



HAL
open science

Is progressive preoperative pneumoperitoneum (PPP) really safe? Assessment of its specific morbi-mortality in a retrospective study over 152 patients

Nicolas Mougin

► To cite this version:

Nicolas Mougin. Is progressive preoperative pneumoperitoneum (PPP) really safe? Assessment of its specific morbi-mortality in a retrospective study over 152 patients. Human health and pathology. 2015. dumas-01205492

HAL Id: dumas-01205492

<https://dumas.ccsd.cnrs.fr/dumas-01205492>

Submitted on 25 Sep 2015

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.

AVERTISSEMENT

Ce document est le fruit d'un long travail approuvé par le jury de soutenance et mis à disposition de l'ensemble de la communauté universitaire élargie.

Il n'a pas été réévalué depuis la date de soutenance.

Il est soumis à la propriété intellectuelle de l'auteur. Ceci implique une obligation de citation et de référencement lors de l'utilisation de ce document.

D'autre part, toute contrefaçon, plagiat, reproduction illicite encourt une poursuite pénale.

Contact au SICD1 de Grenoble : **thesebum@ujf-grenoble.fr**

LIENS

Code de la Propriété Intellectuelle. articles L 122. 4

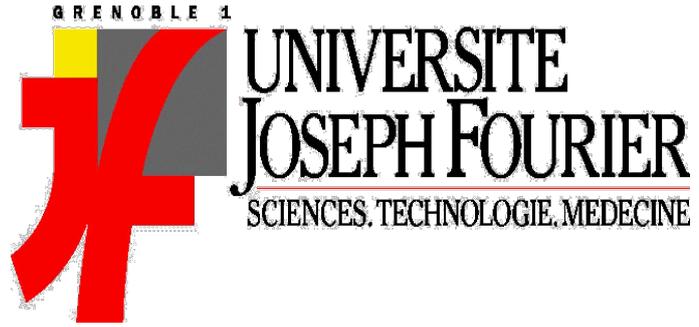
Code de la Propriété Intellectuelle. articles L 335.2- L 335.10

<http://www.cfcopies.com/juridique/droit-auteur>

<http://www.culture.gouv.fr/culture/infos-pratiques/droits/protection.htm>



ANNEE 2015



FACULTE DE MEDECINE DE GRENOBLE

Le pneumopéritoine progressif préopératoire (selon Goni Moreno) est-il sûr ?

Etude rétrospective sur 152 patients pour évaluer sa morbi-mortalité spécifique.

THESE PRESENTEE POUR L'OBTENTION DU DOCTORAT EN MEDECINE
DIPLOME D'ETAT

MOUGIN Nicolas

Né le 26/03/1986 à Lyon

THESE SOUTENUE PUBLIQUEMENT A LA FACULTE DE MEDECINE DE GRENOBLE

Le 18 septembre 2015

DEVANT LE JURY COMPOSE DE :

Monsieur le **Professeur LETOUBLON Christian**, Président du Jury

Madame le **Professeur ARVIEUX-BARTHELEMY Catherine**, Directrice de thèse

Monsieur le **Professeur CHAFFANJON Philippe**

Monsieur le **Docteur RISSE**

Monsieur le **Docteur ABBA**

Doyen de la Faculté : M. le Pr. Jean Paul ROMANET

Année 2014-2015

ENSEIGNANTS A L'UFR DE MEDECINE

CORPS	NOM-PRENOM	Discipline universitaire
PU-PH	ALBALADEJO Pierre	Anesthésiologie réanimation
PU-PH	APIEL Florent	Ophthalmologie
PU-PH	ARVIEUX-BARTHELEMY Catherine	chirurgie générale
PU-PH	BALOSSO Jacques	Radiothérapie
PU-PH	BARRET Luc	Médecine légale et droit de la santé
PU-PH	BENHAMOU Pierre Yves	Endocrinologie, diabète et maladies métaboliques
PU-PH	BERGER François	Biologie cellulaire
PU-PH	BETTEGA Georges	Chirurgie maxillo-faciale, stomatologie
MCU-PH	BIDART-COUTTON Marie	Biologie cellulaire
MCU-PH	BOISSET Sandrine	Agents infectieux
PU-PH	BONAZ Bruno	Gastro-entérologie, hépatologie, addictologie
MCU-PH	BONNETERRE Vincent	Médecine et santé au travail
PU-PH	BOSSON Jean-Luc	Biostatistiques, informatique médicale et technologies de communication
MCU-PH	BOTTARI Serge	Biologie cellulaire
PU-PH	BOUGEROL Thierry	Psychiatrie d'adultes
PU-PH	BOUILLET Laurence	Médecine interne
MCU-PH	BOUZAT Pierre	Réanimation
PU-PH	BRAMBILLA Christian	Pneumologie
PU-PH	BRAMBILLA Elisabeth	Anatomie et cytologie pathologiques
MCU-PH	BRENIER-PINCHART Marie Pierre	Parasitologie et mycologie
PU-PH	BRICAULT Ivan	Radiologie et imagerie médicale
PU-PH	BRICHON Pierre-Yves	Chirurgie thoracique et cardio-vasculaire
MCU-PH	BRIOT Raphaël	Thérapeutique, médecine d'urgence
PU-PH	CAHN Jean-Yves	Hématologie
MCU-PH	CALLANAN-WILSON Mary	Hématologie, transfusion
PU-PH	CARPENTIER Françoise	Thérapeutique, médecine d'urgence
PU-PH	CARPENTIER Patrick	Chirurgie vasculaire, médecine vasculaire
PU-PH	CESBRON Jean-Yves	Immunologie
PU-PH	CHABARDES Stephan	Neurochirurgie

Mise à jour le 14 novembre 2014

PU-PH	CHABRE Olivier	Endocrinologie, diabète et maladies métaboliques
PU-PH	CHAFFANJON Philippe	Anatomie
PU-PH	CHAVANON Olivier	Chirurgie thoracique et cardio- vasculaire
PU-PH	CHIQUET Christophe	Ophthalmologie
PU-PH	CINQUIN Philippe	Biostatistiques, informatique médicale et technologies de communication
PU-PH	COHEN Olivier	Biostatistiques, informatique médicale et technologies de communication
PU-PH	COUTURIER Pascal	Gériatrie et biologie du vieillissement
PU-PH	CRACOWSKI Jean-Luc	Pharmacologie fondamentale, pharmacologie clinique
PU-PH	DE GAUDEMARIS Régis	Médecine et santé au travail
PU-PH	DEBILLON Thierry	Pédiatrie
MCU-PH	DECAENS Thomas	Gastro-entérologie, Hépatologie
PU-PH	DEMATTEIS Maurice	Addictologie
PU-PH	DEMONGEOT Jacques	Biostatistiques, informatique médicale et technologies de communication
MCU-PH	DERANSART Colin	Physiologie
PU-PH	DESCOTES Jean-Luc	Urologie
MCU-PH	DETANTE Olivier	Neurologie
MCU-PH	DIETERICH Klaus	Génétique et procréation
MCU-PH	DOUTRELEAU Stéphane	Physiologie
MCU-PH	DUMESTRE-PERARD Chantal	Immunologie
PU-PH	EPAULARD Olivier	Maladies Infectieuses et Tropicales
PU-PH	ESTEVE François	Biophysique et médecine nucléaire
MCU-PH	EYSSERIC Hélène	Médecine légale et droit de la santé
PU-PH	FAGRET Daniel	Biophysique et médecine nucléaire
PU-PH	FAUCHERON Jean-Luc	chirurgie générale
MCU-PH	FAURE Julien	Biochimie et biologie moléculaire
PU-PH	FERRETTI Gilbert	Radiologie et imagerie médicale
PU-PH	FEUERSTEIN Claude	Physiologie
PU-PH	FONTAINE Éric	Nutrition
PU-PH	FRANCOIS Patrice	Epidémiologie, économie de la santé et prévention
PU-PH	GARBAN Frédéric	Hématologie, transfusion
PU-PH	GAUDIN Philippe	Rhumatologie
PU-PH	GAVAZZI Gaétan	Gériatrie et biologie du vieillissement
PU-PH	GAY Emmanuel	Neurochirurgie
MCU-PH	GILLOIS Pierre	Biostatistiques, informatique médicale et technologies de communication
PU-PH	GODFRAIND Catherine	Anatomie et cytologie pathologiques (type clinique)
MCU-PH	GRAND Sylvie	Radiologie et imagerie médicale
PU-PH	GRIFFET Jacques	Chirurgie infantile
MCU-PH	GUZUN Rita	Endocrinologie, diabétologie, nutrition, éducation thérapeutique
PU-PH	HALIMI Serge	Nutrition
PU-PH	HENNEBICQ Sylviane	Génétique et procréation

