EFFECT OF FAT MASS LOSS AFTER METABOLIC BARIATRIC SURGERY ON DIAPHRAGMATIC MUSCLE FUNCTION AND CONFIGURATION

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INTRODUCTION

Metabolic bariatric surgery (MBS) aims to induce a loss of adipose tissue and fat mass in order to improve the metabolic and general health of patients with obesity. However, concomitantly, patients also experience skeletal muscle mass loss. This side effect has been shown to slightly alter skeletal muscle function and aerobic capacity with an increased fatigue or exercise-induced dyspnea [1,2].

More specifically, little is known about the diaphragmatic function, major muscle of respiration, after MBS. Previous studies showed eather decreased or preserved function, indirectly measured with maximal inspiratory pressure [3].

AIM OF THE STUDY

The aim of the present study was to evaluate the effects of fat mass loss induced by MBS in patient with severe obesity, on diaphragmatic muscle function and configuration.

We hypothesized that a loss of abdominal fat will horizontalize the diaphragm configuration that may reduce muscle force.

METHODS

Population

Nine patients (4 women/5 men, 30-51 years old) with obesity III were tested before and 6 months after MBS.

Inclusion criteria: BMI ≥ 40kg/m^2 , undergoing MBS (sleeve or by-pass), exhibit visceral fat loss after MBS

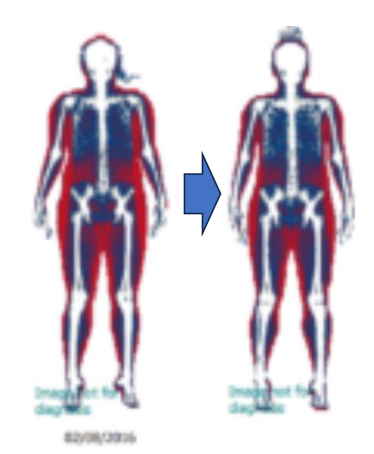
Exclusion criteria: Neuro-muscular pathology, MBS complications (N=2)

9 Patients	Median	Inter-quartile
Sex	4♀/5♂	
Age (year)	41	[37 – 49]
BMI (kg/m^2)	44	[42 – 45]

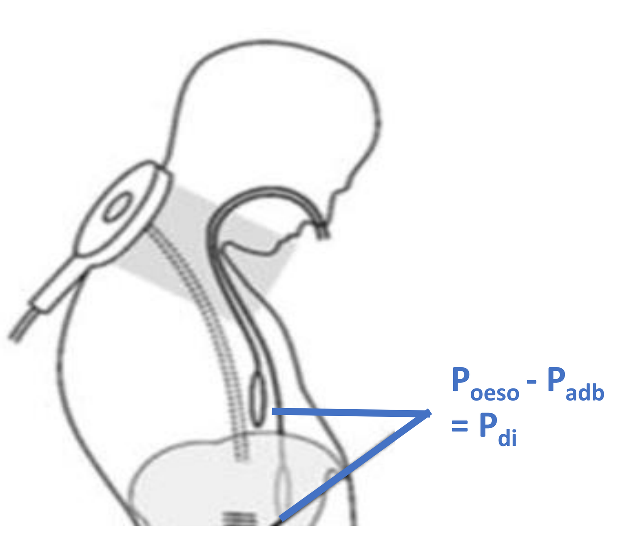
Methods

-Body composition, including visceral fat mass, was measured by two-photon X-ray absorption (DEXA).

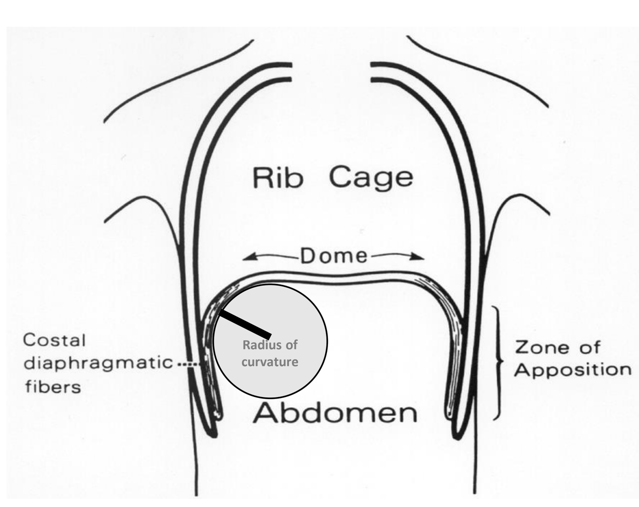
-Respiratory function was evaluated by plethysmography.



-Diaphragm strength was assessed by the gold standard nonvolitional technique of bilateral anterolateral magnetic stimulation of the phrenic nerves, quantifying the twitch transdiaphragmatic pressure (Pdi) calculated from invasively recorded twitch esophageal and gastric pressure.



-Diaphragm conformation was assessed with CT scan[4]. For shape description, the diaphragm was divided into: domes, zone of apposition, and central tendon. The, muscle fibre length, radius of curvature and total area (dome area + apposition area) were assessed.



