacologie clinique ; addictologie
FUCHS Florent	Gynécologie-obstétrique ; gynécologie médicale
GABELLE DELOUSTAL Audrey	Neurologie
GAUJOUX Viala Cécile	Rhumatologie
GODREUIL Sylvain	Bactériologie-virologie ; hygiène hospitalière
GUILPAIN Philippe	Médecine Interne, gériatrie et biologie du vieillissement; addictologie
HERLIN Christian	Chirurgie plastique, reconstructrice et esthétique, brulologie
IMMEDIATO DAIEN Claire	Rhumatologie
JACOT William	Cancérologie ; Radiothérapie
JEZIORSKI Eric	Pédiatrie

JUNG Boris	Médecine intensive-réanimation
KALFA Nicolas	Chirurgie infantile
LACHAUD Laurence	Parasitologie et mycologie
LALLEMANT Benjamin	Oto-rhino-laryngologie
LE QUINTREC DONNETTE Moglie	Néphrologie
LETOUZEY Vincent	Gynécologie-obstétrique ; gynécologie médicale
LONJON Nicolas	Neurochirurgie
LOPEZ CASTROMAN Jorge	Psychiatrie d'Adultes ; addictologie
LUKAS Cédric	Rhumatologie
MENJOT de CHAMPFLEUR Nicolas	Radiologie et imagerie médicale
MILLET Ingrid	Radiologie et imagerie médicale
MURA Thibault	Biostatistiques, informatique médicale et technologies de la communication
NAGOT Nicolas	Biostatistiques, informatique médicale et technologies de la communication
OLIE Emilie	Psychiatrie d'adultes; addictologie
PANARO Fabrizio	Chirurgie viscérale et digestive
PARIS Françoise	Biologie et médecine du développement et de la reproduction ; gynécologie médicale
PELLESTOR Franck	Histologie, embryologie et cytogénétique
PEREZ MARTIN Antonia	Chirurgie vasculaire ; médecine vasculaire (option médecine vasculaire)
POUDEROUX Philippe	Gastroentérologie ; hépatologie ; addictologie
RIGAU Valérie	Anatomie et cytologie pathologiques
RIVIER François	Pédiatrie
ROSSI Jean François	Hématologie ; transfusion
ROUBILLE François	Cardiologie
SEBBANE Mustapha	Médecine d'urgence
SIRVENT Nicolas	Pédiatrie
SOLASSOL Jérôme	Biologie cellulaire
STOEBNER Pierre	Dermato-vénéréologie

SULTAN Ariane	Nutrition
THOUVENOT Éric	Neurologie
THURET Rodolphe	Urologie
TUAILLON Edouard	Bactériologie-virologie; hygiène hospitalière
VENAIL Frédéric	Oto-rhino-laryngologie
VILLAIN Max	Ophtalmologie
VINCENT Denis	Médecine interne ; gériatrie et biologie du vieillissement, médecine générale, addictologie
VINCENT Thierry	Immunologie
WOJTUSCISZYN Anne	Endocrinologie-diabétologie-nutrition

PROFESSEURS DES UNIVERSITES

1re classe :

COLINGE Jacques (Cancérologie, Signalisation cellulaire et systèmes complexes)

LAOUDJ CHENIVESSE Dalila (Biochimie et biologie moléculaire)

VISIER Laurent (Sociologie, démographie)

PROFESSEURS DES UNIVERSITES - Médecine générale

1re classe :

LAMBERT Philippe

AMOUYAL Michel

PROFESSEURS ASSOCIES - Médecine Générale

CLARY Bernard

DAVID Michel

GARCIA Marc

Université de Montpellier
FACULTÉ de MÉDECINE
Montpellier-Nîmes

PROFESSEURS ASSOCIES - Médecine

BESSIS Didier (Dermato-vénéréologie)

MEUNIER Isabelle (Ophtalmologie)

MULLER Laurent (Anesthésiologie-réanimation et médecine péri-opératoire)

PERRIGAULT Pierre-François (Anesthésiologie-réanimation et médecine péri-opératoire)

QUANTIN Xavier (Pneumologie)

ROUBERTIE Agathe (Pédiatrie)

VIEL Eric (Soins palliatifs et traitement de la douleur)

Université de Montpellier
FACULTÉ de MÉDECINE
Montpellier-Nîmes

ANNEE UNIVERSITAIRE 2020 - 2021

PERSONNEL ENSEIGNANT

Maîtres de Conférences des Universités - Praticiens Hospitaliers

MCU-PH Hors classe - Echelon Exceptionnel

RICHARD Bruno	Médecine palliative
SEGONDY Michel	Bactériologie-virologie ; hygiène hospitalière

MCU-PH Hors classe

BADIOU Stéphanie	Biochimie et biologie moléculaire
BOULLE Nathalie	Biologie cellulaire
CACHEUX-RATABOUL Valère	Génétique
CARRIERE Christian	Bactériologie-virologie ; hygiène hospitalière
CHARACHON Sylvie	Bactériologie-virologie ; hygiène hospitalière
FABBRO-PERAY Pascale	Epidémiologie, économie de la santé et prévention
GIANSILY-BLAIZOT Muriel	Hématologie ; transfusion

MCU-PH de 1re classe

BERTRAND Martin	Anatomie
BOUDOUSQ Vincent	Biophysique et médecine nucléaire
BRET Caroline	Hématologie biologique
BROUILLET Sophie	Biologie et médecine du développement et de la reproduction ; gynécologie médicale
COSSEE Mireille	Génétique
GIRARDET-BESSIS Anne	Biochimie et biologie moléculaire
LAVIGNE Géraldine	Hématologie ; transfusion
LESAGE François-Xavier	Médecine et Santé au Travail
MARTRILLE Laurent	Médecine légale et droit de la santé
MATHIEU Olivier	Pharmacologie fondamentale ; pharmacologie clinique ; addictologie

MOUZAT Kévin	Biochimie et biologie moléculaire
PANABIERES Catherine	Biologie cellulaire
RAVEL Christophe	Parasitologie et mycologie
SCHUSTER-BECK Iris	Physiologie
STERKERS Yvon	Parasitologie et mycologie
THEVENIN-RENECéline	Immunologie

MCU-PH de 2ème classe

BERGOUGNOUX Anne	Génétique
CHIRIAC Anca	Immunologie
DE JONG Audrey	Anesthésiologie-réanimation et médecine péri-opératoire
DU THANH Aurélie	Dermato-vénéréologie
FITENI Frédéric	Cancérologie ; radiothérapie
GOUZI Farès	Physiologie
HERRERO Astrid	Chirurgie viscérale et digestive
HUBERLANT Stéphanie	Gynécologie-obstétrique ; Gynécologie médicale
KUSTER Nils	Biochimie et biologie moléculaire
MAKINSON Alain	Maladies infectieuses, Maladies tropicales
PANTEL Alix	Bactérologie-virologie ; hygiène hospitalière
PERS Yves-Marie	Thérapeutique; addictologie
ROUBILLE Camille	Médecine interne ; gériatrie et biologie du vieillissement ; addictologie
SZABLEWSKY	Anatomie et cytologie pathologiques

Université de Montpellier
FACULTÉ de MÉDECINE
Montpellier-Nîmes

Maîtres de Conférences des Universités - Médecine Générale

MCU-MG de 1re classe

COSTA David

OUDE ENGBERINK Agnès

MCU-MG de 2ème classe

FOLCO-LOGNOS Béatrice

CARBONNEL François

Maîtres de Conférences associés - Médecine Générale

CAMPAGNAC Jérôme

LOPEZ Antonio

MILLION Elodie

PAVAGEAU Sylvain

REBOUL Marie-Catherine

SERAYET Philippe

Université de Montpellier
FACULTÉ de MÉDECINE
Montpellier-Nîmes

ANNEE UNIVERSITAIRE 2020 - 2021

PERSONNEL ENSEIGNANT

Maitres de Conférences des Universités

Maîtres de Conférences hors classe

BADIA Eric	Sciences biologiques fondamentales et cliniques
CHAZAL Nathalie	Biologie cellulaire

Maîtres de Conférences de classe normale

BECAMEL Carine	Neurosciences
BERNEX Florence	Physiologie
CHAUMONT-DUBEL Séverine	Sciences du médicament et des autres produits de santé
DELABY Constance	Biochimie et biologie moléculaire
GUGLIELMI Laurence	Sciences biologiques fondamentales et cliniques
HENRY Laurent	Sciences biologiques fondamentales et cliniques
HERBET Guillaume	Neurosciences
LADRET Véronique	Mathématiques appliquées et applications des mathématiques
LAINE Sébastien	Sciences du Médicament et autres produits de santé
LE GALLIC Lionel	Sciences du médicament et autres produits de santé
LOZZA Catherine	Sciences physico-chimiques et technologies pharmaceutiques
MAIMOUN Laurent	Sciences physico-chimiques et ingénierie appliquée à la santé
MOREAUX Jérôme	Science biologiques, fondamentales et cliniques
MORITZ-GASSER Sylvie	Neurosciences
MOUTOT Gilles	Philosophie
PASSERIEUX Emilie	Physiologie
RAMIREZ Jean-Marie	Histologie
RAYNAUD Fabrice	Sciences du Médicament et autres produits de santé
TAULAN Magali	Biologie Cellulaire

Université de Montpellier
FACULTÉ de MÉDECINE
Montpellier-Nîmes

ANNEE UNIVERSITAIRE 2020 - 2021

PERSONNEL ENSEIGNANT

Praticiens Hospitaliers Universitaires

BARATEAU Lucie	Physiologie
BASTIDE Sophie	Epidémiologie, économie de la santé et prévention
CAZAUBON Yoann	Pharmacologie fondamentale ; pharmacologie clinique ; addictologie
DAGNEAUX Louis	Chirurgie orthopédique et traumatologique
DUFLOS Claire	Biostatistiques, informatique médicale et technologies de la communication
GOULABCHAND Radjiv	Médecine interne ; gériatrie et biologie du vieillissement ; addictologie
LATTUCA Benoit	Cardiologie
MARIA Alexandre	Médecine interne ; gériatrie et biologie du vieillissement ; addictologie
MIOT Stéphanie	Médecine interne ; gériatrie et biologie du vieillissement ; addictologie
SARRABAY Guillaume	Génétique
SOUCHE François-Régis	Chirurgie viscérale et digestive

Université de Montpellier
FACULTÉ de MÉDECINE
Montpellier-Nîmes

ANNEE UNIVERSITAIRE 2020 - 2021

PERSONNEL ENSEIGNANT

PH chargés d'enseignements

ABOUKRAT Patrick	BLANCHET Catherine	COROIAN Flavia-Oana	GINIES Patrick
AKKARI Mohamed	BLATIERE Véronique	COUDRAY Sarah	GRECO Frédéric
ALRIC Jérôme	BOBBIA Xavier	CRANSAC Fréderic	GUEDJ Anne Marie
AMEDRO Pascal	BOGE Gudrun	CUNTZ Danielle	GUYON Gaël
AMOUROUX Cyril	BOURRAIN Jean Luc	DARDALHON Brigitte	HENRY Vincent
ANTOINE Valéry	BOUYABRINE Hassan	DAVID Aurore	JAMMET Patrick
ARQUIZAN Caroline	BRINGER-DEUTSCH Sophie	DE BOUTRAY Marie	JEDRYKA François
ATTALIN Vincent	BRINGUIER BRANCHEREAU Sophie	DE LA TRIBONNIÈRE Xavier	JREIGE Riad
AYRIGNAC Xavier	BRISOT Dominique	DEBIEN Blaise	KINNE Mélanie
BADR Maliha	BRONER Jonathan	DELPONT Marion	LABARIAS Coralie
BAIS Céline	CADE Stéphane	DENIS Hélène	LACAMBRE Mathieu
BARBAR Saber Davide	CAIMMI Davide Paolo	DEVILLE de PERIERE Gilles	LANG Philippe
BASSET Didier	CARR Julie	DJANIKIAN Flora	LAZERGES Cyril
BATIFOL Dominique	CARTIER César	DONNADIEU-RIGOLE Hélène	LE GUILLOU Cédric
BATTISTELLA Pascal	CASPER Thierry	FAIDHERBE Jacques	LEGLISE Marie Suzanne
BAUCHET Luc	CASSINOTTO Christophe	FATTON Brigitte	LOPEZ Régis
BENEZECH Jean-Pierre	CATHALA Philippe	FAUCHERRE Vincent	LUQUIENS Amandine
BENNYS Karim	CAZABAN Michel	FILLERON Anne	MANZANERA Cyril
BERNARD Nathalie	CHARBIT Jonathan	FITENI Frédéric	MARGUERITTE Emmanuel
BERTCHANSKY Ivan	CHEVALLIER Thierry	FOURNIER Philippe	MARTIN Lucille
BIBOULET Philippe	CHEVALLIER-MICHAUD Josyane	GAILLARD Nicolas	MATTATIA Laurent
BIRON-ANDREANI Christine	COLIN Olivier	GALMICHE Sophie	MEROUEH Fadi
BLANC Brigitte	CONSEIL Mathieu	GENY Christian	MEYER Pierre
BLANCHARD Sylvie	CORBEAU Catherine	GERONIMI Laetitia	MILESI Christophe