Mise à jour le 14 novembre 2014

PU-PH	HOFFMANN Pascale	Gynécologie obstétrique
PU-PH	HOMMEL Marc	Neurologie
PU-PH	JOUK Pierre-Simon	Génétique
PU-PH	JUVIN Robert	Rhumatologie
PU-PH	KAHANE Philippe	Physiologie
PU-PH	KRACK Paul	Neurologie
PU-PH	KRAINIK Alexandre	Radiologie et imagerie médicale
PU-PH	LABARERE José	Epidémiologie ; Eco. de la Santé
PU-PH	LANTUEJOU Sylvie	Anatomie et cytologie pathologiques
MCU-PH	LAPORTE François	Biochimie et biologie moléculaire
MCU-PH	LARDY Bernard	Biochimie et biologie moléculaire
MCU-PH	LARRAT Sylvie	Bactériologie, virologie
MCU-PH	LAUNOIS-ROLLINAT Sandrine	Physiologie
PU-PH	LECCIA Marie-Thérèse	Dermato-vénérologie
PU-PH	LEROUX Dominique	Génétique
PU-PH	LEROY Vincent	Gastro-entérologie, hépatologie, addictologie
PU-PH	LETOUBLON Christian	chirurgie générale
PU-PH	LEVY Patrick	Physiologie
MCU-PH	LONG Jean-Alexandre	Urologie
PU-PH	MACHECOURT Jacques	Cardiologie
PU-PH	MAGNE Jean-Luc	Chirurgie vasculaire
MCU-PH	MAIGNAN Maxime	Thérapeutique, médecine d'urgence
PU-PH	MAITRE Anne	Médecine et santé au travail
MCU-PH	MALLARET Marie-Reine	Epidémiologie, économie de la santé et prévention
MCU-PH	MARLU Raphaël	Hématologie, transfusion
MCU-PH	MAUBON Danièle	Parasitologie et mycologie
PU-PH	MAURIN Max	Bactériologie - virologie
MCU-PH	MCLEER Anne	Cytologie et histologie
PU-PH	MERLOZ Philippe	Chirurgie orthopédique et traumatologie
PU-PH	MORAND Patrice	Bactériologie - virologie
PU-PH	MOREAU-GAUDRY Alexandre	Biostatistiques, informatique médicale et technologies de communication
PU-PH	MORO Elena	Neurologie
PU-PH	MORO-SIBILOT Denis	Pneumologie
MCU-PH	MOUCHET Patrick	Physiologie
PU-PH	MOUSSEAU Mireille	Cancérologie
PU-PH	MOUTET François	Chirurgie plastique, reconstructrice et esthétique, brûlogie
MCU-PH	PACLET Marie-Hélène	Biochimie et biologie moléculaire
PU-PH	PALOMBI Olivier	Anatomie
PU-PH	PARK Sophie	Hémato - transfusion
PU-PH	PASSAGGIA Jean-Guy	Anatomie
PU-PH	PAYEN DE LA GARANDERIE Jean-François	Anesthésiologie réanimation
MCU-PH	PAYSANT François	Médecine légale et droit de la santé

Mise à jour le 14 novembre 2014

MCU-PH	PELLETIER Laurent	Biologie cellulaire
PU-PH	PELLOUX Hervé	Parasitologie et mycologie
PU-PH	PEPIN Jean-Louis	Physiologie
PU-PH	PERENNOU Dominique	Médecine physique et de réadaptation
PU-PH	PERNOD Gilles	Médecine vasculaire
PU-PH	PIOLAT Christian	Chirurgie infantile
PU-PH	PISON Christophe	Pneumologie
PU-PH	PLANTAZ Dominique	Pédiatrie
PU-PH	POLACK Benoît	Hématologie
PU-PH	POLOSAN Mircea	Psychiatrie d'adultes
PU-PH	PONS Jean-Claude	Gynécologie obstétrique
PU-PH	RAMBEAUD Jacques	Urologie
MCU-PH	RAY Pierre	Génétique
PU-PH	REYT Émile	Oto-rhino-laryngologie
MCU-PH	RIALLE Vincent	Biostatistiques, informatique médicale et technologies de communication
PU-PH	RIGHINI Christian	Oto-rhino-laryngologie
PU-PH	ROMANET J. Paul	Ophthalmologie
MCU-PH	ROUSTIT Matthieu	Pharmacologie fondamentale, pharmacologie clinique, addictologie
MCU-PH	ROUX-BUISSON Nathalie	Biochimie, toxicologie et pharmacologie
PU-PH	SARAGAGLIA Dominique	Chirurgie orthopédique et traumatologie
MCU-PH	SATRE Véronique	Génétique
PU-PH	SAUDOU Frédéric	Biologie Cellulaire
PU-PH	SCHMERBER Sébastien	Oto-rhino-laryngologie
PU-PH	SCHWEBEL-CANALI Carole	Réanimation médicale
PU-PH	SCOLAN Virginie	Médecine légale et droit de la santé
MCU-PH	SEIGNEURIN Arnaud	Epidémiologie, économie de la santé et prévention
PU-PH	STAHL Jean-Paul	Maladies infectieuses, maladies tropicales
PU-PH	STANKE Françoise	Pharmacologie fondamentale
MCU-PH	STASIA Marie-José	Biochimie et biologie moléculaire
PU-PH	TAMISIER Renaud	Physiologie
PU-PH	TONETTI Jérôme	Chirurgie orthopédique et traumatologie
PU-PH	TOUSSAINT Bertrand	Biochimie et biologie moléculaire
PU-PH	VANZETTO Gérald	Cardiologie
PU-PH	VUILLEZ Jean-Philippe	Biophysique et médecine nucléaire
PU-PH	WEIL Georges	Epidémiologie, économie de la santé et prévention
PU-PH	ZAOUI Philippe	Néphrologie
PU-PH	ZARSKI Jean-Pierre	Gastro-entérologie, hépatologie, addictologie

Mise à jour le 14 novembre 2014

Le pneumopéritoine progressif préopératoire (selon Goni Moreno) est-il sûr ? Etude rétrospective sur 152 patients pour évaluer sa morbi-mortalité spécifique.

Mougin N, Venchiarutti V, Abba J, Risse O, Létoublon C, Arvieux C

Département de chirurgie digestive et de l'urgence, Centre Hospitalier Universitaire de Grenoble, France.

Objectif: Evaluer la morbi-mortalité spécifique du pneumopéritoine progressif préopératoire (PPP) dans la prise en charge des éventrations larges de l'abdomen.

Patients et méthodes:

Etude monocentrique, constituée d'une cohorte rétrospective de 152 patients, traités entre Octobre 1974 et Février 2014.

Le critère principal est le taux de complications induites par le PPP. Les objectifs secondaires concernent les résultats des techniques chirurgicales (taux de complications postopératoires, taux de récurrence).

Résultats:

Le taux de complications spécifiques au PPP est de 20% : 15% de complications mineures, 5% de complications majeures. Le taux de mortalité est inférieur à 1%.

La cure chirurgicale a été réalisée dans 98,6% des cas (91% avec une prothèse de renfort pariétal). Le taux de complications postopératoires est de 40% (mineures 20%, majeures 16%); le taux de mortalité est inférieur à 3%. La durée médiane d'hospitalisation est de 30 jours. Le taux de récurrence est de 15% (suivi médian de 12 mois).

Conclusions:

Le PPP n'est pas dénué de risques, les 5% de complications majeures incitent à ne pas l'utiliser en ambulatoire. L'utilisation d'un cathéter intrapéritonéal placé chirurgicalement, sans dépasser 2 semaines d'insufflations, pourrait permettre de baisser sa morbi-mortalité spécifique.

Une prise en charge multidisciplinaire péri-opératoire (nutrition, chirurgie bariatrique) et l'emploi de nouveaux procédés chirurgicaux (préservation des artères perforantes, prothèses biologiques) pourraient améliorer les résultats chirurgicaux.

Mots clés: éventration large de l'abdomen, perte du droit de cité, pneumopéritoine, prothèse pariétale

Is progressive preoperative pneumoperitoneum (PPP) really safe? Assessment of its specific morbi-mortality in a retrospective study over 152 patients.

Mougin N, Venchiarutti V, Abba J, Risse O, Létoublon C, Arvieux C

Digestive surgery department, Grenoble University Hospital, France.

Objective: To assess PPP specific morbi-mortality, before large abdominal hernia repair.

Patients and methods:

Monocentric retrospective study over 152 patients, treated between October 1974 and February 2014.

Primary endpoint is PPP related morbidity and mortality rates. Secondary endpoints are surgical care results (postoperative complications rate, recurrence rate).

Results:

PPP specific complications rate is 20%: 15% for minor complications, 5% for major complications. Mortality rate is inferior to 1%.

Surgical repair rate is 98.9% (91% with mesh reinforcement). Postoperative complications rate reach 40% (minor 20%, major 16%); mortality is inferior to 3%. Median length of stay is 30 days. Recurrence rate is 15% (median follow up of 12 months).

Conclusions:

PPP is not totally safe, and with its 5% of major complications, we do not recommend to use it on an outpatient basis. Using surgically placed intraperitoneal catheter, with less than 2 weeks of insufflation period, may decrease its specific morbi-mortality.

Multidisciplinary perioperative management program (nutrition, bariatric surgery) and new surgical techniques (perforating arteries sparing, biological mesh) should improve surgical results.

Keys words: large hernia, loss of domain, pneumoperitoneum, mesh

Introduction

Incisional hernia is a frequent complication after abdominal surgery. Some of these patients have a large incisional hernia, defined by the European Hernia Society as a fascial defect of 10 cm or more in any direction(1). They are often associated with severe symptoms (chronic pain or wounds, respiratory disturbance...) resulting in a decreased quality of life. Surgical repair of such defects is known to be challenging, regarding patient's history (obesity, severe co-morbidities, abdominal traumatism or infection, previous mesh repair) and hernia's characteristics (loss of domain, contamination status). Slater and al summarized criteria for definition of complex abdominal wall hernia, and proposed three patient severity classes to assess the risk of a complicated post-operative course(2).

A feared complication is that the abdominal wall closure creates an abdominal hypertension, or even an abdominal compartment syndrome, who can lead to multi-visceral organ failure and to death(3,4). To prevent this, preoperative progressive pneumoperitoneum (PPP) has been described in 1947. The « Goni Moreno protocol » prepares the patient for the increased abdominal pressure after hernia repair(5). Since then, the effect of PPP have been demonstrated: respiratory rehabilitation(6), abdominal wall muscles lengthening(7), enlargement of the peritoneal cavity(8). Some authors even suggest that PPP will facilitate the surgery by progressive adhesions air-dissection(9). With these multiple effects, PPP allows us to operate patients that would be otherwise unfit for hernia repair surgery.

Many reports of PPP use have been published, but most of them are based on a small population size. It is sometimes difficult to know which type of hernia were treated (LIH, loss of domain, ventral or lateral); and the specific morbidity of PPP is rarely fully described, although it is considered « safe » by most of the authors (*Annex 1*). The aim of this study was to evaluate the safety of this procedure over a large population: thus we analysed preoperative

data, morbidity and mortality of PPP, and number of patient that underwent elective surgical repair of their hernia after PPP. We also analysed surgical care and follow-up data to assess mesh repair, postoperative complications and recurrent hernia rates as secondary objective.

Patients and methods

DESIGN

This is a single center study, from the digestive surgery department at Grenoble University Hospital, France. Period of interest runs from October 1974 to February 2014. Data have been collected retrospectively, from patients' charts (paper and informatic, using Cristalnet software).

POPULATION

During this time, 152 patients were selected for our study. Inclusion criterion was enrolment in a PPP program. In our team, we used this strategy when a patient has a large hernia (incisional or not) AND a severity index at least moderate. A large hernia is defined by fascial defect diameter superior to 10 cm. Patient severity index refers to Slater's classification(2). Patients with severe respiratory or cardio circulatory disturbance were excluded, as well as those with infected abdominal wall. We did not use this technique for strangulated hernias. We analyzed demographic data (age, gender) and medical history (cardio circulatory and pulmonary disease, smoking or drinking habits, BMI), and assessed ASA (American Society of Anaesthesiologists) status. We also used morphological hernias' characteristics (size, site) and surgical history (first surgery, incisional or recurrent type, previous mesh repair or infection) to determine Slater's grade.

PROGRESSIVE PREOPERATIVE PNEUMOPERITONEUM

We used two methods to induce a PPP: repeated peritoneal punctures (as Dr Goni Moreno described it(5)), or intraperitoneal surgically placed catheter (connected to subcutaneous chamber or not). Ambient air has been insufflated according to different protocols (constant or increased amount of air, daily or up to every 5 days insufflations). If scapular pain, nausea or dyspnoea appears, insufflations were stopped or delayed. The patient was hospitalized, and received daily kinesiology rehabilitation, and deep venous thrombosis prophylactic treatment. An abdominal belt covered the hernia 24/24h until the surgery, to avoid the full feeling of the hernia only. We stopped the PPP when abdominal muscles relaxation was reached on physical examination.

SURGERY

Our gold standard technique is open surgery, with retromuscular mesh repair (retrorectus for midline hernia – Rives' technique(10), intermuscular for subcostal and flank hernia) or extraperitoneal mesh repair – Stoppa's technique(11) (flank or inguinal hernia); we used Mersilene[®] mesh - Ethicon, Optilene[®] mesh - B-Braun, fixed with separated Prolene sutures. If the posterior sheath can't be closed, we used intraperitoneal mesh – IPOM technique (Parietex[™] mesh – Covidien), combined to aponeuroplasty(12). We often combined mesh reinforcement and Clotteau Premont anterior aponeuroplasty (13). For contaminated surgery we choosed herniorraphy without mesh (Welti-Eudel aponeuroplasty)(14); more recently we used biological mesh for some hernia repairs. Thus we assessed the Ventral Hernia Working Group (VHWG) classification's grade(15). Sometimes, we combined abdominal wall repair with abdominoplasty. We always used pre and subfascial drains. We removed subfascial drains after 48 hours, but prefascial drains could be kept much longer (seroma, dermolipectomy). Patients had to wear abdominal belt for at least 1 month. We analyzed surgical data (mesh use

or not, mesh position), post-operative complication rates (using Clavien-Dindo's classification), hospital length of stay time, and recurrence rate.

FOLLOW UP

Patients had systematic physical examination 1 month after hospital discharge. As it is a retrospective study, some patients' charts had missing data, and there were some patients lost of follow up. We analyzed skin cicatrisation, wound complications, reoperation rate, and recurrence rate.

STATISTICS

Data were analyzed with basic statistical tools (median, minimum and maximum value, percentage), statistical differences and subgroup analysis were assessed using R software.

Results

POPULATION

Among 152 patients, we treated 81 men and 71 women. Median age was 57 years; 11 patients were over 75 years old (7%), and 14 were under 40 years old (9%). Median BMI (Body Mass Index) was 32 kg/m²; 65% of the patient had BMI over 30 (obesity), and 25% over 40 (morbid obesity).

DEMOGRAPHIC DATA	median (min-max)	n =152	%
<i>Sex (men/women)</i>		81/71	53/47
<i>Age (years)</i>	57 (30-83)		
<i>BMI (kg/m²)</i>	32 (20-53)		

87 patients (59%) had at least 1 cardiovascular disease: the most frequent was arterial hypertension. 81 patients (55%) had at least 1 pulmonary disease; the most frequent was

COPD (chronic obstructive pulmonary disease). 22% were smokers, and 21% had diabetes. Half of the patients had an ASA (American Society of Anaesthesiologists) physical status grade 3.

MEDICAL HISTORY	n = 152	%
<i>Cardiologic</i>		
Acute myocardial infarction	12	8
Arrhythmia	11	7
Cardiac insufficiency	5	3
<i>Circulatory</i>		
Arterial hypertension	48	32
Deep venous thrombosis	17	12
Peripheral arteriopathy	16	11
<i>Pulmonary</i>		
COPD	24	16
Sleep apnoea syndrome	20	14
Asthma	9	6
<i>Other</i>		
Smoking	33	22
Diabetes	31	21
Dyslipidemia	19	13
Drinking	18	12
<i>ASA physical status</i>		
1	22	15
2	55	36
3	75	49

Median hernia defect size was 15 cm, with a maximum size of treated hernia of 37 cm. According to EHS classification(1) for primary and incisionnal abdominal wall hernias, we treated 120 (79%) midline hernias, 16 (10%) subcostal hernias, and less than 10% iliac, lumbar or flank hernias. There was a loss of domain for 40 patients (26%), suggested by physical examination: the hernia content cannot be reintegrated in the abdomen (it is fixed by adhesions). Only 4% were primary hernias. 146 (96%) were incisionnal hernias, among which 27% were recurrent (24 had 1 previous repair, 13 had 2 previous repair, 4 had 3 previous repair; 20 had previous mesh implantation). 35 (23%) had previous wound infection, and 9 (6%) had ulcerated skin. We used Slater's criteria of complex abdominal wall hernia to assess our patients' severity classes: 67% were grade II, 33% were grade III.

HERNIAS CHARACTERISTICS	median (min-max)	n = 152	%
<i>Size (cm)</i>	15 (10-37)		
<i>Localisation</i>			
Midline		120	79
Subcostal		16	10
Iliac		10	7
Lumbar- flank		6	4
<i>Reducibility</i>			
Loss of domain		40	26
<i>Surgical history</i>			
Incisionnal		146	96
Recurrent		41	27
Primary		6	4
<i>Abdominal wall history</i>			
Previous wound infection		35	23
Ulcerated skin		9	6
<i>Slater's grade</i>			
II		102	67
III		50	33

PROGRESSIVE PREOPERATIVE PNEUMOPERITONEUM

Both techniques to induced PPP were used equally: 74 patients with surgically placed intraperitoneal catheter, 78 patients with repeated punctures. Median duration of insufflation was 15 days: 5 days for the less compliant abdomen (pain with low volume of insufflated air), up to 44 days for the longest time (at the beginning of PPP use). Specific morbidity was about 20%: complications were cutaneous (9%), digestive (6%), and pulmonary (6%).

PROGRESSIVE PREOPERATIVE PNEUMOPERITONEUM	median (min-max)	n = 152	%
<i>Technique</i>			
Surgical catheter insertion		74	49
Repeated punctures		78	51
<i>PPP use</i>			
Duration (days)	15 (5-36)		
Volume (litres)	12 (5-44)		
<i>Morbidity</i>		31	20
Cutaneous		13	9
Digestive		9	6
Pulmonary		9	6
<i>Mortality</i>		1	0,7

There were 15 complications for patients with repeated puncture, and 16 for surgical catheter insertion (no statistical difference, $p = 0,84$). Complications' rates showed no statistical difference between both groups, although there was a trend for subcutaneous emphysema in the repeated puncture group ($p=0,09$). Subcutaneous emphysema and pneumomediastinum represented almost half of PPP's complications (48%).