Université de Montpellier
FACULTÉ de MÉDECINE
Montpellier-Nîmes

MORAU Estelle	SEGURET Fabienne
MOSER Camille	SENESSE Pierre
MOUSTY Eve	SKALLI El Medhi
MOUTERDE Gaël	SOLA Christelle
PANSARD Nicole	SOULLIER Camille
PERNIN Vincent	STOEBNER DELBARRE Anne
PERRIGAULT Pierre François	TEOT Luc
PEYRON Pierre-Antoine	THIRION Marina
PICARD Eric	VACHIERY-LAHAYE Florence
PICOT Marie Christine	VERNES Eric
PIERONI Laurence	VINCENT Laure
POQUET Hélène	WAGNER Laurent
PUJOL Sarah-Lise	ZERKOWSKI Laetitia
PUPIER Florence	
QUANTIN Xavier	
RAFFARD Laurence	
RAPIDO Francesca	
RIBRAULT Alice	
RICHAUD-MOREL Brigitte	
RIDOLFO Jérôme	
RIPART Sylvie	
RONGIERES Michel	
ROULET Agnès	
RUBENOVITCH Josh	
SANTONI Fannie	
SASSO Milène	
SCHULDINER Sophie	

Remerciements

Aux membres du Jury :

Professeur Samir Jaber

Vous me faites l'honneur de présider ce jury et je vous en remercie. Veuillez trouver ici le témoignage de mon plus grand respect pour vos enseignements et vos valeurs. L'accueil dans votre équipe à Saint-Eloi a été exemplaire.

Professeur David Nocca

Merci de m'avoir permis de travailler sur cette cohorte. Plus forte encore est la gratitude que ces patients expriment des années après et dont j'ai été témoin, mon regard sur la chirurgie bariatrique en sera marqué. Egalement, une pensée pour vous ponctuera mes venues au port de Sète.

Professeur Arnaud Bourdin

Je vous remercie d'avoir accepté de juger ce travail, votre regard de pneumologue sera précieux. Vous avez su vous rendre accessible et avenant et je vous en remercie.

Docteur De Jong

Audrey, c'est grâce à toi que j'ai pu conclure ces années, avec fluidité. Dès notre premier contact à Saint-Eloi j'ai su que ça matcherai, avec ou sans mauvais jeu de mots. Ça a été un plaisir de travailler et d'échanger avec toi. Tu as vraiment une personnalité unique et rare. Je te souhaite un épanouissement toujours plus grand dans ta carrière universitaire, un peu, mais surtout le reste.

A ma Famille :

A ma **mère** et **mon père,** que j'aime et admire.

Cathy, tu es mon troisième parent de fait. Ni le temps ni la distance ne changera le fait que tu m'as élevé, je te dois plus que je ne puisse l'imaginer.

Mathilde, je suis là pour toi et le serai toujours. Je sais que l'inverse est vrai, même si on ne sait pas trop se le dire.

Gaëlle, simplicité, tempérance, je ne sais pas ce qui fait que c'est si bon de passer du temps ensemble. Que ca dure.

Christophe, tu fais partie de mes modèles, sincèrement. Mais, modèle pour tes domaines comme la culture, le sarcasme, le sens commun, la musique ou encore les déclarations d'imposition. Pour les cheveux ou l'horticulture par exemple t'es moins mon modèle.

Louna, tu n'imagines pas comme c'est intéressant de t'avoir vu grandir, devenir adulte (ou franchement pas loin). Tu vas m'épater, je le sais.
Constance, toi aussi j'ai hâte que tu grandisses, c'est un bonheur de te voir.

Axelle, grâce à toi si je suis passé de geek hardcore à geek normal-cool, merci de ton intervention en date. Je suis heureux d'avoir enfin l'occasion de rentrer dans ton monde calédonien. En espérant qu'un jour quand même tu reviennes dans le nôtre. **Vincent, Camille, Maxence** on a du temps à rattraper.

Gregoire, si on avait pas été cousins, on aurait pu être frères. Pas jumeaux mais pas loin. Tu manques plus que tu ne l'imagines.

A **Pierrot** et **Guy**, les chibani.

Au clan **Cessot**, une famille de second ordre, certes, mais de première classe.

A mes Maîtres dans l'Art,
comme on disait dans l'temps

Benoit Bataille, de tous les médecins que j'ai côtoyé, tu as indubitablement les synapses les mieux fournies. J'ai beaucoup appris en t'écoutant simplement parler, ta culture scientifique est éblouissante.

Pierre Coquet : « le Bon sens paysan en unité de soins critiques », bientôt disponible en livre de poche. Une façon d'exercer inspirante. Je regrette de ne pas avoir gardé contact.

Estelle Morau, si je crois savoir communiquer avec les futures maman, c'est que tu m'en a donné sinon les clés, la volonté.

Pierre Barbaste, le réanimateur aux poumons d'acier. Etonnant, non ? Merci pour la ballade hypnotique. J'ai apprécié ces instants métaphysiques ponctués de Gauloise et de café, sans filtre. Un personnage inspirant et inspiré.

JC Sleth, ce ~~vieux~~ gourou de l'anesthésie. Le Lucky Luke de la péri. Tu m'as enseigné de la meilleur façon qui soit, par l'exemple, et avec des trucs qui marchent. J'aurai aimé en croiser plus des comme toi, mais bon tant pis, y'en a pas.

M'sieur **Yvan**, tu auras été mon mentor de cette fin d'internat, je continue de garder tous tes conseils dans un coin de ma tête. Je te dois un peu pour cette thèse, mais surtout pour le reste. Respects et amitiés.

A mes coloc'

Tous mes meilleurs amis d'un temps

Damien, une rencontre si peu probable, une amitié rapidement évidente, c'est grâce à toi que je suis là. Enfin, ici. Bref je t'ai suivi.

Matthieu, on se les fera ces soirées 30 ans après. En attendant, n'attendons pas.

Nico, le Roi des éléphants, tu as rêvé du Mont-Vénus pelé, tu as rejoint la Montagne qui l'est. Arrête de te cacher, même sur ton île on viendra te chercher.

Mein geliebt freund **JIB**, du hast mich gelerht, dass in diese veruckten gefickt welt, mann muss wie Schrittgeschwindigkeitness sich verhalten. Kennst du dass nicht? Schrittgeschwindigkeitness? It's like "chillin'", before it was mainstream. Enfin bref, comme dit le proverbe « Alles schade, alles trist wenn du fern von mir bist ». Gibt das Wort an Anne weiter, in Hochdeutsche bitte. Tu la mérites.

Brou, depuis depuis que tu as été porté disparu et retrouvé une semaine plus tard échoué sur notre canapé, je dois te compter dans les coloc, pas le choix. Ravi de pas t'avoir perdu !

Alexis, je sais pas si j'ai apprécié notre cohabitation, je pense qu'on devrait retenter le coup juste pour être sûr.

Gros, je n'aurai pas assez d'un codex pour coucher à l'écrit ces moments de rire partagés, et les souvenirs sont parfois brouillés. Alors ce carnet, il faut le retrouver!

Malou, t'es plus que la copine de mon ami. Fini. Plus je te connais, plus j'ai envie de te connaitre.

Yann, avec toi le soleil chante, les oiseaux brillent, et ça sent le tabac chaud. On s'quitte pas nigga'.

Jean-kévin, Marion, Mam' Bourdass, Florent et ma très chère **Naïs**, je penserai à vous à chaque bénédicité. Amen. Une joyeuse coloc.

Caroline, sache que je n'en ai jamais voulu à Mina, je dors sur son urine séchée depuis 3 ans et ça sent presque rien.

Corentin, j'ai longtemps parcouru ton corps, babylone, effleuré 100 fois ton visage et j'ai trouvé qu'on est vraiment comme les quatre doigts de la main tous les deux, alors sans vouloir vendre la peau de l'ours avant les bœufs, j'aimerai qu'on embarque celui qui suit et on part en tournée. Parce que c'est notre projet.

Nico, j'ai pas les mots. Je les ai perdus, ou peut-être oublié quelque part… c'était sur un bout de papier, je sais plus ce que j'avais écrit, mais ça parlait de loukoum et de froissartage en milieu hostile il me semble, ça parait insensé dit comme ça mais c'était un texte fluide avec des beaux passages sur l'amitié au grand air. Non, rien de sexuel, non. Dommage que j'ai perdu les mots ça t'aurai ému.

Et les derniers coloc : Toute la **Communauté Belleau**, une belle somme d'individus excentriques qui donne un tableau vraiment pas triste.

Mes amis du lycée, **Marion & Nico**, finalement ceux qui restent. Merci de m'avoir recueilli quand j'étais petit oisillon chétif et farouche d'1m42. C vous, ceux qui restent. Même si d'autres ont compté, il est trop tard, je dois imprimer cette thèse vraiment bientôt alors je passe les commentaires sur Eve, Gaëtan, Frank, Nico, Romane…

Timothée, tu es sans doute mon plus vieil ami, géographie aidant mais quand même... Je te souhaite le bonheur que tu mérites. C'est fou autant de qualités en un seul homme.

Marie, j'allais écrire une connerie avec un second degré mal amené, mais c'est l'heure de la sincérité, alors sache que ces sous-colles à tes côtés ont été un calvaire. C'est simple tu m'as ralenti. Et ce **Paul** que tu ramènes depuis peu il n'est pas très fréquentable. Et attache moi ces cheveux t'as l'air d'une hippie comme ça.

Ondine, tiens : compliment, compliment, compliment, compliment. T'en veux plus ? Compliment. Encore ? Compliment. Toi, on voit que t'aimes les compliments, hain ? Tiens mange-moi bien tous ces compliments. Fais comme si c'était des chips. Voiila… compliment.

Paulin : Je voulais être le premier à te citer, mais **Gary** l'a fait avant moi (toujours à se faire remarquer celui-là, s'il n'était pas un type formidable je le claquerai). Alors tant pis, tu auras tes

remerciements quand tu sauras aligner trois mots. Dernièrement c'est que du bruit, on comprend rien. Grandis un peu.

Xav : Quand tu auras fini tes tours du monde de service d'urgence, tu reviendras te poser sur mon canap' comme tu savais bien y faire.

Benben : Pam,palapam,palapam,palapam et cætera... C'est pourtant pas compliqué.

Etienne, tu retiendras que j'étais Soumraniste de la première heure. Ça mérite son lot de vierges.

Pierre, tu n'es pas que sectaire et moche, tu es surtout champion la semaine 17 de l'année 2021 sur Capitales du Monde de jeux-géo et ça, ça pardonne toutes les tares.

Lilian, tap' sur l'épaule droite. Tu t'y attendais pas hain. On règlera ce problème de flemme, demain sans faute.

Ianis, du bist über Alles man !

Les co-interne qui m'en voudront pas : Jade, Yasmina, Jacques, Thomas, aussi les autres.