COMPLICATIONS	surgical catheter	repeated punctures	n	statistical difference
<i>Cutaneous</i>	4	9	13	$p=0,38$
Emphysema	2	8	10	$p=0,09$
Abscess	2	0	2	$p=0,23$
Hematoma	0	1	1	$p=1$
<i>Digestive</i>	6	3	9	$p=0,53$
Occlusion	3	0	3	$p=0,11$
Mesenteric insufflation	1	2	3	$p=1$
Bowel injury	1	1	2	$p=1$
Hemoperitoneum (torn adhesions)	1	0	1	$p=0,48$
<i>Pulmonary</i>	6	3	9	$p=0,32$
Pneumomediastinum	3	2	5	$p=0,67$
Pneumothorax	2	0	2	$p=0,23$
Acute respiratory insufficiency	1	1	2	$p=1$
<i>Total</i>	16	15	31	$p=0,84$

Minor morbidity (Clavien I and II) reached 15%, major morbidity (Clavien III, IV, V) 5%. Three patients had specific surgery for PPP complications (abscess, pneumothorax, bowel injury), without hernia repair surgery. Two patients had emergency surgery: one for hemoperitoneum (torn adhesions; day 5 of PPP) leading to skin closure only; one for acute respiratory failure (day 16 of PPP) leading to exploratory laparotomy (no bowel ischemia, aponeuroplasty), then abdominal compartment syndrome (re-laparotomy and VAC closure at H+10), and finally death (multi visceral failure at H+28). Grade III (or superior) complications happened within the first week of PPP; median PPP duration for patients with PPP's complications was 17 days (data not shown).

<i>CLAVIEN CLASSIFICATION</i>	surgical catheter	repeated punctures	n	statistical difference
<i>Minor morbidity</i>			24	
I	6	13	19	p=0,14
II	4	1	5	p=0,02
<i>Major morbidity</i>			7	
III a	4	0	4	p=0,43
III b	2	1	3	p=0,61
IV	0	0	0	
<i>Mortality</i>				
V	1	0	1	p=0,48

SURGERY

One patient with ischemic bowel segment (intraoperative findings; day 30 of PPP) underwent bowel resection and skin closure only. One with really large defect (even after component separation technique) had skin closure only. We have been able to repair the hernia of 145 (99%) patients: 132 (90%) with mesh reinforcement, 13 (9%) with aponeuroplasty. We mainly used polyester mesh (82%). We used 3 positions for mesh reinforcement: retromuscular (56%), intraperitoneal (30%), extraperitoneal (14%). Clotteau – Premont anterior aponeuroplasty have been used for 37 patients. 102 (69%) patients had a VHWG (Ventral Hernia Working Group) grade 1 or 2. Two patients underwent bowel resection: we repaired their hernia with intraperitoneal mesh (1 biological). Twelve patients underwent dermolipsectomy at the end of the surgery.

ELECTIVE SURGERY	n =147	%
<i>Technique</i>		
Mesh reinforcement	132	90
Aponeuroplasty	13	9
Skin closure only	2	1
<i>Mesh type</i>		
Polyester (Mersilene [®] / Parietex [™])	108 (94/14)	82
Polypropylene (Optilene [®])	19	14
Biological	5	4
<i>Mesh position</i>		
Retromuscular	74	56
Intraperitoneal	39	30
Extraperitoneal	19	14

<i>Concomitant surgery</i>		
Clotteau – Premont aponeuroplasty	37	26
Dermolipectomy	12	8
Bowel resection	3	0,7
<i>VHWG grade</i>		
1 / 2	25 / 77	17 / 52
3 / 4	45 / 0	31 / 0

We compared patients with repeated punctures and those with surgically placed catheter: there were no difference for mesh reinforcement rate (91% vs. 89%) and aponeuroplasty rate (9% each). We found no significant statistical difference (regarding preoperative data) between the two hernia repair groups (mesh reinforcement and aponeuroplasty). We also compared patients with intraperitoneal mesh and those with retromuscular mesh: they were more obese (median BMI 38 kg/m² vs. 32), and had more complex medical and surgical history (COPD: 53% vs. 20%, previous wound infection: 41% vs. 10%, LOD: 50% vs. 20%, VHWG grade 3 (56% vs. 19%); data not shown.

POSTOPERATIVE CARE

Median postoperative length of stay was 13 days; median overall length of stay was 30 days. 30 patients (20%) had minor morbidity (Clavien-Dindo grade I or II): superficial skin necrosis, hematoma, small abscess, bowel occlusion. 24 patients (16%) had major morbidity (Clavien-Dindo grade III a or b): abscess, deep fat necrosis: they underwent a second surgery, among which 4 had partial mesh removal and VAC® therapy. Four patients died: 3 during the first postoperative week (2 from severe arrhythmia, 1 from acute mesenteric infarction), 1 at the end of the third postoperative week (COPD history, with bilateral pneumonia).

POST OPERATIVE CARE	median (min-max)	n = 147	%
<i>Length of stay</i>			
Postoperative	13 (4-62)		
Overall	30 (12-87)		
<i>Complications</i>		58	40
<i>Cutaneous</i>			
Superficial necrosis (skin)		15	10
Hematoma		14	9
Seroma		9	6
Deep necrosis (skin and fat)		6	4
Abscess		5	3
<i>Digestive</i>			
Occlusion		2	1
<i>Death</i>			
Arrhythmia		2	1
Acute mesenteric infarction		1	0,7
Bilateral pneumonia		1	0,7
<i>Clavien-Dindo classification</i>			
I / II		0 / 30	0 / 20
III a / III b		7 / 17	5 / 12
IV / V		0 / 4	0 / 3

The two women who died from severe postoperative arrhythmia had the same kind of medical history: age over 70 years old, previous acute myocardial infarction, midline incisional hernia with loss of domain repaired with intraperitoneus polyester mesh, after 25 and 27 days of PPP. Patients with grade III complications had specific patterns of medical history: they were older (median age 60 years old vs. 57), half of them had previous abdominal wall complex history (wound infection, skin closure only, skin graft), and underwent dermolipectomy (59%) or bowel resection (67%).

FOLLOW UP

Median time of follow up was 12 months; but 20 (14%) patients were lost to follow up and 53 (37%) had a follow up time inferior to one year. Chronic wound infection reached 8% of the patients: 4 patients had non-absorbable sutures removal, and 3 had partial mesh removal. Global recurrence rate was 13% (18 patients); adjusted (119 patients with at least one year of follow up) recurrence rate was 15%.

FOLLOW UP	median (min-max)	n = 143	%
<i>Follow up</i>			
Time (months)	12 (1-156)		
Less than 12 months		53	37
Missing data		20	3
<i>Complications</i>			
Chronic wound infection		11	8
Sutures removal		4	3
Partial mesh removal		3	2
<i>Recurrent hernia</i>		18	13

Among eleven patients with chronic wound infection, 5 (45%) had surgery after the hernia repair (2 for hematoma, 3 for deep necrosis), and two of them had third surgery for sutures and/or partial mesh removal; 4 (36%) patients had recurrent hernia: they were all women with BMI > 35 kg/m². Among 18 patients with recurrent hernia, all had mesh repair: 12 (67%) retromuscular, 5 (42%) intraperitoneal, 1 extraperitoneal; 5 (42%) had a VHWG grade 3, and 4 patients had chronic wound infection during post-operative course

PATIENTS' FLOW

Annex 2

Discussion

BIAS

By design, our study has methodological bias (missing data, lost of follow up) that we tried to take into account in our results analysis. In the meanwhile, this is the biggest cohort reporting results of progressive preoperative pneumoperitoneum use, giving us appropriate statistical power.

RESULTS

Primary objective

To assess the specific morbi-mortality of the PPP was our primary objective in this study, because we believe it is underestimated in the literature. Previous studies did not specifically quantify this, but in a detailed review of those publications (annex 1) we found a global PPP's morbidity from 4% up to 90%. Most of the time it was minor morbidity (Clavien's grade I or II), but half of the studies had patients that did not underwent hernia repair because of a PPP's complication. At the beginning of PPP use, nausea, pain and subcutaneous emphysema were more reported; by the time, with protocol modifications (change of gas, rhythm and volume of insufflations) and increased patients number, respiratory, cardiovascular and digestive problems appeared.

In our study, among 152 patients selected for the Goni Moreno protocol, 147 (97%) reached the elective surgery time. 5 (3%) patients needed complications care or emergency surgery that put them out of criteria for elective hernia repair. The most frequent complications were cutaneous (9%), digestive (6%), and pulmonary (6%). If cutaneous or catheter related complications did not impact on surgical project, bowel injuries or acute respiratory failure forced surgeons to operate in emergency situations, without the possibility to treat the hernia (or without a mesh reinforcement). One patient died from abdominal compartment syndrome, even after emergency decompression surgery. So, if mortality was rare (inferior to 1%), morbidity reached 20%. Major morbidity (Clavien grade superior to III) happened within the first week, and minor morbidity (Clavien grade inferior to II) seems to increase after the second week of PPP (median time = 17 days). We found no statistical differences for complications rate between the two techniques used to induce PPP (repeated puncture, surgically placed catheter). Bowel occlusion during the second week of PPP should

be considered as a warning sign of mesenteric ischemia (4 patients had occlusion symptoms, 1 developed an abdominal compartment syndrome and 1 had an ischemic bowel segment).

Secondary objective

We also evaluated surgical cares, from mesh placement to follow up. 147 patients reached the elective hernia repair surgery. Intraoperative findings forced us to do a skin closure only for 2 patients (1,4%). The other 145 (98,6%) patients had their hernia repaired: 13 (9%) with aponeuroplasty alone, 132 (91%) with mesh. Patients with midline hernia had a retrorectus mesh in 61% of cases; risk factors for failure of retromuscular mesh reinforcement seems to be obesity $> 35\text{kg/m}^2$, COPD, previous wound infection, loss of domain and VHWG grade 3. Postoperative morbidity reached 40% of cases: 20% for minor complications, 16% for major complications; risk factors for wound complications seems to be age > 60 years old, complex skin history (skin closure only, skin graft, previous wound infection), concomitant dermolipectomy or bowel resection. 4 patients (2,7%) died from cardiovascular or pulmonary complications (the only common factor was age over 70 years old). We considered that 7 (4,6%) patients had a PPP strategy failure, meaning they had cardio-circulatory or respiratory troubles (PPP is used to avoid these complications): 3 did not tolerate PPP, 4 did not tolerate hernia repair after PPP. For them, median age was 69 years old, median ASA was 3, and median PPP duration was 21 days; they all had at least 1 previous respiratory and 1 cardio-circulatory disease. This pattern may be considered predictive of PPP failure. Median overall hospital length of stay was 30 days. Median follow up was 12 months: chronic wound infection reached 8%, global recurrence rate was 15%. A relevant fact is that all recurrent hernias have been found in women with at least class II obesity ($> 35\text{ kg/m}^2$), among which 1 over 2 had VHWG grade 3.

In a recent review, Deerenberg and al summarized large incisional hernia repair techniques and results, with open or laparoscopic surgery, with or without mesh(16). They reported wound complications rate from 13 to 48%, and mortality from 0,4% to 10,4% (these variations depended on the hernia complexity). Our results (morbidity 40%, mortality 2,7%) are concordant to this review, and to those we found in PPP specific studies (morbidity from 8 to 91%, mortality from 0 to 10%). They also showed that sublay (retromuscular), sandwich (extraperitoneal) and aponeuroplasty + IPOM are the three techniques with the lowest recurrence rate (4%): these are the same techniques that we used in our study. On the other side, only a few study compared two groups of patients with loss of domain (with or without PPP): recurrence rate without PPP was 15 to 20%(17)(18). Our high recurrence rate can be explained by the fact that we treated patients with more severe medical history (old people, 50% of the patients with ASA 3, 25% with morbid obesity...) and complex hernia (Slater's grade high in 33% of the cases), including recurrent incisional hernia or hernia with loss of domain.

DISCUSSION

With these results, we can say that the PPP is a risky procedure that surgeons should not use for every one's hernia. There is still no clear algorithm for PPP use. In our opinion, patients should have a high risk of complicated postoperative course, so that PPP benefits will offset its specific risks. Slater's classification(2), with four criteria categories, is an exhaustive and helpful tool for the surgeon to select these patients. But the more complex these patients will be, the more high recurrence rate we will have... bringing us into a vicious circle. So how can we improve our results?

We can think of other surgical techniques that will help the surgeons to treat such hernias. Plastic surgeons have developed tissue expander techniques, to prepare patients with

large skin resection to a simultaneous reconstruction surgery. Carr used this after damage control laparotomy, for abdominal wall repair (sometimes with stoma), with good results(19). But it does not have any respiratory rehabilitation effects, or abdominal muscles relaxation. Another solution is local injection of botulinum A toxin in these muscles to induce their paralysis, consequently increasing intra-abdominal volume and decreasing its pressure(20). This study reports safe results on rats, but had never been used with humans. Other techniques are reported, but they are not preoperative treatments: phrenic nerve resection, hernia content's resection, musculo-cutaneous flaps... The Component Separation Technique(21) could be a good option. Agnew and al reported good results with CST combined to mesh repair, which increase intra-abdominal volume without pulmonary disturbance(22). But this technique can't be use for non-ventral hernia or transversal incisional hernia, and does not have the progressive respiratory rehabilitation effect. In a word, there is (to our knowledge) no other equivalent preoperative technique to prepare to surgery both patient's cardio-pulmonary system and abdominal wall tissues.

So, if we choose to stick with PPP, Goni Moreno protocol modifications may help to improve our results. Since its first report, it as already evolved at many times: insufflations gas changes (from nitrous oxide and CO₂ to ambient air), various insufflations rhythm and volume (from every five days to daily insufflations), insufflations techniques (from repeated punctures to 3 lumens-catheter surgically placed in the peritoneal cavity). Nowadays, most of surgical teams use daily ambient air insufflations (with antibacterial filter). But the question of how long we should induce PPP does not have a consensus answer. Moreno stopped the procedure when bulging of the flanks was noted (abdominal wall stretching was considered as enough). But to reach this goal, PPP may be induced for very long time (up to 40 days). In our study, we showed that complications rate increased during the third week. For Willis, PPP should not exceed 6-10 days, arguing that after this time only intra-abdominal pressure will

increase, but intraperitoneal volume will not(23). Mason and Murr may have an explanation for these late complications, saying that compression of the vena cava or renal vein will occur with larger volume(24)(25). For these reasons, Tanaka and al studied volumetric changes during PPP(26): they described a technique to assess abdominal cavity and hernia sac volume, that will give objective data to include patients in a PPP program, and also to calculate the volume of gas that should be insufflated before surgery. We agree with the real impact of preoperative abdominal computerized tomography (every patient should have one, especially obese patients), because it allows good evaluation of defect size and location, and quality of muscular and aponeurotic layers. But Tanaka's article has some limitations: it only considered PPP for hernia with loss of domain, and a random cutoff at 25% for volume ratio between hernia sac and intra-abdominal volume was used (but loss of domain was defined for lower ratio volume: for example, it was 15-20% for Kingsnorth(27)). Volumetric effects of PPP were later studied(8)(28), Sabbagh and al even assessed a significant ratio volume cut off at 20%(29). Based on this review, we suggest to assess the hernia sac volume on tomography, then to insufflate its equivalent amount of gas within a maximum of two weeks, and -if this PPP allows bulging of the abdominal muscles- to operate the patient.

Finally, we come to surgical cares and their outcomes. As we saw previously, our higher recurrent hernia rate (than in Deerenberg's review) can be explained by our more complicated patients. Indeed, most of them had more than two risks factors for wound complications (especially age > 60 years old and previous wound complication). Patients with concomitant bowel resection or dermolipectomy also had a significantly increased wound complications rate. Another important fact is that all recurrent hernia occurred for women with BMI > 35kg/m². In 1956, Mason already assessed morbid obesity role in high recurrence rate, telling surgeon to first treat overweight with bariatric surgery, before even thought of hernia repair(24). Technical progress (laparoscopy) and long-term results (effects on

metabolism, allowing better control of diabetes or dyslipidemia) of bariatric surgery make Mason's strategy even more actual. But patients over 60 years old (half of patients eligible for PPP) often fail in pursuing bariatric preoperative program (alimentary habits changes, physical exercises rehabilitation, medical comorbidities control), and therefore are unfit for elective bariatric surgery. Even if they do follow this program, laparoscopic bariatric surgery is really uneasy when patients have large abdominal hernia. Nevertheless, we now insist on the fact that surgery is not an option until patients have lost weight, stop smoking, healed their previous wound complications, and changed their physical exercise habits; if needed, we work with a rehabilitation center to help them achieving these goals. On a more technical point of view, wound complications rate may decrease if we find ways to preserve tissue vascularisation. Some authors noticed that anterior aponeuroplasty or component separation technique damage perforating arteries, decreasing blood flow to the skin. And perforating arteries sparing techniques already exists: endoscopic component separation technique (CST)(30), Transversus Abdominis Release (TAR) which is a posterior CST(31), Open Peri-umbilical Perforator Sparing Components Separation (OPUPS)(32). At last, using biological mesh may have a place for these patients (grade 2 or 3 of VHWG classification)(15), but there is a lack of data for now (especially long term recurrence rate).

CONCLUSIONS

Progressive preoperative pneumoperitoneum is not always safe, and exposes patients to rare but potentially severe complications such as bowel injury or cardio-pulmonary disturbance, and even death. Therefore, we do not use it in an outpatient basis, even if it increases overall hospital length of stay (and hospitalisation cost). Inducing PPP with intraperitoneal surgically placed catheter and without exceeding two weeks of daily insufflations may decrease its specific morbi-mortality.