Julie, **Sacha**, **Martin**, **Maëlle**, **Ambro**, **Elea**, **Alex** et la petite **Charlie**, je vous adore mais il faut vraiment que j'imprime là, c'est plus le moment de trainer alors peut être que je ne vous dirai pas à quel po… Bises.

Donc ceux qui liront ces lignes que j'ai eu le culot de ne point citer, je vous attends à la sortie et on règle ça entre hommes.

Mais aussi,

à m'amie, la mère-grand de nos petits-enfants,

à l'aventure…

SUMMARY

I. Introduction **25**

II. Materials and methods **28**

Study design & setting **28**

Patients Selection **28**

Data collection & variables **28**

Statistical analysis **31**

III. Results **32**

Study participants **32**

Baseline characteristics of the matched cohort **32**

Main primary outcome **33**

Main secondary outcome **33**

Other long-term secondary outcomes **33**

Peri-operative secondary outcomes **34**

IV. Discussion **35**

V. Conclusion **39**

Tables & Figures **40**

References **50**

I. Introduction

Obesity is a rising public health challenge of the past decades.[1–4] Far from being a condition controlled by individual choices and caused only by environmental factors, obesity involves multiple biological systems that are in a constant fight to protect us from losing body weight. Obesity is defined as excess accumulation of body fat (estimated by the Body Mass Index (BMI), which is weight in kilograms divided by height in meters squared). Above an optimal BMI comprised between 22.5 and 25 kg/m², each 5 kg/m² higher BMI is on average associated with 30% higher overall mortality.[5] In France, 47.3% of the global population is overweight (Body Mass Index [25-30] kg/m²), and 17% suffers from obesity (BMI > 30 kg/m²).[6]

The accumulation of fatty tissues in the neck narrows the upper respiratory tract, that is more likely to collapse in the supine position during sleep.[7] This phenomenon leads to an obstructive sleep breathing disorder strongly associated with obesity: obstructive sleep apnea.[8] Obstructive episodes lead to hypopnea, apnea and intermittent hypoxia (with acute drop of oxygen saturation)[9], often followed by transient brain arousal and awakenings that have multiple acute and chronic adverse consequences: excessive daytime sleepiness, car accidents, deterioration in quality of life and chronic sympathetic activation resulting in premature mortality by cardio-vascular events.[10]

In the peri-operative setting, obstructive sleep apnea and obesity are now recognized as independent risk factors of respiratory complications: difficult mask ventilation, difficult intubation and related complications, postoperative pulmonary complications including atelectasis, pneumonia, acute respiratory distress syndrome and intensive care unit admission.[11–20]

Continuous Positive-Airway-Pressure (CPAP) therapy, with a device that provides a continuous jet of air to the airway as the person breathes, helps to keep the throat from

narrowing during sleep. This device is considered the first-line therapy for severe obstructive sleep apnea. [11,21,22] However, adherence to treatment is challenging : about two thirds of patients report bad adherence.[23]

The key to obstructive sleep apnea resolution among patients with obesity is weight-loss.[24,25] Surgical procedures are more effective than medical procedures to achieve a sustainable weight loss.[26] Weight loss by non-surgical means is non-satisfactory and non-sustainable, while bariatric surgery has been proven to be the most effective mean for durable weight loss. In addition to weight loss, bariatric surgery results in cure or improvement of obstructive sleep apnea in a significant proportion of patients.[27–29] Rate of use of Sleeve gastrectomy has increased regularly and represented 61.1% of all bariatric operations in 2018, taking the share of adjustable gastric banding.[30] The middle and long-term benefits obtained with Sleeve gastrectomy regarding excessive weight-loss and resolution of comorbidities including obstructive sleep apneas result in a postoperative shift from high risk to lower risk in the American Society of Anesthesiologists (ASA) risk category.[31–42] This decrease in the ASA risk category is especially relevant for anesthesiologists, meaning a decrease in postoperative complications when the patient will experience other surgeries, months or years following the bariatric surgery.

An issue remains, as about half of patients experience de novo-gastroesophageal reflux symptoms after sleeve gastrectomy, leading to heartburn and regurgitation symptoms, chronic esophagitis, metaplasia and neoplasia, and proton-pump inhibitor dependence.[43–48] An alternative to sleeve gastrectomy with concomitant anti-reflux fundoplication (Nissen-Sleeve Gastrectomy) has recently emerged as a new valid option to treat preexisting gastroesophageal reflux disease or prevent de novo-gastroesophageal reflux apparition after sleve gastrectomy.[49–51]

The relationship between gastroesophageal reflux and sleep apnea is often overlooked. Peri-operative and long-term respiratory outcomes of patients with severe sleep obstructive sleep apneas following Nissen-sleeve have never been studied yet. The aim of this study was to investigate if the Nissen-Sleeve was associated with higher rate of CPAP discontinuation at 3 years after surgery, in comparison with Sleeve gastrectomy. The secondary objectives were to investigate if the Nissen-Sleeve was associated with a decrease in the rate of patients reporting gastroesophageal reflux symptoms and post-operative surgical and respiratory complications. We made the hypothesis that the Nissen-Sleeve would be associated with a decrease of CPAP requirement at 3 years after surgery, in comparison with Sleeve gastrectomy.

II. Materials and methods

Study design & setting

This single center, observational, historic-prospective cohort-based study was carried out at the University Hospital of Saint-Eloi, Montpellier, France.

Patients Selection

All consecutive patients who underwent Nissen-Sleeve gastrectomy or Sleeve gastrectomy as part of routine clinical care from 1st January 2018 to January 2019 were assessed for eligibility. Patients with unknown obstructive sleep apneas status or no indication for CPAP-therapy were not included.

The year 2018 to include patients was chosen as the indications of adding a Nissen-fundoplication to standard Sleeve gastrectomy evolved in our institution from patients with preoperative gastroesophageal reflux disease only to a less restrictive indication. This resulted in about a half/half distribution between Nissen-Sleeve and Sleeve gastrectomy during this year.

Data collection & variables

Data were collected prospectively through an observational cohort including all patients having a bariatric procedure in our institution. The study project has been approved by the appropriate ethics committee ‘Comité-de-Protection-des-Personnes (N° ID-RCB

: 2011-A01324-37). The need for informed consent was waived by the ethics committee. The cohort was registered on clinicaltrials.gov “NCT02310178”. The data were collected

during systematic pre and post-operative check-in by a multidisciplinary medical and paramedical team dedicated to bariatric surgical patients. The patients who did not fulfill their check-ins and whose personal data was outdated were tracked. They were contacted privately by phone call conducted by a single medical assistant, blinded from the type of surgery, at 3-years follow-up between January and June 2021. Missing baseline characteristics were completed retrospectively using the patient's medical record.

All patients were screened for obstructive sleep apnea before surgery by either intra-hospital or ambulatory nocturnal polygraphic assessment. Obstructive sleep apnea status and apnea-hypopnea index values were evaluated by patient's chosen sleep-physicist using his routine definition criteria. The demographic profile and comorbidities were collected during multidisciplinary (surgeon, endocrinologist, anesthesiologist) medical consultation conducted between 1 week and 3 months before surgery. Ideal body weight (kg) and excess body weight (kg) were calculated using Devine formula.

Per-operative data were collected through the anesthetic per-operative and post-anesthesia care unit (PACU) report file: surgery duration (from incision to closure), positive pressure pre-oxygenation, rapid sequence induction, type of neuromuscular blocker used, difficult mask ventilation, Cormack score, minimal post-induction oxygen saturation, minimal mean non-invasive arterial pressure, per-operative surgical complication, Sequential Acute Physiologic Score II (SAPS-II) on monitored care unit admission, in PACU: CPAP use, oxygen support and length of stay. Post-operative complications were collected prospectively and retrospectively based on medical record (DxCare®).

Long-terms outcomes were collected on systematic post-operative ambulatory one-day-hospitalization visit proposed yearly for each patient. Missing variables were collected during a private phone-teleconsultation conducted by a physicist blinded to the type of surgery. Patients were asked about CPAP discontinuation, if they undergo sleep study before discontinuation, about self-reported CPAP adherence, about residual obstructive sleep apnea manifestation (American Association of Sleep Medicine, International Classification of Sleep Disorder-3 criteria and STOP-BANG questionnaire without neck circumference as this data was not collected), about current sleep-physicist follow-up, current weight, nadir weight, physical activity habits (Short-Form-36 quality of life questionnaire physical activity assessment and resulting metabolic equivalent (eqMET) categorization), gastroesophageal reflux symptoms (occasional or daily heartburn or regurgitation) and anti-acid intake (occasional or daily)**,** insulin or oral antidiabetic discontinuation and if their antihypertensive treatment was lightened or discontinued.

The primary endpoint was self-reported CPAP discontinuation. The main secondary endpoint was self-reported gastroesophageal reflux symptoms. The other secondary endpoints were long-term and peri-operative criteria. Long-term endpoints collected were: Nocturnal polygraphy before discontinuation, post-operative apnea-hypopnea index, self-reported sleep disturbance, high residual obstructive sleep apnea syndrome probability, medical sleep follow-up, proton-pump-inhibitor intake, Short-form health survey (SF-36) physical activity score, metabolic equivalent category, Insulin or oral antidiabetic discontinuation, anti-hypertensive medication discontinuation, underwent an other surgery under general anesthesia since bariatric procedure, excess body-weight. Peri-operative endpoints were: Surgery duration, intraoperative surgical complication, SAPS II, PACU CPAP use, PACU morphine titration, PACU length of stay, PACU oxygen therapy, intra-hospital postoperative complication, intra-hospital length of stay.

Statistical analysis

Expecting a difference of first-attempt success of 35% between Sleeve gastrectomy and Nissen-Sleeve groups (from 45% to 80%),[29] we calculated the sample size as 29 per group, using a $\chi 2$ test, with an α level of 0.05 and a power of 0.80. We decided to include at least 40 surgeries per period (total of 80 surgeries) to compensate for missing data and matching procedure and calculated that the one-year period of 2018 would allow to include at least the required number of surgeries.

All quantitative variables were described with median and interquartile range (25^{th}-75th percentile) and compared with non-parametric test (Wilcoxon/Mann-Whitney). Qualitative variables were described with percentage (%) and compared with $\chi 2$ or exact Fisher test as appropriate. In case of missing values, the number of available values was clearly stated for each variable.

A matching procedure was performed to form two groups with equivalent baseline characteristics and limit selection bias between Nissen-Sleeve and Sleeve-gastrectomy groups. Patients with Nissen Sleeve were matched to patients with Sleeve gastrectomy, according to the following three criteria: gender, gastroesophageal reflux symptoms and body mass index ±5%.

Main and secondary outcomes were evaluated in all matched patients except those whom data was either not found in medical report file and patients were unreachable by e-mail or phone. For the main outcome and the main secondary outcome, a $\chi 2$ test was used to compare Nissen-sleeve and Sleeve-gastrectomy groups. Odds ratio with corresponding 95% confidence interval were computed. For the other outcomes, a $\chi 2$ test, exact Fisher test or Mann-Whitney test was used according to the type of outcome (qualitative or quantitative).

The statistical analysis was performed with the help of statistical software: SAS version 9.3, SAS Institute; Cary, NC). P value <0.05 was considered statistically significant.

III. Results

Study participants

Two-hundred and twenty-three patients underwent bariatric surgery between 1st January 2018 and 31th December 2018. Seven patients underwent other bariatric procedure than Nissen-Sleeve or Sleeve-Gastrectomy (1 gastric bypass, 4 Toupet-Sleeve and 2 unspecified other bariatric interventions). Twelve patients had missing preoperative data about obstructive sleep apnea and were not included, 118 patients had no severe obstructive sleep apnea requiring CPAP.

Baseline characteristics of the 46 Nissen-Sleeve and 40 Sleeve gastrectomy eligible for analysis are presented in Table 1.