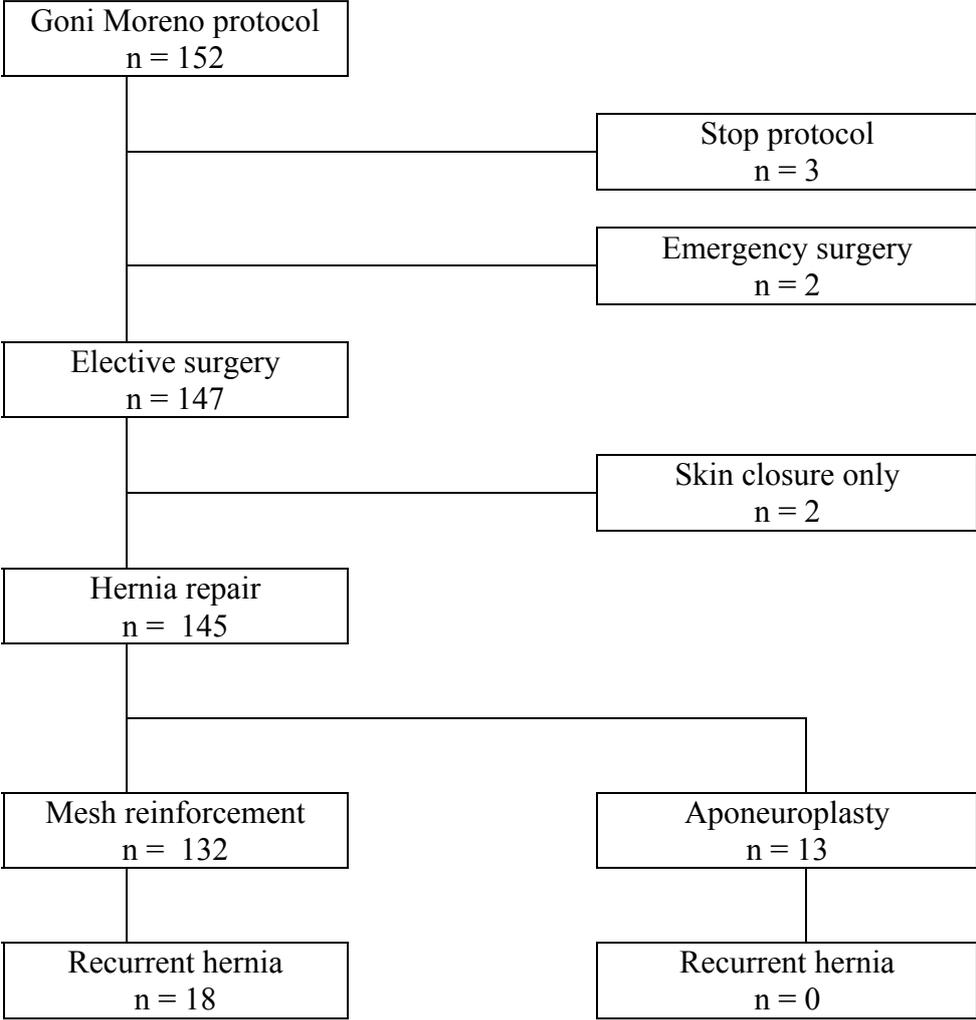
This simple technique allowed us to bring almost all of our complex patients to their hernia repair, who would have been otherwise unfit for surgery. If surgical mesh reinforcement rate was good, wound complications and recurrence rates were high. Previous bariatric surgery, avoiding concomitant bowel resection or dermolipectomy, perforating arteries sparing techniques should be considered as relevant options to improve these results. With this in mind, we tried to create an algorithm for patients with complex abdominal hernia we want to include in a PPP program (*Annex 3*).

Annex 1: Literature review (23, 25, 33–54)

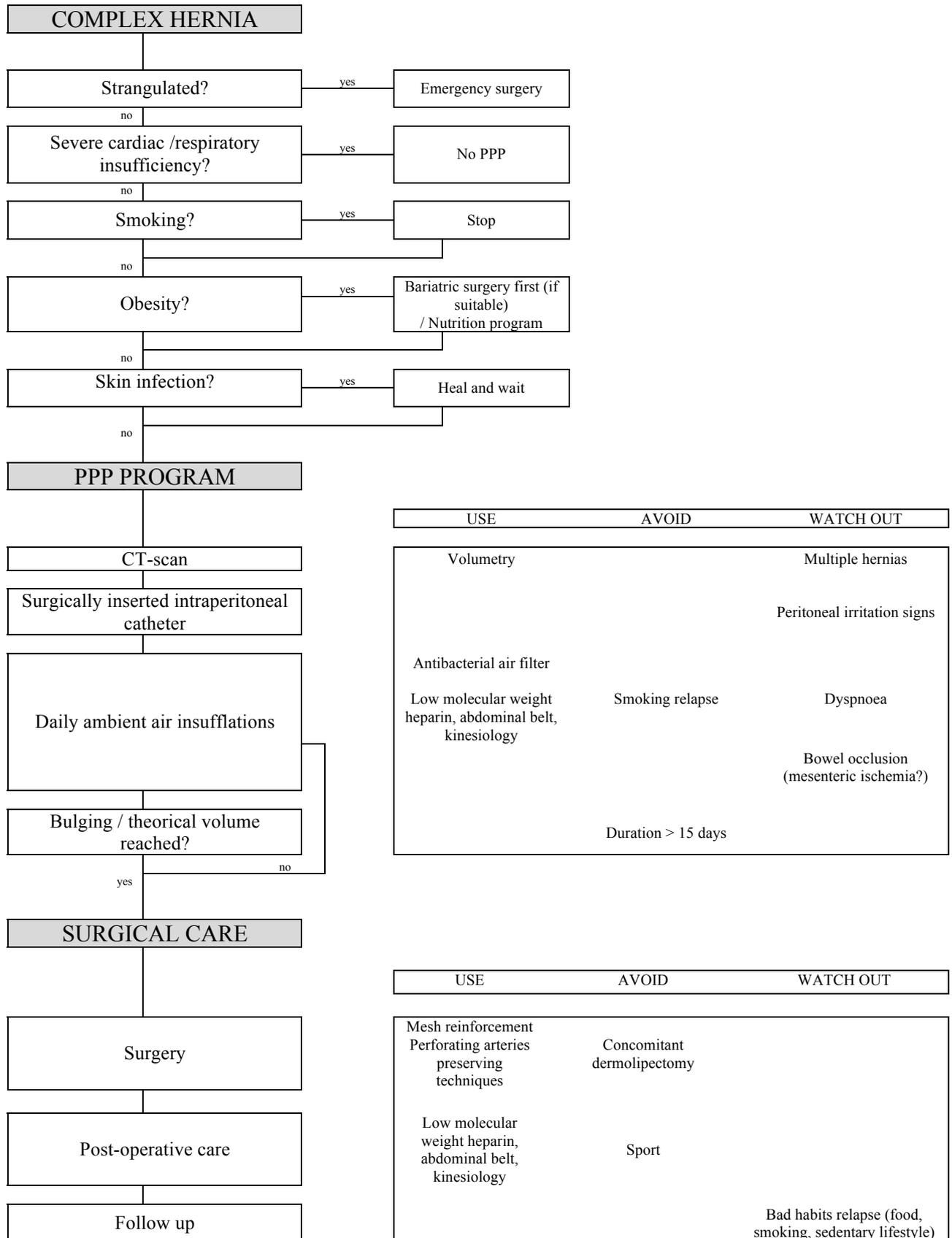
DATE	NAME	PATIENTS	HERNIA			PPP		POSTOPERATIVE COMPLICATIONS	RECCURENCE
			VH	IH	LOD	Morbidity	Mortality		
2014	Oprea	17	14	3	5	0	1 urinary sepsis > multi visceral failure (6%)		0
2013	Lopez Sanclemente	11	8	3	8	2 decompensate COPD 2 subcutaneous emphysema (36%)	0	10 seroma 4 VAC therapy	1
2012	Sabbagh	26 > 19	17	2	2	5 subcutaneous emphysema 2 acute respiratory distress 1 acute kidney injury 1 deep venous thrombosis 1 anaphylactic shock (47%)	1 mesenteric infarction 1 infected COPD (10%)	2 abdominal compartment syndrome (1 with mesenteric infarction) 1 full thickness necrosis 2 abscess (37%)	
2010	Tanaka	23					1 acute myocardial infarction (4%)	6 wound infections (26%)	1
2010	Bilians'kyi	25							
2010	Piskin	2		2					
2009	Mcadory	9 > 7	6	1		1 deep venous thrombosis 1 acute kidney injury 1 infected catheter 1 twisted catheter	1 aspergillosis	1 ventral tachycardia	1
2009	Minossi	6	5	1			1 pneumonia	1 wound infection	0
2006	Rodriguez Ortega	4				0			0
2006	Mayagoitia	12 > 10	9	1	10	2 subcutaneous emphysema (20%)		2 wound infection (20%)	
2002	Toniato	77	66	0		1 acute respiratory distress 1 intraperitoneal catheter migration 1 significant bleeding around catheter (4%)	0	6 wound infection (8%)	2
2000	Willis	11 > 10	5	4	10	1 stop because of pain 1 catheter infection 7 subcutaneous emphysema (1 infected COPD	0
1994	Murr	27	17			3 subcutaneous emphysema (11%)	0	1 pulmonary embolism 1 hematoma (7%)	
1993	Coehlo	36				1 intracolonic insufflation 1 acute respiratory distress 4 subcutaneous emphysema (17%)		3 wound infections (8%)	3
1992	Masi	3	3						
1990	Volpato	2		2					
1990	Luder	11							
1990	Caldironi	40							2
1986	Rieu	4							
1985	Louis	42							
1985	Raynor	8							3
1978	Swelstad	5							
1972	Johnson	10							
1969	Connolly	3				1 subcutaneous emphysema			
1968	Pingree	21							
1954	Koontz	8			4				1

VH: ventral hernia; IH: inguinal hernia; LOD: loss of domain; COPD: Chronic Obstructive Pulmonary Disease

Annex 2: Patients flow chart



Annex 3: algorithm



CONCLUSION

THESE SOUTENUE PAR: Nicolas MOUGIN

Titre: Le pneumopéritoine progressif préopératoire (selon Goni Moreno) est-il sûr ? Etude rétrospective sur 152 patients pour évaluer sa morbi-mortalité spécifique.