Thirty-three Nissen-Sleeve patients were matched with 33 Sleeve Gastrectomy patients. The matching procedures was performed on variables that were statistically different between groups before matching (Table 1): gender, gastroesophageal reflux symptoms and BMI. The effectiveness of matching was 81% on gender category, 70% on gastroesophageal reflux symptoms and 100% on BMI (±5%). Flow chart of the study participants is presented in Figure 1.

Baseline characteristics of the matched cohort

Baseline characteristics of the matched cohort are reported in Table 2 and peri-operative characteristics of the matched cohort are reported in Table 3.

Median age at the time of surgery was 51 (44-58) years, 74% were classified ASA III and 26% ASA II. Their median BMI was 42 (38-46) kg/m² preoperatively, corresponding to a median excess body weight of 56 (46-69) kg. The two groups were clinically comparable after matching. There was no difference of baseline excess body weight between groups (Figure 2).

Main primary outcome

At 3 years follow-up, CPAP therapy status was known for 63 patients. Among them, 43/63 (68%) had discontinued their CPAP therapy: 25/31 (81%) and 18/32 (56%) in the Nissen-Sleeve and Sleeve Gastrectomy group respectively (p=0.038, odds ratio 3.24 95%CI(1.04-10.05)). Results on the main-primary outcome are shown in Figure 3.

Main secondary outcome

In the Nissen-Sleeve group, 30 (91%) patients did not report any gastroesophageal reflux symptoms, 3 (9%) reported symptoms. In the Sleeve gastrectomy group, 14 (42%) did not report any gastroesophageal reflux symptoms, 19 (47%) reported symptoms. The difference was statistically significant (p<0.001, odds ratio 13.6 95% CI (3.4-53.6). Results on the main secondary outcome are shown in Figure 4.

Other long-term secondary outcomes

Before CPAP discontinuation, 13/43 (30%) did not underwent nocturnal polygraphy (7/25 and 6/18 patients in Nissen-Sleeve and Sleeve Gastrectomy groups respectively, p=0.202). Post-operative apnea-hypopnea index were available for 13 patients, median apnea-hypopnea index was 21 (7.4-32), 17.5 (7.4-22), 40.2 (5.6-68) in overall, Nissen-

Sleeve and Sleeve Gastrectomy groups respectively (p=0.091). The results on long-term outcomes are shown in Table 4. There was no difference of excess body weight between groups 6 months, 1 year and 3 years following surgery (Figure 2).

Peri-operative secondary outcomes

Median Surgery duration was 105 minutes (89-130) in the Nissen-Sleeve and 95 minutes (70-110) in the Sleeve Gastrectomy groups (p=0.070). Non-invasive positive pressure pre-oxygenation was performed in 10 (15%) of patients, rapid sequence induction in 12% of cases. Difficult mask ventilation occurred in 6/62 (11%) cases. Thirteen (20%) cases were scored Cormack 3 or 4. Twenty-four (36%) received Morphine during PACU stay, 2 (3%) had CPAP-therapy during PACU. Fifty-six (85%) required oxygen during the first post-operative night. The median length of stay in monitored care unit and hospital was 1 (1-1) and 4 (4-4) nights respectively. There was no difference between groups. The results on secondary outcomes are shown in Table 5.

IV. Discussion

For the first time, we reported in this matched historic-prospective cohort study, that the rate of CPAP discontinuation was higher in the Nissen-Sleeve group than in the Sleeve gastrectomy group: 25/31 (81%) and 18/32 (56%) respectively (p=0.038) (Figure 2, Table 4), despite similar baseline characteristics. Meanwhile, the rate of gastroesophageal reflux symptoms was thirteen times lower in the Nissen-Sleeve group than in the Sleeve-gastrectomy group, with no difference on other long-term respiratory outcomes or peri-operative outcomes.

Other studies that investigated this outcome after bariatric surgery owed almost similar rates of CPAP discontinuation. In these studies, factors including younger age, lower pre-procedure weight and greater weight loss were found to positively predict self-reported obstructive sleep apnea remission.[52–55] Those variables were equivalent between the two groups assessed in the present study, Nissen-Sleeve and Sleeve gastrectomy groups. Of the 43 CPAP discontinuations, 30 (70%) patients underwent nocturnal polygraphy, however in the other 13 cases (30%) no objective measure of sleep events like apnea-hypopnea index was performed. While CPAP is considered a valuable patient-centered endpoint to evaluate improvements in obstructive sleep apnea, CPAP discontinuation might likely be inappropriate, as potentially in relation with a subjective feeling of obstructive sleep apnea resolution consecutive to weight loss. In a meta-analysis by Greenburg et al.[56], of twelve studies including 342 patients who underwent bariatric surgery, mean body-mass-index dropped from 55.3 to 37.7 kg/m² while the mean apnea-hypopnea index dropped from 54.7 event/h to 15.8 events/h. They conclude that despite improvement of apnea-hypopnea index values in nearly all cases after surgery, residual obstructive sleep apnea might persist in mild or moderate forms in the vast majority of cases.[56,57] In the present study, median baseline apnea-hypopnea index was 48 (39.0-60.9) event per hour, and dropped to 21 (7.4-32) in a small sample of 13 post-

operative apnea-hypopnea index values available, which is consistent with moderately severe persisting obstructive sleep apnea (Table 4). Nastałek et al.[58] recently studied modification of obstructive sleep apnea severity and CPAP compliance around bariatric surgery in a prospective study. One third of the original sample underwent postoperative polysomnography, with residual obstructive sleep apnea in most cases. Compliance to CPAP rate was less than 50%. Two thirds of the original sample did not undergo post-operative polysomnography.[58] In the present study, at 3 years follow-up, 60% of patients with previous severe obstructive sleep apnea had no regular sleep follow-up, whereas 71% had high probability of residual obstructive sleep apnea (STOP-BANG > 2, with limitations regarding neck-circumference measurement in the setting of phone consultation, or more than 2 AASM diagnosis criteria, Table 5). These results highlight the need for more frequent and probably more effectively enforced follow-up visits after bariatric surgery. This could be accompanied by CPAP compliance analysis and identification of possible issues influencing CPAP therapy (value of pressure, mask fit, psychosocial factors affecting CPAP use).[59] Failing to recognize or treat persistent obstructive sleep apnea may significantly impact health and quality of life, leading to ensuing weight gain and increased cardiovascular risks.[60]

Our main secondary outcome was self-reported gastroesophageal reflux. As expected, self-reported gastroesophageal reflux was significantly lower after Nissen-Sleeve (3 patients, 9%) than after Sleeve-gastrectomy (19 patients, 58%). Those results are consistent with previous studies.[46,61] De novo reflux might impact patients' quality of life, requiring lifelong proton pump inhibitor medication, increases the risk of esophagitis and formation of Barrett's metaplasia. Gastroesophageal reflux disease is one the most common reason for conversion to gastric bypass. For the same reason, preoperative reflux is still considered a relative contra-indication to Sleeve-gastrectomy, and hinders its widespread.[62]

In the present study, peri-operative surgical complications occurred in only 2 cases: one intraoperative minor bleeding of the splenic artery and one major hemorrhagic shock that occurred in PACU following a Nissen-Sleeve gastrectomy. No symptomatic respiratory complication occurred. The 3 patients with respiratory complications (Table 5) were asymptomatic pleural effusion and atelectasis. These observations are consistent with previous studies about post-operative complications after bariatric surgery. In a multi-center prospective database from the American College of Surgeons,[63] respiratory complications occurred in 0.6% for post-operative pneumonia and 0.6% for postoperative respiratory failure. In the sample of 66 patients reported in the present study, post-operative pulmonary complications were unlikely to happen in any group. As expected, no pulmonary embolism was reported.

The most dreadful post-operative complication of this procedure is gastric leak, which implies a long hospital stay, interventions, morbidities and sometime mortality. The International Sleeve Gastrectomy Expert Panel Consensus Statement 2011, reported a leak rate of 1.06%,[64] but it can vary between 1% and 3%.[65] The present study sample is small and no gastric leak or perforation occurred. Increased risk of post-operative respiratory or surgical complication when associating fundoplication remains of debate as no comparative study still exists.[51,66]

Besides these limitations, the strength of the current study is that it's the first to investigate potential respiratory benefits of combining fundoplication to standard Sleeve gastrectomy.

Recent researches have reported that obstructive sleep apnea and gastroesophageal reflux symptoms are closely related. However, the exact causative relationship between them remains contradictory.[67,68] Obstructive sleep apnea and gastroesophageal reflux disease are common chronic diseases among patients with obesity and share several similar risk factors. The prevalence of gastroesophageal reflux in obstructive sleep apnea

patients is significantly higher than in the general population; however, no temporal or causal relationship has ever been demonstrated between gastroesophageal reflux and obstructive sleep apnea.[69] One recent study found that gastroesophageal reflux is independently associated with obstructive sleep apnea, even while controlling for potentially related conditions. The strongest relationship was seen when using the strictest definitions of gastroesophageal reflux disease and obstructive sleep apnea in a study that was performed by 24h-pH monitoring and nocturnal polysomnography.[70]

However, gastroesophageal reflux and obstructive sleep apnea might be related because of the positive effects that result from their treatment, although pathogenesis could not reveal the exact causal associations. The causal relationship of CPAP treatment on nocturnal gastroesophageal reflux symptoms resolution is well established. In the study of Tawk et al,[71] one-week CPAP use seemed to be effective in obstructive sleep apnea patients with heartburn symptoms. The underlying mechanism might be negative mediastinal pressure during obstructive events favoring gastroesophageal reflux episodes, thus mitigated by positive airway pressure therapy.[71–74]

It would be controversial to say whether treatment of gastroesophageal reflux could improve obstructive sleep apnea. Treatment of gastroesophageal reflux disease in obstructive sleep apnea patients improves sleep quality, but only few studies found significant difference in obstructive events.[75–77] Effective treatment of gastroesophageal reflux disease could improve subjective sleep parameters, such as sleep duration and sleep quality regardless of any effect of apnea/hypopnea events. Out of the bariatric setting, Nissen fundoplication was found improving patient’s perception of their sleep quality, with polysomnographic modifications of sleep architecture.[78]

The strengths of this study is that it is the first study to investigate obstructive sleep apnea after Nissen-Sleeve. The 3 years assessment of the main outcome was blinded to the

type of surgery and there was few missing data. The potential selection bias was mitigated by a matching procedure to ensure comparability.
The major weaknesses are, on one hand, that the study sample is too small to evaluate the post-operative complications rate that are uncommon. On the other hand, a systematic polysomnography would have been useful to quantitatively evaluate sleep events and obstructive apnea resolution.

V. Conclusion

This study showed a higher rate of CPAP discontinuation 3 years after Nissen-sleeve than after Sleeve-gastrectomy. Self-reported post-operative gastroesophageal reflux symptoms were also significantly reduced. A causal association between those two endpoints remains to be further investigated.

Tables:

Table 1: Main Characteristics of the 86 patients with CPAP before Matching procedure

	Overall (N=86)	Nissen-Sleeve (n=46)	Sleeve Gastrectomy (n=40)	p value
Age at the time of surgery, years				0.744
Median	50.5 (44.5-56)	51.5 (45-56)	49 (42.5-57)	
Range	16-76	16-71	16-76	
ASA category, n (%)				0.541
I	0 (0%)	0 (0%)	0 (0%)	
II	22 (26%)	13 (28%)	9 (23%)	
III	64 (74%)	33 (72%)	31 (78%)	
IV	0 (0%)	0 (0%)	0 (0%)	
Body mass index, kg/m^2				0.020
Median	41.5 (38-46)	40.5 (38-44)	43.5 (39-47.5)	
Range	34-64	34–61	34–64	
Gender, n (%)				0.022
Female	54 (63%)	34 (74%)	20 (50%)	
Male	32 (37%)	12 (26%)	20 (50%)	
Diabetes, n (%)				0.344
No	54 (63%)	31 (67%)	23 (58%)	
Yes	32 (37%)	15 (33%)	17 (42%)	
Hypertension, n (%)				0.181
No	30 (35%)	17 (37%)	13 (33%)	
Yes	56 (65%)	29 (63%)	27 (67%)	
Self-reported CPAP adherence n, (%)				0.539
No	24/81 (30%)	14/33 (33%)	10/38 (36%)	
Yes	57/81 (70%)	29/33 (67%)	28/38 (74%)	
Apnea-Hypopnea-Index, event/hour*				0.205
Median	48 (37-60.9)	48 (32-58)	48 (40-70)	
Range	9.8-108	9.8-108	20-103	
Gastroesophageal reflux symptoms , n (%)				0.014
No	45 (52%)	18 (39%)	27 (68%)	
Yes	41 (48%)	28 (61%)	13 (32%)	
Proton-pump-inhibitor intake, n (%)				0.041
No	50 (58%)	21 (46%)	29 (73%)	
Yes	36 (42%)	25 (54%)	11 (27%)	

Abbreviations: ASA = American Society of Anesthesiologists; CPAP = Continuous Positive Airway Pressure

* Apnea-Hypopnea-Index was available for 29 patients in the group Nissen-Sleeve and 23 patients in the group Sleeve gastrectomy.

Quantitative variables are presented as median and interquartile range (25th percentile -75th percentile) and Range (minimal and maximal value). Qualitative variables are expressed in numbers and %.

Table 2: Baseline characteristics of the 66 patients with CPAP after matching procedure

	Overall (N=66)	Nissen-Sleeve (n=33)	Sleeve Gastrectomy (n=33)	p value
Age at the time of surgery, years				0.938
Median	51 (44-58)	52 (44-55)	50 (43-60)	
Range	16-76	16-71	16-76	
ASA category, n (%)				0.778
I	0 (0%)	0 (0%)	0 (0%)	
II	17 (26%)	8 (24%)	9 (27%)	
III	49 (74%)	25 (76%)	24 (73%)	
IV	0 (0%)	0 (0%)	0 (0%)	
Body mass index, kg/m^2				0.884
Median	42 (38-46)	42 (38-45)	42 (34-46)	
Range	34-64	34–61	34–64	
Body mass index category, n (%)				0.792
30-40	21 (32%)	11 (33%)	10 (30)	
40-50	39 (59%)	19 (58%)	20 (61%)	
>50	6 (9%)	3 (9%)	3 (9%)	
Excess Body Weight, kg				0.899
Median	56 (46-69)	56 (45-68)	56 (48-70)	
Range	43-84	37-109	38-126	
Gender, n (%)				0.215
Female	37 (56%)	21 (64%)	16 (48%)	
Male	29 (44%)	12 (36%)	17 (52%)	
Diabetes, n (%)				0.211
No	39 (59%)	22 (67%)	17 (42%)	
Yes	27 (41%)	11 (33%)	16 (48%)	
Hypertension, n (%)				0.181
No	25 (38%)	16 (48%)	9 (32%)	
Yes	41 (62%)	17 (52%)	24 (68%)s	
Respiratory disease, n (%)				0.682
Asthma	6 (18%)	2 (6%)	4 (12%)	
Chronic obstructive pulmonary disease	2 (6%)	1 (3%)	1 (3%)	
Pulmonary embolism	2 (6%)	2 (6%)	0 (0%)	
Self-reported CPAP adherence n, (%)				0.637
No	18/65 (28%)	10/32 (33%)	11 (39%)	
Yes	47/65 (72%)	23/32 (72%)	24 (72%)	
Apnea-Hypopnea-Index, event/hour*				0.264
Median	34.6-61.9	44.5 (32-58.5)	46.8 (39.5-70)	
Range (min-max)	9.8-108	9.8-108.0	20.0-103.0	
Gastroesophageal reflux symptoms , n (%)				0.618
No	38 (58%)	18 (55%)	20 (61%)	
Yes	28 (42%)	15 (45%)	13 (39%)	
Occasional	8 (12%)	1 (3%)	7 (21%)	
Daily	20 (30%)	14 (42%)	6 (18%)	
Proton-pump-inhibitor intake, n (%)				0.306
No	42 (64%)	19 (58%)	23 (70%)	
Yes	24 (36%)	14 (42%)	10 (30%)	
Occasional	6 (9%)	4 (12%)	2 (6%)	
Daily	18 (27%)	10 (30%)	8 (24%)	

Abbreviations: ASA = American Society of Anesthesiologists; CPAP = Continuous Positive Airway Pressure

* Apnea-Hypopnea-Index was available for 24 patients in the group Nissen-Sleeve and 20 patients in the group Sleeve-gastrectomy.

Quantitative variables are presented as median and interquartile range (25th percentile -75th percentile) and Range (minimal and maximal value). Qualitative variables are expressed in numbers and %.

Table 3: Peri-operative characteristics of the study population after matching procedure

	Overall (N=66)	Nissen-Sleeve (n=33)	Sleeve Gastrectomy (n=33)	p value
Positive pressure pre-oxygenation, n (%)				0.492
No	56 (85%)	29 (88%)	27 (82%)	
Yes	10 (15%)	4 (12%)	6 (18%)	
Rapid sequence induction, n (%)				0.425
No	51/58 (88%)	25/30 (83%)	26/28 (93%)	
Yes	7/58 (12%)	5/30 (17%)	2/28 (7%)	
Mask ventilation, n (%)				0.513
Not performed	6/55 (11%)	5/30 (14%)	2/26 (8%)	
Easy	43/55 (78%)	23/30 (79%)	20/26 (77%)	
Difficult	6/55 (11%)	2/30 (7%)	4/26 (15%)	
Neuromuscular blocking agent, n (%)				1.000
Cisatracurium	49/50 (98%)	26/27 (96%)	23/23 (100%)	
Suxamethonium	1/50 (2%)	1/27 (34%)	0/23 (0%)	
Cormack score, n (%)				0.757
1-2	53 (80%)	27 (82%)	26 (79%)	
3-4	13 (20%)	6 (18%)	7 (21%)	
Yes	45 (78%)	25 (83%)	20 (71%)	
Minimal SpO2, %*				0.223
Median	94 (90-97)	95 (91-97)	93 (89-95)	
Range	57-100	83-100	57-100	
Minimal mean arterial pressure, mmHg**				0.313
Median	62 (55-70)	62 (55-68)	62 (58-71)	
Range	34-97	34-84	47-97	

Abbreviations: SpO2 = pulsed oxygen saturation (%)

* Minimal SpO2 was available for 26 patients in the group Nissen-Sleeve and 26 patients in the group Sleeve gastrectomy.

** Minimal mean arterial pressure was available for 26 patients in the group Nissen-Sleeve and 26 patients in the group Sleeve gastrectomy.

Quantitative variables are presented as median and interquartile range (25^{th} percentile -75^{th} percentile) and Range (minimal and maximal value). Qualitative variables are expressed in numbers and %.

Table 4: Long term outcomes (3 years after surgery) after matching procedure

	Overall (N=66)	Nissen-Sleeve (n=33)	Sleeve Gastrectomy (n=33)	p value
Obstructive sleep apnea related outcomes				
CPAP discontinuation, n (%)				0.038
No	20/63 (32%)	6/33 (19%)	14/32 (44%)	
Yes	43/63 (68%)	25/33 (81%)	18/32 (56%)	
Nocturnal polygraphy before discontinuation, n (%)				0.202
No	13/43 (30%)	6/25 (24%)	7/18 (39%)	
Yes	30/43 (70%)	19/25 (76%)	11/18 (61%)	
Post-operative apnea-hypopnea index, event/hour*				0.091
Median	21 (7.4, 32)	17.5 (7.4, 22)	40.2 (5.6, 68)	
Range	7.4-97	2-32	5-97	
Self-reported sleep disturbance, n (%)				0.430
No	39/62 (63%)	21/31 (68%)	18/31 (58%)	
Yes	23/62 (37%)	10/31 (32%)	13/31 (42%)	
High residual OSAS probability, n (%)				
STOP-BANG > 2	44/62 (71%)	22/31 (71%)	22/31 (71%)	1.000
AASM clinical criteria > 2	46/62 (74%)	23/31 (74%)	23/31 (74%)	0.836
Medical sleep follow-up, n (%)				0.196
No	37/62 (60%)	21/31 (68%)	16/31 (52%)	
Yes	25/62 (40%)	10/31 (32%)	15/31 (48%)	
Gastroesophagal reflux disease related outcomes				
Gastroesophageal reflux symptoms , n (%)				<0.001
No	44 (67%)	30 (91%)	14 (42%)	
Yes	22 (33%)	3 (9%)	19 (58%)	
Proton-pump-inhibitor intake, n (%)				<0.001
No	46 (70%)	30 (91%)	16 (48%)	
Yes	20 (30%)	3 (9%)	17 (52%)	
Other outcomes				
SF-36 physical activity score (/30)* **				0.369
Median	28 (26-29)	28 (26-29)	27 (26-29)	
Range	10-30	17-30	10-30	
Metabolic equivalent category, n (%)				0.826
≤ 4	8/60 (13%)	3/30 (10%)	5/30 (17%)	
> 4	52/60 (87%)	27/30 (90%)	25/30 (83%)	
4-7	26/60 (43%)	13/30 (43%)	13/30 (43%)	
≥ 7	26/60 (43%)	14/30 (47%)	12/30 (40%)	
Insulin or oral antidiabetic discontinuation, n (%)				0.687
No	10/27 (37%)	5/11 (45%)	5/16 (31%)	
Yes	17/27 (63%)	6/11 (55%)	11/16 (69%)	
Anti-hypertensive medication discontinuation, n (%)				0.965
No	25/41 (61%)	10/17 (59%)	15/24 (62%)	
Yes	16/41 (39%)	7/17 (41%)	9/24 (38%)	
Underwent an other surgery under general anesthesia since bariatric procedure, n (%)				0,921
No	21/39 (54%)	9/17 (53%)	12/22 (55%)	
Yes	18/39 (46%)	8/17 (47%)	10/22 (45%)	

Abbreviation: PACU = Post-Anesthesia Care Unit Abbreviations; SAPS II: Sequential Acute Physiologic Score II 2; SF: Short-Form; OSAS: Obstructive Sleep Apnea Syndrome

* Post-operative Apnea-Hypopnea-Index was available for 7 patients in the group Nissen-Sleeve and 6 patients in the group Sleeve gastrectomy.
**STOP-BANG Score: 1 point per item, loud snoring, sleepiness, remarked obstructive events, hypertension, BMI > 35, Male gender and age above 50 years. Neck-circumference was not available.
*** SF-36 physical activity score was available for 30 patients the group Nissen-Sleeve and 31 patients in the group Sleeve gastrectomy. 10 item, Score varies between 10 (extremely limited physical activity) and 30 (no limitation in daily physical activity)
Quantitative variables are presented as median and interquartile range (25th percentile -75th percentile) and Range (minimal and maximal value). Qualitative variables are expressed in numbers and %.

Table 5: Peri-operative outcomes after matching procedure

	Overall (N=66)	Nissen-Sleeve (n=33)	Sleeve Gastrectomy (n=33)	p value
Surgery duration, minutes*				0.070
Median	101 (81-120)	105 (89-130)	95 (70-110)	
Range	36-183	53-180	36-183	
Intraoperative surgical complication, n (%)				1.000
Hemorrhage	2 (3%)	1 (1.5%)	1 (1.5%)	
Other	0 (0%)	0 (0%)	0 (0%)	
Sequential Acute Physiologic Score II**				0.880
Median	13 (11-18)	13 (10.5-18)	13 (11-18)	
Range	6-40	6-40	6-29	
PACU CPAP use, n (%)				1.000
No	62/64 (97%)	31/32 (97%)	31/32 (97%)	
Yes	2/64 (3%)	1/32 (3%)	1/32 (3%)	
PACU morphine titration, n (%)				
No	42 (64%)	19 (58%)	23(70%)	
Yes	24 (36%)	14 (42%)	10 (30%)	
Dose, mg	7 (4-10)	8 (4-10)	6 (5-8)	0.280
PACU length of stay, number of nights				0.320
Median (25th,75th %-ile)	1 (1-1)	1 (1-1)	1 (1-1)	
Range (min-max)	1-7	1-7	1-2	
PACU oxygen therapy, n (%)				0.608
No	10 (15%)	4 (12%)	6 (18%)	
Yes	56 (85%)	29 (88%)	27 (82%)	
Intra-hospital postoperative complication, n (%)				1.000
Respiratory	3 (5%)	1 (3%)	2 (6%)	
Atelectasis	1 (2%)	0 (0%)	1 (3%)	
Pleural effusion	2 (3%)	1 (3%)	1 (3%)	
Hemorrhage	1 (2%)	1 (3%)	0 (0%)	
Intra-hospital length of stay, number of nights				0.725
Median	4 (4-4)	4 (4-4)	4 (4-4)	
Range	3-10	3-10	3-5	

Abbreviation: PACU = Post-Anesthesia Care Unit Abbreviations

* Surgery duration was available for 31 patients in the group Nissen-Sleeve and 33 patients in the group Sleeve gastrectomy.