Objectif: Evaluer la morbi-mortalité spécifique du pneumopéritoine progressif préopératoire (PPP) dans la prise en charge des éventrations larges de l'abdomen.

Patients et méthodes:

Etude monocentrique, constituée d'une cohorte rétrospective de 152 patients, traités entre Octobre 1974 et Février 2014.

Le critère principal est le taux de complications induites par le PPP. Les objectifs secondaires concernent les résultats des techniques chirurgicales (taux de complications postopératoires, taux de récurrence).

Résultats:

Le taux de complications spécifiques au PPP est de 20% : 15% de complications mineures, 5% de complications majeures. Le taux de mortalité est inférieur à 1%.

La cure chirurgicale a été réalisée dans 98,6% des cas (91% avec une prothèse de renfort pariétal). Le taux de complications postopératoires est de 40% (mineures 20%, majeures 16%); le taux de mortalité est inférieur à 3%. La durée médiane d'hospitalisation est de 30 jours. Le taux de récurrence est de 15% (suivi médian de 12 mois).

Conclusions:

Le PPP n'est pas dénué de risques, les 5% de complications majeures incitent à ne pas l'utiliser en ambulatoire. L'utilisation d'un cathéter intrapéritonéal placé chirurgicalement, sans dépasser 2 semaines d'insufflations, pourrait permettre de baisser sa morbi-mortalité spécifique.

Une prise en charge multidisciplinaire péri-opératoire (nutrition, chirurgie bariatrique) et l'emploi de nouveaux procédés chirurgicaux (préservation des artères perforantes, prothèses biologiques) pourraient améliorer les résultats chirurgicaux.

VU ET PERMIS D'IMPRIMER

Grenoble, le 26/08/2015

LE DOYEN
J.P. ROMANET



LE PRESIDENT DE THESE
PROFESSEUR C. LETOUBLON



Bibliographie

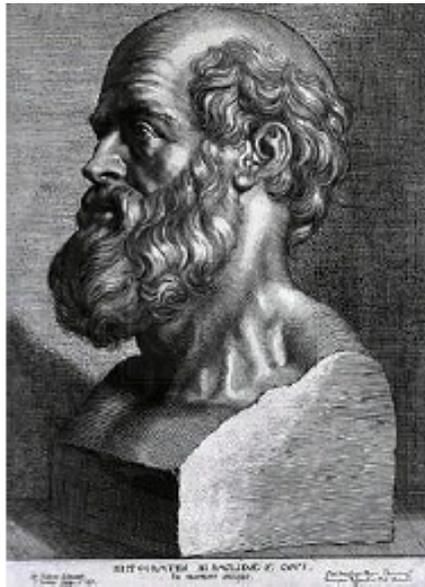
1. Muysoms FE, Miserez M, Berrevoet F, Campanelli G, Champault GG, Chelala E, et al. Classification of primary and incisional abdominal wall hernias. *Hernia J Hernias Abdom Wall Surg.* 2009 Aug;13(4):407–14.
2. Slater NJ, Montgomery A, Berrevoet F, Carbonell AM, Chang A, Franklin M, et al. Criteria for definition of a complex abdominal wall hernia. *Hernia J Hernias Abdom Wall Surg.* 2014 Feb;18(1):7–17.
3. De Santis L, Frigo F, Bruttocao A, Terranova O. Pathophysiology of giant incisional hernias with loss of abdominal wall substance. *Acta Bio-Medica Atenei Parm.* 2003;74 Suppl 2:34–7.
4. Munegato G, Brandolese R. Respiratory physiopathology in surgical repair for large incisional hernias of the abdominal wall. *J Am Coll Surg.* 2001 Mar;192(3):298–304.
5. Moreno IG. Chronic eventrations and large hernias; preoperative treatment by progressive pneumoperitoneum; original procedure. *Surgery.* 1947 Dec;22(6):945–53.
6. Champetier J, Laborde Y, Letoublon C, Durand A. Treatment of post-operative ventral hernia: elementary biomechanical basis. Report of 51 cases treated by mersilene mesh. *J Chir (Paris).* 1978 Nov;115(11):585–90.
7. Dumont F, Fuks D, Verhaeghe P, Brehant O, Sabbagh C, Riboulot M, et al. Progressive pneumoperitoneum increases the length of abdominal muscles. *Hernia J Hernias Abdom Wall Surg.* 2009 Apr;13(2):183–7.
8. Sabbagh C, Dumont F, Fuks D, Yzet T, Verhaeghe P, Regimbeau J-M. Progressive preoperative pneumoperitoneum preparation (the Goni Moreno protocol) prior to large incisional hernia surgery: volumetric, respiratory and clinical impacts. A prospective study. *Hernia.* 2012 Feb;16(1):33–40.
9. Rakower SR. Intentional progressive preoperative pneumoperitoneum for adhesiolysis in the hostile surgical abdomen. *Am Surg.* 2011 Sep;77(9):E193–4.
10. Rives J, Lardennois B, Pire JC, Hibon J. Large incisional hernias. The importance of flail abdomen and of subsequent respiratory disorders. *Chir Mém Académie Chir.* 1973 Jun;99(8):547–63.
11. Stoppa R. Les plasties de la paroi abdominale. Monographie du 75e congrès français de chirurgie. Masson; 1973.
12. Briennon X, Lermite E, Meunier K, Desbois E, Hamy A, Arnaud J-P. Surgical treatment of large incisional hernias by intraperitoneal insertion of Parietex® composite mesh with an associated aponeurotic graft (280 cases). *J Visc Surg.* 2011 Feb;148(1):54–8.
13. Clotteau JE, Premont M. Treatment of severe median abdominal cicatricial eventrations by an aponeurotic plastic procedure. *Chir Mém Académie Chir.* 1979;105(4):344–6.
14. Welti H, HEudel F. Un procédé de cure radicale des éventrations postopératoires par auto-étalement des muscles grands droits après incision du feuillet antérieur de leur gaine. *Mem Acad Chir;* 1941.
15. Ventral Hernia Working Group, Breuing K, Butler CE, Ferzoco S, Franz M, Hultman CS, et al. Incisional ventral hernias: review of the literature and recommendations regarding the grading and technique of repair. *Surgery.* 2010 Sep;148(3):544–58.
16. Deerenberg EB, Timmermans L, Hogerzeil DP, Sliker JC, Eilers PHC, Jeekel J, et al. A systematic review of the surgical treatment of large incisional hernia. *Hernia J Hernias Abdom Wall Surg.* 2015 Feb;19(1):89–101.
17. Berlemont M. Pneumoperitoneum as a cure for enormous irreducible hernias. *Mém Académie Chir Fr.* 1952 Jan;78(1-3):77–8.
18. Hamer DB, Duthie HL. Pneumoperitoneum in the management of abdominal incisional hernia. *Br J*

Surg. 1972 May;59(5):372–5.