** Sequential Acute Physiologic Score II was available for 28 patients in the group Nissen-Sleeve and 23 patients in the group Sleeve gastrectomy.

Quantitative variables are presented as median and interquartile range (25^{th} percentile -75^{th} percentile) and Range (minimal and maximal value). Qualitative variables are expressed in numbers and %.

Figures:

Figure 1: Flow diagram of Study Participants

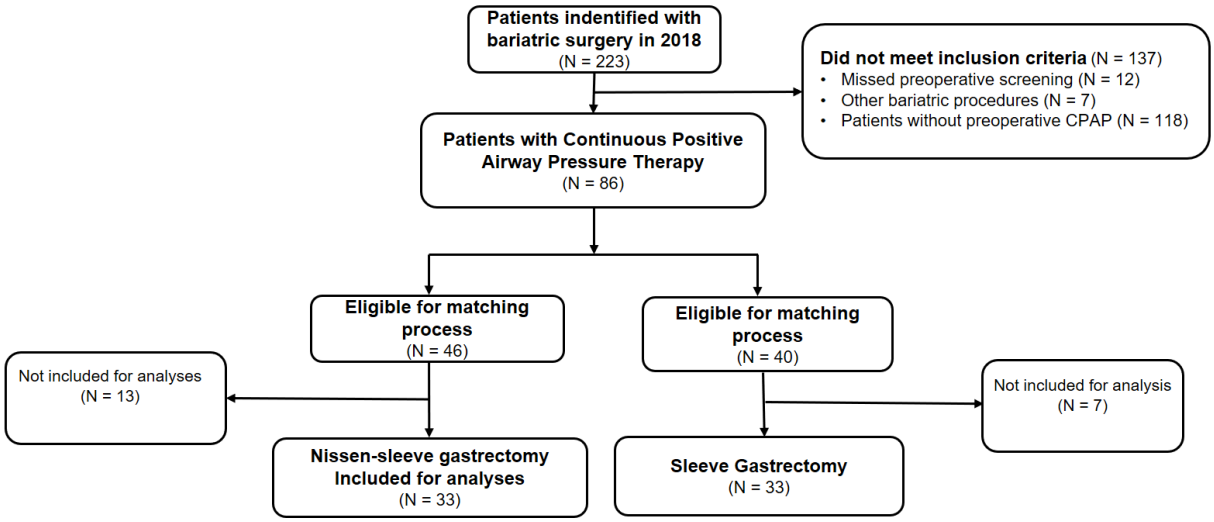


Figure 1 : Flow Diagram of Study Participant.

Figure 2. Excess body weight loss, in kilograms, at preoperative assessment (n=66), 6 months (n=44), 1 year (n=65), 3 years (n=66).
P values at each time-point were not significant.

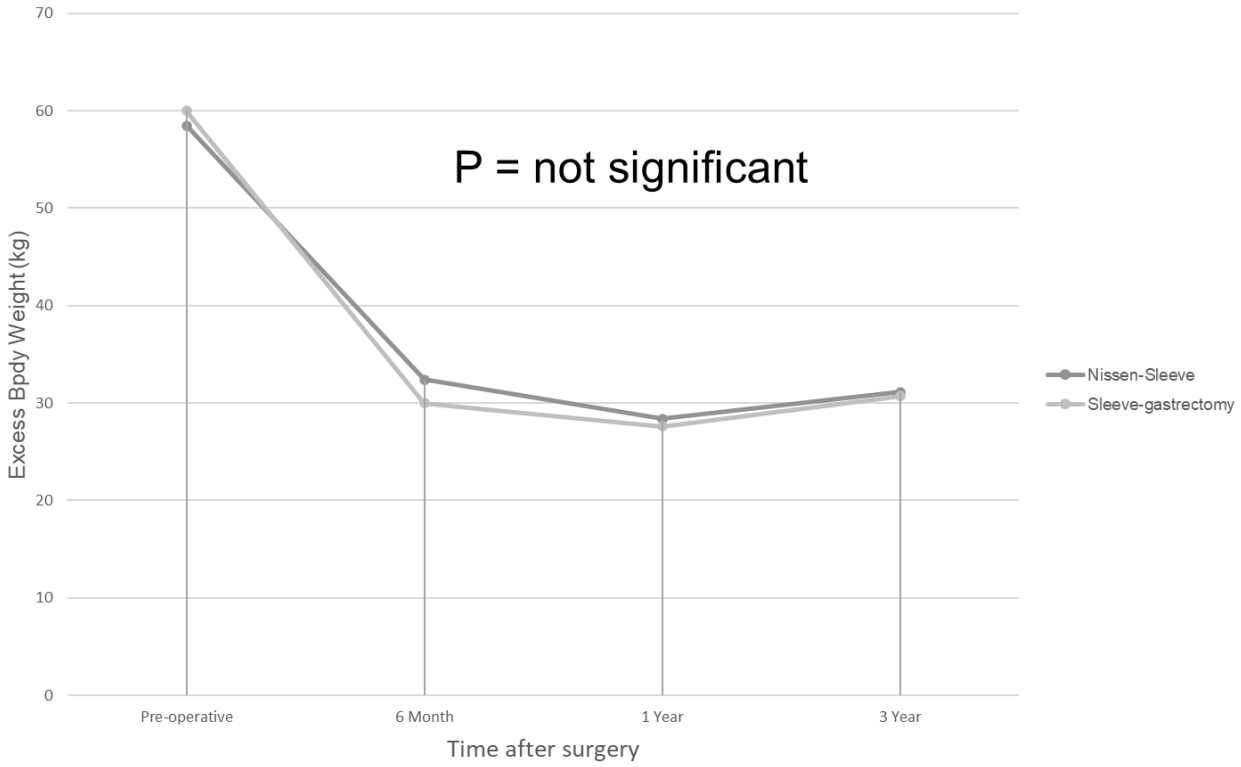


Figure 3: Percentage of patients who discontinued their CPAP at 3 years follow-up after Nissen-Sleeve or Sleeve-Gastrectomy.

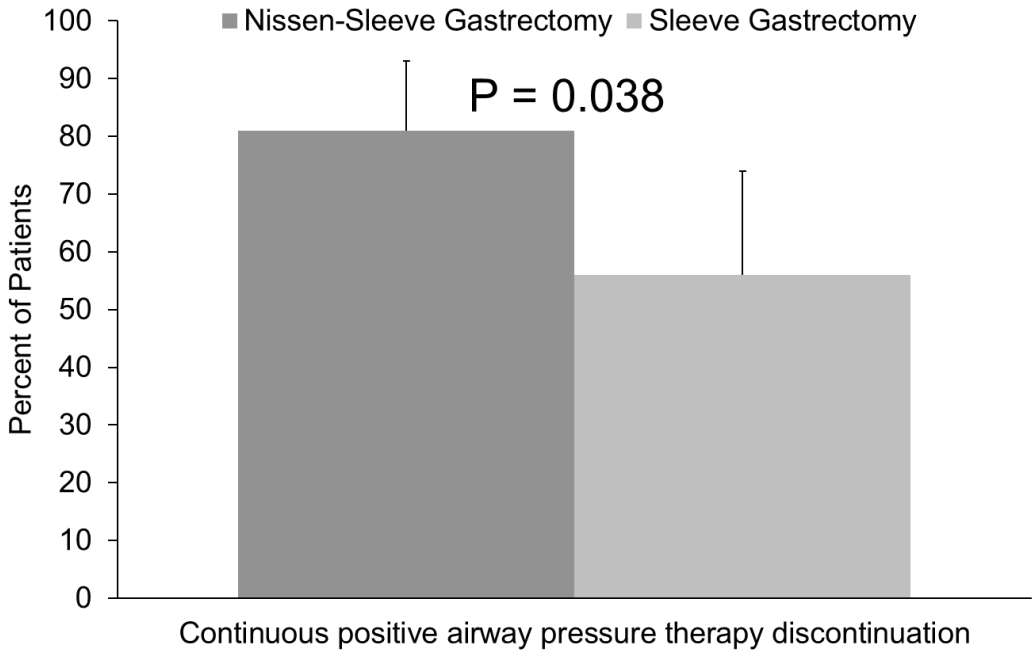
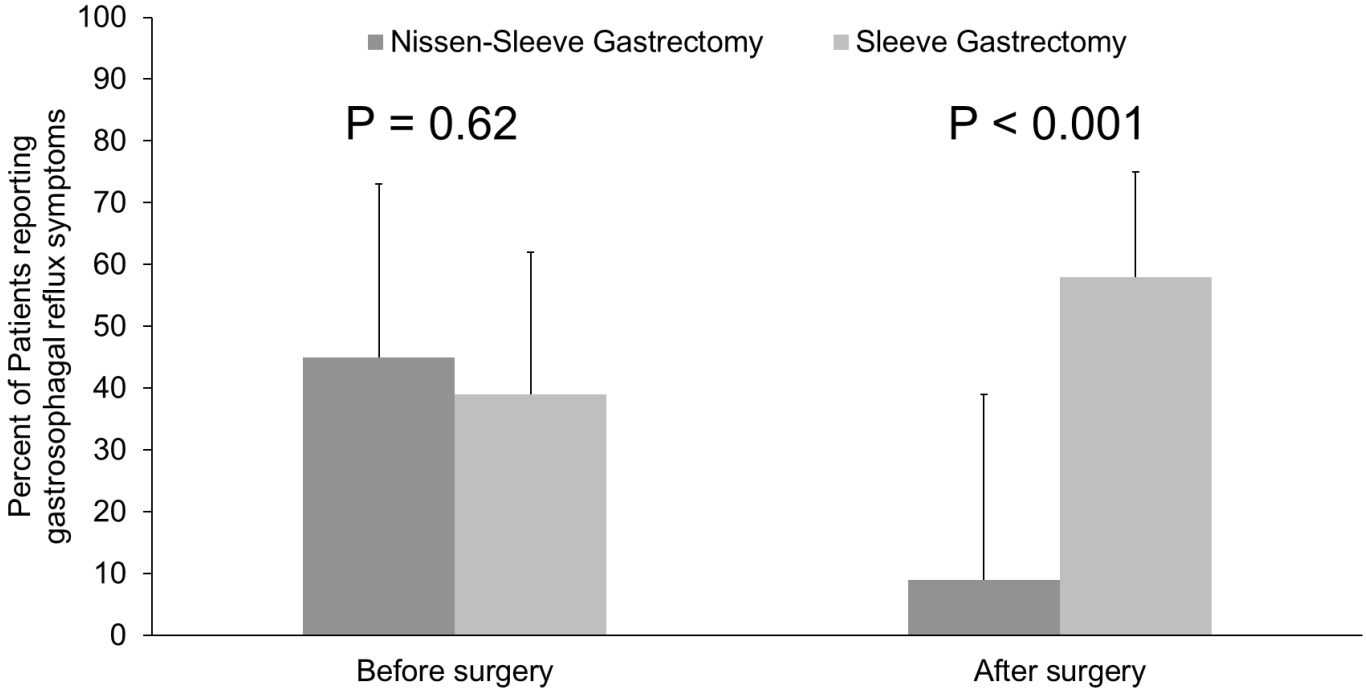


Figure 4: Percentage of patients reporting gastroesophagal reflux symptoms before and after (3 years) surgery.



References:

1. Angelantonio ED, Bhupathiraju SN, Wormser D, Gao P, Kaptoge S, Gonzalez AB de, et al. Body-mass index and all-cause mortality: individual-participant-data meta-analysis of 239 prospective studies in four continents. The Lancet. 20 août 2016;388(10046):776-86.

2. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. The Lancet. 30 août 2014;384(9945):766-81.

3. Schetz M, De Jong A, Deane AM, Druml W, Hemelaar P, Pelosi P, et al. Obesity in the critically ill: a narrative review. Intensive Care Med. 1 juin 2019;45(6):757-69.

4. De Jong A, Wrigge H, Hedenstierna G, Gattinoni L, Chiumello D, Frat J-P, et al. How to ventilate obese patients in the ICU. Intensive Care Med. 1 déc 2020;46(12):2423-35.

5. Prospective Studies Collaboration, Whitlock G, Lewington S, Sherliker P, Clarke R, Emberson J, et al. Body-mass index and cause-specific mortality in 900 000 adults: collaborative analyses of 57 prospective studies. Lancet. 28 mars 2009;373(9669):1083-96.

6. Taille, poids et tour de taille : photographie 2020 des Français [Internet]. [cité 4 nov 2021]. Disponible sur: https://liguecontrelobesite.org/actualite/taille-poids-et-tour-de-taille-photographie-2020-des-francais/

7. Glicksman A, Hadjiyannakis S, Barrowman N, Walker S, Hoey L, Katz SL. Body Fat Distribution Ratios and Obstructive Sleep Apnea Severity in Youth With Obesity. J Clin Sleep Med. 15 avr 2017;13(4):545-50.

8. Peppard PE, Young T, Barnet JH, Palta M, Hagen EW, Hla KM. Increased prevalence of sleep-disordered breathing in adults. Am J Epidemiol. 1 mai 2013;177(9):1006-14.

9. Destors M, Tamisier R, Galerneau L-M, Lévy P, Pepin J-L. [Pathophysiology of obstructive sleep apnea syndrome and its cardiometabolic consequences]. Presse Med. avr 2017;46(4):395-403.

10. Phillips BG, Kato M, Narkiewicz K, Choe I, Somers VK. Increases in leptin levels, sympathetic drive, and weight gain in obstructive sleep apnea. Am J Physiol Heart Circ Physiol. juill 2000;279(1):H234-237.

11. Raaff CAL de, Gorter-Stam MAW, Vries N de, Sinha AC, Bonjer HJ, Chung F, et al. Perioperative management of obstructive sleep apnea in bariatric surgery: a consensus guideline. Surgery for Obesity and Related Diseases. 1 juill 2017;13(7):1095-109.

12. Bazurro S, Ball L, Pelosi P. Perioperative management of obese patient. Current Opinion in Critical Care. déc 2018;24(6):560-7.

13. De Jong A, Verzilli D, Chanques G, Futier E, Jaber S. [Preoperative risk and perioperative management of obese patients]. Rev Mal Respir. oct 2019;36(8):985-1001.

14. Opperer M, Cozowicz C, Bugada D, Mokhlesi B, Kaw R, Auckley D, et al. Does Obstructive Sleep Apnea Influence Perioperative Outcome? A Qualitative Systematic Review for the Society of Anesthesia and Sleep Medicine Task Force on Preoperative Preparation of Patients with Sleep-Disordered Breathing. Anesth Analg. mai 2016;122(5):1321-34.

15. De Jong A, Rollé A, Souche F-R, Yengui O, Verzilli D, Chanques G, et al. How can I manage anaesthesia in obese patients? Anaesth Crit Care Pain Med. avr 2020;39(2):229-38.

16. De Jong A, Verzilli D, Jaber S. ARDS in Obese Patients: Specificities and Management. Critical Care. 9 mars 2019;23(1):74.

17. De Jong A, Verzilli D, Geniez M, Chanques G, Nocca D, Jaber S. [Why is the morbidly obese patient at high risk of anesthetic complications?]. Presse Med. mai 2018;47(5):453-63.

18. De Jong A, Rolle A, Molinari N, Paugam-Burtz C, Constantin J-M, Lefrant J-Y, et al. Cardiac Arrest and Mortality Related to Intubation Procedure in Critically Ill Adult Patients: A Multicenter Cohort Study. Crit Care Med. avr 2018;46(4):532-9.

19. De Jong A, Chanques G, Jaber S. Mechanical ventilation in obese ICU patients: from intubation to extubation. Critical Care. 21 mars 2017;21(1):63.

20. De Jong A, Molinari N, Pouzeratte Y, Verzilli D, Chanques G, Jung B, et al. Difficult intubation in obese patients: incidence, risk factors, and complications in the operating theatre and in intensive care units. Br J Anaesth. févr 2015;114(2):297-306.

21. Cao MT, Sternbach JM, Guilleminault C. Continuous positive airway pressure therapy in obstuctive sleep apnea: benefits and alternatives. Expert Rev Respir Med. avr 2017;11(4):259-72.

22. Zaremba S, Shin CH, Hutter MM, Malviya SA, Grabitz SD, MacDonald T, et al. Continuous Positive Airway Pressure Mitigates Opioid-induced Worsening of Sleep-disordered Breathing Early after Bariatric Surgery. Anesthesiology. juill 2016;125(1):92-104.

23. Sarrell EM, Chomsky O, Shechter D. [Treatment compliance with continuous positive airway pressure device among adults with obstructive sleep apnea (OSA): how many adhere to treatment?]. Harefuah. mars 2013;152(3):140-4, 184, 183.

24. Joosten SA, Hamilton GS, Naughton MT. Impact of Weight Loss Management in OSA. CHEST. 1 juill 2017;152(1):194-203.

25. Medical Advisory Secretariat. Polysomnography in patients with obstructive sleep apnea: an evidence-based analysis. Ont Health Technol Assess Ser. 2006;6(13):1-38.

26. Ashrafian H, Toma T, Rowland SP, Harling L, Tan A, Efthimiou E, et al. Bariatric Surgery or Non-Surgical Weight Loss for Obstructive Sleep Apnoea? A Systematic Review and Comparison of Meta-analyses. OBES SURG. 1 juill 2015;25(7):1239-50.

27. Fritscher LG, Canani S, Mottin CC, Fritscher CC, Berleze D, Chapman K, et al. Bariatric surgery in the treatment of obstructive sleep apnea in morbidly obese patients. Respiration. 2007;74(6):647-52.

28. Romero-Corral A, Caples SM, Lopez-Jimenez F, Somers VK. Interactions between obesity and obstructive sleep apnea: implications for treatment. Chest. mars 2010;137(3):711-9.

29. Dixon JB, Schachter LM, O'Brien PE, Jones K, Grima M, Lambert G, et al. Surgical vs Conventional Therapy for Weight Loss Treatment of Obstructive Sleep Apnea: A Randomized Controlled Trial. JAMA. 19 sept 2012;308(11):1142-9.

30. Oberlin P, de Peretti C. Bariatric Surgery in France from 1997 to 2018. Surgery for Obesity and Related Diseases. 1 août 2020;16(8):1069-77.

31. Kikkas EM, Sillakivi T, Suumann J, Kirsimägi Ü, Tikk T, Värk PR. Five-Year Outcome of Laparoscopic Sleeve Gastrectomy, Resolution of Comorbidities, and Risk for Cumulative Nutritional Deficiencies. Scand J Surg. mars 2019;108(1):10-6.

32. Albanopoulos K, Tsamis D, Natoudi M, Alevizos L, Zografos G, Leandros E. The impact of laparoscopic sleeve gastrectomy on weight loss and obesity-associated comorbidities: the results of 3 years of follow-up. Surg Endosc. 1 févr 2016;30(2):699-705.

33. Kowalewski PK, Olszewski R, Walędziak MS, Janik MR, Kwiatkowski A, Gałązka-Świderek N, et al. Long-Term Outcomes of Laparoscopic Sleeve Gastrectomy-a Single-Center, Retrospective Study. Obes Surg. janv 2018;28(1):130-4.

34. Abbas M, Cumella L, Zhang Y, Choi J, Vemulapalli P, Melvin WS, et al. Outcomes of Laparoscopic Sleeve Gastrectomy and Roux-en-Y Gastric Bypass in Patients Older than 60. OBES SURG. 1 déc 2015;25(12):2251-6.

35. Reges O, Greenland P, Dicker D, Leibowitz M, Hoshen M, Gofer I, et al. Association of Bariatric Surgery Using Laparoscopic Banding, Roux-en-Y Gastric Bypass, or Laparoscopic Sleeve Gastrectomy vs Usual Care Obesity Management With All-Cause Mortality. JAMA. 16 janv 2018;319(3):279-90.

36. Catheline J-M, Fysekidis M, Bendacha Y, Portal J-J, Huten N, Chouillard E, et al. Prospective, multicentric, comparative study between sleeve gastrectomy and Roux-en-Y gastric bypass, 277 patients, 3 years follow-up. J Visc Surg. déc 2019;156(6):497-506.

37. Genio G del, Limongelli P, Genio F del, Motta G, Docimo L, Testa D. Sleeve gastrectomy improves obstructive sleep apnea syndrome (OSAS): 5 year longitudinal study. Surgery for Obesity and Related Diseases. 1 janv 2016;12(1):70-4.

38. El Moussaoui I, Van Vyve E, Johanet H, Dabrowski A, Piquard A, Delaunay T, et al. Five-year Outcomes of Sleeve Gastrectomy: A Prospective Multicenter study. Am Surg. 19 févr 2021;3134821991984.

39. Yılmaz Kara B, Kalcan S, Özyurt S, Gümüş A, Özçelik N, Karadoğan D, et al. Weight Loss as the First-Line Therapy in Patients with Severe Obesity and Obstructive Sleep Apnea Syndrome: the Role of Laparoscopic Sleeve Gastrectomy. OBES SURG. 1 mars 2021;31(3):1082-91.

40. Salminen P, Helmiö M, Ovaska J, Juuti A, Leivonen M, Peromaa-Haavisto P, et al. Effect of Laparoscopic Sleeve Gastrectomy vs Laparoscopic Roux-en-Y Gastric Bypass on Weight Loss at 5 Years Among Patients With Morbid Obesity: The SLEEVEPASS Randomized Clinical Trial. JAMA. 16 janv 2018;319(3):241-54.

41. Results following laparoscopic sleeve gastrectomy in elderly obese patients: a single center experience with follow-up at three years - Minerva Chirurgica 2020 April;75(2):77-82 [Internet]. [cité 23 oct 2021]. Disponible sur: https://www.minervamedica.it/en/journals/minerva-surgery/article.php?cod=R06Y2020N02A0077

42. D'Hondt M, Vanneste S, Pottel H, Devriendt D, Van Rooy F, Vansteenkiste F. Laparoscopic sleeve gastrectomy as a single-stage procedure for the treatment of morbid obesity and the resulting quality of life, resolution of comorbidities, food tolerance, and 6-year weight loss. Surg Endosc. août 2011;25(8):2498-504.

43. Fujiwara Y, Arakawa T, Fass R. Gastroesophageal reflux disease and sleep disturbances. J Gastroenterol. juill 2012;47(7):760-9.

44. Elkassem S. Gastroesophageal Reflux Disease, Esophagitis, and Barrett's Esophagus 3 to 4 Years Post Sleeve Gastrectomy. Obes Surg. 2 oct 2021;

45. Lim CH, Lee PC, Lim E, Tan J, Chan WH, Tan HC, et al. Correlation Between Symptomatic Gastro-Esophageal Reflux Disease (GERD) and Erosive Esophagitis (EE) Post-vertical Sleeve Gastrectomy (VSG). Obes Surg. janv 2019;29(1):207-14.