19. Carr JA. Tissue expander-assisted ventral hernia repair for the skin-grafted damage control abdomen. *World J Surg.* 2014 Apr;38(4):782–7.
20. Cakmak M, Caglayan F, Somuncu S, Leventoglu A, Ulusoy S, Akman H, et al. Effect of paralysis of the abdominal wall muscles by botulinum A toxin to intraabdominal pressure: an experimental study. *J Pediatr Surg.* 2006 Apr;41(4):821–5.
21. Ramirez OM, Ruas E, Dellon AL. “Components separation” method for closure of abdominal-wall defects: an anatomic and clinical study. *Plast Reconstr Surg.* 1990 Sep;86(3):519–26.
22. Agnew SP, Small W, Wang E, Smith LJ, Hadad I, Dumanian GA. Prospective measurements of intra-abdominal volume and pulmonary function after repair of massive ventral hernias with the components separation technique. *Ann Surg.* 2010 May;251(5):981–8.
23. Willis S, Schumpelick V. Use of progressive pneumoperitoneum in the repair of giant hernias. *Hernia.* 2000 Jun;4(2):105–11.
24. Mason EE. Pneumoperitoneum in the Treatment of Giant Hernias, with Special Reference to Obesity. In: MD RB, MD JA, MD MEA, MD JBF, MD EHP, editors. *Abdominal Wall Hernias.* Springer New York; 2001. p. 675–9.
25. Murr null, Mason null, Scott null. The Use of Pneumoperitoneum in the Repair of Giant Hernias. *Obes Surg.* 1994 Nov;4(4):323–7.
26. Tanaka EY, Yoo JH, Jr AJR, Utiyama EM, Birolini D, Rasslan S. A computerized tomography scan method for calculating the hernia sac and abdominal cavity volume in complex large incisional hernia with loss of domain. *Hernia.* 2010 Feb;14(1):63–9.
27. Kingsnorth AN, Sivarajasingham N, Wong S, Butler M. Open mesh repair of incisional hernias with significant loss of domain. *Ann R Coll Surg Engl.* 2004 Sep;86(5):363–6.
28. Lardièrre-Deguelte S. Efficacité du pneumopéritoine progressif préopératoire dans le traitement des grandes éventrations : évaluation volumétrique par tomodensitométrie. *Acad Natl Chir;* 2010.
29. Sabbagh C, Dumont F, Robert B, Badaoui R, Verhaeghe P, Regimbeau J-M. Peritoneal volume is predictive of tension-free fascia closure of large incisional hernias with loss of domain: a prospective study. *Hernia.* 2011 Oct;15(5):559–65.
30. Lowe JB, Garza JR, Bowman JL, Rohrich RJ, Strodel WE. Endoscopically assisted “components separation” for closure of abdominal wall defects. *Plast Reconstr Surg.* 2000 Feb;105(2):720–9; quiz 730.
31. Novitsky YW, Elliott HL, Orenstein SB, Rosen MJ. Transversus abdominis muscle release: a novel approach to posterior component separation during complex abdominal wall reconstruction. *Am J Surg.* 2012 Nov;204(5):709–16.
32. Saulis AS, Dumanian GA. Periumbilical rectus abdominis perforator preservation significantly reduces superficial wound complications in “separation of parts” hernia repairs. *Plast Reconstr Surg.* 2002 Jun;109(7):2275–80; discussion 2281–2.
33. Oprea V, Matei O, Gheorghescu D, Leuca D, Buia F, Rosianu M, et al. Progressive preoperative pneumoperitoneum (PPP) as an adjunct for surgery of hernias with loss of domain. *Chir Buchar Rom* 1990. 2014 Sep;109(5):664–9.
34. López Sanclemente MC, Robres J, López Cano M, Barri J, Lozoya R, López S, et al. Progressive preoperative pneumoperitoneum in patients with giant hernias of the abdominal wall. *Cir Esp.* 2013 Sep;91(7):444–9.
35. Piskin T, Aydin C, Barut B, Dirican A, Kayaalp C. Preoperative progressive pneumoperitoneum for giant inguinal hernias. *Ann Saudi Med.* 2010 Aug;30(4):317–20.
36. Bilians’kyi LS, Todurov IM, Kosiukhno SV, Perekhrestenko OV. Progressive pneumoperitoneum

technique in surgical treatment of patients with giant defects of the abdominal wall. *Klin Khirurgiia Minist Okhorony Zdorovia Ukraïny Nauk Tovarystvo Khirurgiv Ukraïny*. 2010 Apr;(4):49–52.

37. Mcadory RS, Cobb WS, Carbonell AM. Progressive preoperative pneumoperitoneum for hernias with loss of domain. *Am Surg*. 2009 Jun;75(6):504–8; discussion 508–9.
38. Minossi JG, Oliveira WK de, Llanos JC, Ielo SM, Hasimoto CN, Pereira RS de C. Preoperative progressive pneumoperitoneum in voluminous abdominal wall hernias. *Arq Gastroenterol*. 2009 Apr;46(2):121–6.
39. Rodríguez Ortega M, Fernández Lobato R, Garaulet González P, Ríos Blanco R, Jiménez Carneros V, Limones Esteban M. Use of pneumoperitoneum in the repair of giant abdominal hernias. *Cir Esp*. 2006 Oct;80(4):220–3.
40. Mayagoitia JC, Suárez D, Arenas JC, León VD de. Preoperative progressive pneumoperitoneum in patients with abdominal-wall hernias. *Hernia*. 2006 Jun;10(3):213–7.
41. Toniato A, Pagetta C, Bernante P, Piotta A, Pelizzo MR. Incisional hernia treatment with progressive pneumoperitoneum and retromuscular prosthetic hernioplasty. *Langenbecks Arch Surg Dtsch Ges Für Chir*. 2002 Oct;387(5-6):246–8.
42. Coelho JC, Brenner AS, Freitas AT, Campos AC, Wiederkehr JC. Progressive preoperative pneumoperitoneum in the repair of large abdominal hernias. *Eur J Surg Acta Chir*. 1993 Jun;159(6-7):339–41.
43. Masi C, Benvenuti P, Cardelicchio S, Pacifico G, Seghi P. [Progressive pneumoperitoneum in the preparation for surgical intervention for voluminous ventral hernias]. *Minerva Chir*. 1992 Sep;47(17):1327–35.
44. Volpato G, Silvestri M, Massera F, Orlandoni G. The use of the expanded PTFE (Gore-Tex) prosthesis with progressive preoperative pneumoperitoneum in the repair of massive inguinal hernias and large laparocoeles. *Minerva Chir*. 1990 Nov;45(21-22):1365–9.
45. Luder PJ, Haller BG, Gertsch P, Blumgart LH, Lerut JP. Pneumoperitoneum and Mersilene mesh in the treatment of giant abdominal wall hernias. *Helv Chir Acta*. 1990 Apr;56(6):927–30.
46. Caldironi MW, Romano M, Bozza F, Pluchinotta AM, Pelizzo MR, Toniato A, et al. Progressive pneumoperitoneum in the management of giant incisional hernias: a study of 41 patients. *Br J Surg*. 1990 Mar;77(3):306–7.
47. Rieu PN, van Knippenberg LA, van den Berg W. Progressive pneumoperitoneum as preoperative preparation for large hernial repair in patients with severe chronic obstructive lung disease. *Neth J Surg*. 1986 Feb;38(1):15–7.
48. Raynor RW, Del Guercio LR. Update on the use of preoperative pneumoperitoneum prior to the repair of large hernias of the abdominal wall. *Surg Gynecol Obstet*. 1985 Oct;161(4):367–71.
49. Louis D, Stoppa R, Henry X, Verhaeghe P. Postoperative eventrations. Apropos of 247 surgically treated cases. *J Chir (Paris)*. 1985 Oct;122(10):523–7.
50. Swelstad J, Caprini JA. Use of progressive pneumoperitoneum in the treatment of giant abdominal hernias. *Am Surg*. 1978 Jun;44(6):337–41.
51. Johnson WC. Preoperative progressive pneumoperitoneum in preparation for repair of large hernias of the abdominal wall. *Am J Surg*. 1972 Jul;124(1):63–8.
52. Connolly DP, Perri FR. Giant hernias managed by pneumoperitoneum. *JAMA*. 1969 Jul;209(1):71–4.
53. Pingree JH, Clark JH. Pneumoperitoneum. A neglected procedure for the repair of large abdominal hernias. *Arch Surg Chic Ill 1960*. 1968 Feb;96(2):252–3.
54. Koontz AR, Graves JW. Preoperative Pneumoperitoneum as an Aid in the Handling of Gigantic Hernias. *Ann Surg*. 1954 Nov;140(5):759–62.



SERMENT D'HIPPOCRATE

En présence des Maîtres de cette Faculté, de mes chers condisciples et devant l'effigie d'HIPPOCRATE,

Je promets et je jure d'être fidèle aux lois de l'honneur et de la probité dans l'exercice de la Médecine.

Je donnerais mes soins gratuitement à l'indigent et n'exigerai jamais un salaire au dessus de mon travail. Je ne participerai à aucun partage clandestin d'honoraires.

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

Je ne permettrai pas que des considérations de religion, de nation, de race, de parti ou de classe sociale viennent s'interposer entre mon devoir et mon patient.

Je garderai le respect absolu de la vie humaine.

Même sous la menace, je n'admettrai pas de faire usage de mes connaissances médicales contre les lois de l'humanité.

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

Que les hommes m'accordent leur estime si je suis fidèle à mes promesses.

Que je sois couvert d'opprobre et méprisé de mes confrères si j'y manque.

REMERCIEMENTS

A Céline, qui m'accompagne tous les jours, et partage mes espoirs, mes doutes et mes joies.

A mes parents, mon frère, ma famille, qui m'ont toujours soutenu dans mes choix et dans les longues années des études de médecine.

A mes maîtres en chirurgie, qui m'ont délié les mains, inculqué les bases puis les secrets de leur art, et transmis leur passion.

A mes co-internes, assistants et autres membres de l'Agiccl, avec lesquels j'ai passé ces années d'internat, découvert Grenoble, eu de franches rigolades mais aussi abattu de longues heures de boulot, et qui construisent l'hôpital de demain.

Aux infirmières, aides soignantes, kinés, secrétaires, qui ont rattrapé mes erreurs de débutant et m'ont fait progresser chaque jour.

A mes amis de toujours, qui savent aussi bien me sortir de mon univers lors des moments durs, qu'écouter mes nombreuses anecdotes de vie carabine.

A Stéphanie, Nadia, Norbert, Patrick, pour leur généreuse participation au pot de thèse.