46. Borbély Y, Schaffner E, Zimmermann L, Huguenin M, Plitzko G, Nett P, et al. De novo gastroesophageal reflux disease after sleeve gastrectomy: role of preoperative silent reflux. Surg Endosc. mars 2019;33(3):789-93.

47. Assalia A, Gagner M, Nedelcu M, Ramos AC, Nocca D. Gastroesophageal Reflux and Laparoscopic Sleeve Gastrectomy: Results of the First International Consensus Conference. OBES SURG. 1 oct 2020;30(10):3695-705.

48. Chen W, Wang Y, Zhu J, Wang C, Dong Z. Esophagogastric Cancer After Sleeve Gastrectomy: A Systematic Review of Case Reports. Cancer Manag Res. 2021;13:3327-34.

49. Mandeville Y, Van Looveren R, Vancoillie P-J, Verbeke X, Vandendriessche K, Vuylsteke P, et al. Moderating the Enthusiasm of Sleeve Gastrectomy: Up to Fifty Percent of Reflux Symptoms After Ten Years in a Consecutive Series of One Hundred Laparoscopic Sleeve Gastrectomies. Obes Surg. juill 2017;27(7):1797-803.

50. Nocca D, Nedelcu M, Loureiro M, Palermo M, Silvestri M, Jong A de, et al. The Nissen Sleeve Gastrectomy: Technical Considerations. J Laparoendosc Adv Surg Tech A. nov 2020;30(11):1231-6.

51. Carandina S, Zulian V, Nedelcu A, Danan M, Vilallonga R, Nocca D, et al. Is It Safe to Combine a Fundoplication to Sleeve Gastrectomy? Review of Literature. Medicina (Kaunas). 18 avr 2021;57(4):392.

52. Nagendran M, Carlin AM, Bacal D, Genaw JA, Hawasli AA, Birkmeyer NJ, et al. Self-reported remission of obstructive sleep apnea following bariatric surgery: cohort study. Surg Obes Relat Dis. juin 2015;11(3):697-703.

53. Agosta C, Borel J-C, Reche F, Arvieux C, Wion N, Jaber S, et al. Treatment Discontinuation Following Bariatric Surgery in Obstructive Sleep Apnea: a Controlled Cohort Study. OBES SURG. 1 sept 2016;26(9):2082-8.

54. Currie AC, Kaur V, Carey I, Al-Rubaye H, Mahawar K, Madhok B, et al. Obstructive sleep apnea remission following bariatric surgery: a national registry cohort study. Surg Obes Relat Dis. sept 2021;17(9):1576-82.

55. de Raaff CAL, Coblijn UK, Ravesloot MJL, de Vries N, de Lange-de Klerk ESM, van Wagensveld BA. Persistent moderate or severe obstructive sleep apnea after laparoscopic Roux-en-Y gastric bypass: which patients? Surg Obes Relat Dis. déc 2016;12(10):1866-72.

56. Greenburg DL, Lettieri CJ, Eliasson AH. Effects of Surgical Weight Loss on Measures of Obstructive Sleep Apnea: A Meta-Analysis. The American Journal of Medicine. 1 juin 2009;122(6):535-42.

57. Buchwald H, Avidor Y, Braunwald E, Jensen MD, Pories W, Fahrbach K, et al. Bariatric Surgery: A Systematic Review and Meta-analysis. JAMA. 13 oct 2004;292(14):1724.

58. Nastałek P, Polok K, Celejewska-Wójcik N, Kania A, Sładek K, Małczak P, et al. Impact of bariatric surgery on obstructive sleep apnea severity and continuous positive airway

pressure therapy compliance-prospective observational study. Sci Rep. 2 mars 2021;11(1):5003.

59. Van Ryswyk E, Anderson CS, Antic NA, Barbe F, Bittencourt L, Freed R, et al. Predictors of long-term adherence to continuous positive airway pressure in patients with obstructive sleep apnea and cardiovascular disease. Sleep [Internet]. 9 oct 2019 [cité 20 nov 2021];42(10). Disponible sur: https://doi.org/10.1093/sleep/zsz152

60. Lettieri CJ, Eliasson AH, Greenburg DL. Persistence of Obstructive Sleep Apnea After Surgical Weight Loss. Journal of Clinical Sleep Medicine. 15 août 2008;04(04):333-8.

61. Amor IB, Casanova V, Vanbiervliet G, Bereder JM, Habitan R, Kassir R, et al. The Nissen-Sleeve (N-Sleeve): Results of a Cohort Study. Obes Surg. sept 2020;30(9):3267-72.

62. Felsenreich DM, Kefurt R, Schermann M, Beckerhinn P, Kristo I, Krebs M, et al. Reflux, Sleeve Dilation, and Barrett's Esophagus after Laparoscopic Sleeve Gastrectomy: Long-Term Follow-Up. Obes Surg. déc 2017;27(12):3092-101.

63. Predictors of pulmonary complications after bariatric surgery. Surgery for Obesity and Related Diseases. 1 sept 2012;8(5):574-81.

64. Rosenthal R, Diaz A, Arvidsson D, Baker R, Basso N, Bellanger D, et al. International Sleeve Gastrectomy Expert Panel Consensus Statement: best practice guidelines based on experience of >12,000 cases. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery. 29 févr 2012;8:8-19.

65. Fuks D, Verhaeghe P, Brehant O, Sabbagh C, Dumont F, Riboulot M, et al. Results of laparoscopic sleeve gastrectomy: a prospective study in 135 patients with morbid obesity. Surgery. janv 2009;145(1):106-13.

66. Yadlapati R, Hungness ES, Pandolfino JE. Complications of Antireflux Surgery. Official journal of the American College of Gastroenterology | ACG. août 2018;113(8):1137-47.

67. Iqbal M, Batch AJ, Moorthy K, Cooper BT, Spychal RT. Outcome of surgical fundoplication for extra-oesophageal symptoms of reflux. Surg Endosc. mars 2009;23(3):557-61.

68. Zanation AM, Senior BA. The relationship between extraesophageal reflux (EER) and obstructive sleep apnea (OSA). Sleep Medicine Reviews. 1 déc 2005;9(6):453-8.

69. Caparroz FA, Campanholo M de AT, Regina CG, Park SW, Haddad L, Gregório LC, et al. Clinical and polysomnographic predictors of laryngopharyngeal reflux in obstructive sleep apnea syndrome. Brazilian Journal of Otorhinolaryngology. 1 juill 2019;85(4):408-15.

70. Gilani S, Quan SF, Pynnonen MA, Shin JJ. Obstructive Sleep Apnea and Gastroesophageal Reflux: A Multivariate Population-Level Analysis. Otolaryngol Head Neck Surg. 1 févr 2016;154(2):390-5.

71. Tawk M, Goodrich S, Kinasewitz G, Orr W. The Effect of 1 Week of Continuous Positive Airway Pressure Treatment in Obstructive Sleep Apnea Patients With Concomitant Gastroesophageal Reflux. Chest. oct 2006;130(4):1003-8.

72. Cao MT, Sternbach JM, Guilleminault C. Continuous positive airway pressure therapy in obstuctive sleep apnea: benefits and alternatives. Expert Rev Respir Med. avr 2017;11(4):259-72.

73. Li C, Wu Z-H, Pan X-L, Yuan K. Effect of continuous positive airway pressure on gastroesophageal reflux in patients with obstructive sleep apnea: a meta-analysis. Sleep Breath. sept 2021;25(3):1203-10.

74. Wang L, Han H, Wang G, Liu H, Sun Z, Li B, et al. Relationship between reflux diseases and obstructive sleep apnea together with continuous positive airway pressure treatment efficiency analysis. Sleep Medicine. 1 nov 2020;75:151-5.

75. Modolell I, Esteller E, Segarra F, Mearin F. Proton-pump inhibitors in sleep-related breathing disorders: clinical response and predictive factors. Eur J Gastroenterol Hepatol. oct 2011;23(10):852-8.

76. Ermis F, Akyuz F, Arici S, Uyanikoglu A, Yakar F, Pinarbasi B, et al. Effect of proton pump inhibitor (PPI) treatment in obstructive sleep apnea syndrome: an esophageal impedance-pHmetry study. Hepatogastroenterology. oct 2011;58(110-111):1566-73.

77. Meta-analysis of the effect of proton pump inhibitors on obstructive sleep apnea symptoms and indices in patients with gastroesophageal reflux disease. - literature database - CNGBdb [Internet]. [cité 21 nov 2021]. Disponible sur: https://db.cngb.org/search/literature/26722154/

78. Cohen JA, Arain A, Harris PA, Byrne DW, Holzman MD, Sharp KW, et al. Surgical trial investigating nocturnal gastroesophageal reflux and sleep (STINGERS). Surgical Endoscopy. 1 mars 2003;17(3):394-400.

SERMENT

En présence des Maîtres de cette école, de mes chers condisciples et devant l'effigie d'Hippocrate, je promets et je jure, au nom de l'Etre suprême, d'être fidèle aux lois de l'honneur et de la probité dans l'exercice de la médecine.

Je donnerai mes soins gratuits à l'indigent et n'exigerai jamais un salaire au-dessus de mon travail.

Admis dans l'intérieur des maisons, mes yeux ne verront pas ce qui s'y passe, ma langue taira les secrets qui me seront confiés. Mon état ne servira pas à corrompre les mœurs, ni à favoriser le crime.

Respectueux et reconnaissant envers mes Maîtresses et Maîtres, je rendrai à leurs enfants l'instruction que j'ai reçue de leurs pères.

Que les Hommes et Femmes m'accordent leur estime si je suis fidèle à mes promesses. Que je sois couvert d'opprobre et méprisé de mes confrères et consœurs si j'y manque.

Résumé

Introduction : La clé de la rémission du syndrome d'apnée obstructive du sommeil (SAOS) chez les patients avec obésité est la perte de poids. La Sleeve-gastrectomie est un moyen efficace pour perdre l'excès de poids, améliorer le SAOS et diminuer les recours à la pression positive continue (PPC). Une fundoplicature de Nissen concomitante a récemment été proposée pour diminuer le reflux gastroœsophagien (RGO) post-opératoire. L'objectif de cette étude était d'évaluer le taux d'arrêt du traitement par PPC ainsi que le devenir post-opératoire des patients après une Nissen-Sleeve, en comparaison avec une Sleeve gastrectomie.

Méthodes : Dans cette étude monocentrique rétrospective, les patients appareillés par PPC opérés d'une Nissen-sleeve ou d'une Sleeve-gastrectomie au CHU de Montpellier en 2018 ont été inclus. Chaque Nissen-sleeve a été appariée à une Sleeve-gastrectomie selon le sexe, les symptômes de RGO et l'indice de masse corporelle.. Le critère de jugement principal était l'arrêt de la PPC après 3 ans de suivi. Le critère de jugement secondaire principal était la symptomatologie de RGO. Les complications postopératoires respiratoires et chirurgicales ont aussi été évaluées.

Résultats : Quatre-vingt-six patients ont répondu aux critères d'inclusion. Trente-trois patients opérés de Nissen-Sleeve ont été appariés avec 33 patients opérés de Sleeve-gastrectomie. L'arrêt de l'appareillage par PPC était significativement plus élevé dans le groupe Nissen-Sleeve (25/31, 81%) par rapport au groupe Sleeve-gastrectomie (18/32, 56%, p=0,038). Le nombre de patients présentant des symptômes de RGO à 3 ans était significativement plus bas après Nissen-Sleeve (3/33, 9 %) qu'après Sleevegastrectomie (19/33, 58 %, p<0,0001). Aucune différence significative n'a été rapportée concernant les complications postopératoires respiratoires et chirurgicales.

Conclusion : Chez les patients avec SAOS appareillé, la Nissen-Sleeve était associée à plus d'arrêt de l'appareillage par PPC à 3 ans, par rapport à une Sleeve-gastrectomie.

Mots clés : chirurgie bariatrique # Nissen-Sleeve # syndrome d'apnées obstructive du sommeil # Pression positive continue # fundoplicature # obesité # reflux gastro-oesophagien # péri-opératoire.