RESULTS

BODY COMPOSITION

	Pre-MBS	Post-MBS	Δ	P-value
Visceral adipose tissue, Kg	2,4 [2,2-3,3]	1,3 [1,1-1,5]	-1,6 [-0,8- -1,9]	<0,001
Androïd Fat Mass, Kg	6,2 [6,0–6,9]	3,7 [3,5–3,8]	-2,4 [-2,2– -3,1]	<0,001
Total lean mass, Kg	65,7 [52,3-69,1]	58,9 [47,5– 63,2]	-5,3 [-3,6- -6,8]	0,003

Significant loss of total weight by 23% and visceral fat mass by 44% induced by MBS were associated with increased lung function and volumes: FEV1: +13%, TLC: +6% and RV: +22%.

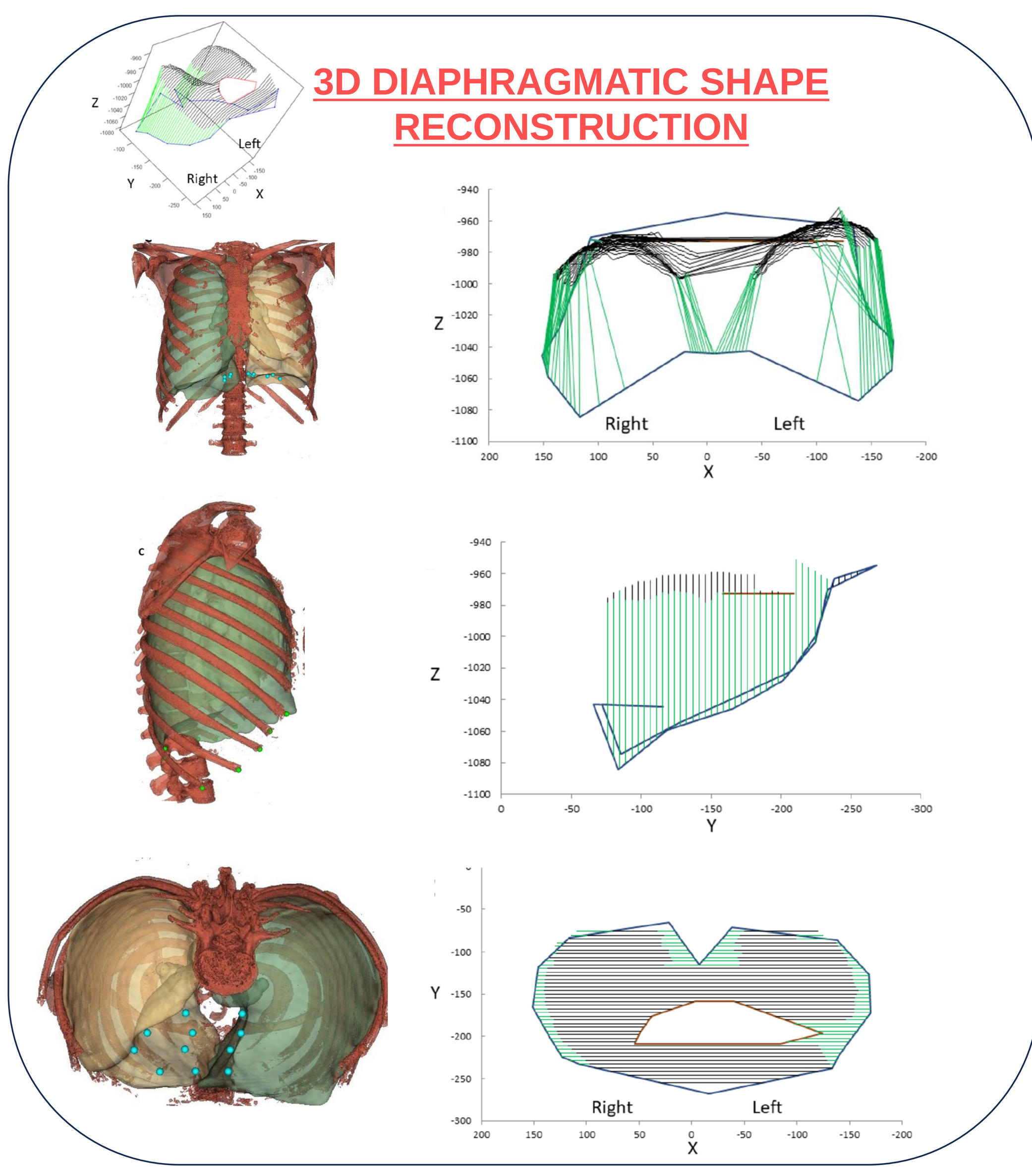
SPIROMETRY

	Pre-MBS	Post-MBS	Δ	P-value
FEV1, L	2,6 [2,4 – 2,9]	2,9 [2,6 – 3,7]	0,34	0,026
FEV1, %	81 [78 – 90]	91 [87 – 94]	13	0,022
VC, L	2,8 [2,7 – 3,7]	3,4 [3,2 – 4,9]	0,5	0,071
VC, %	82 [75– 86]	97 [84 – 100]	13	0,055
TLC, L	5,4 [4,7 – 6,4]	5,6 [4,8 – 6,6]	0,2	0,015
TLC, %	94 [77 – 100]	100 [82 – 106]	6	0,002
RV, L	1,8 [0,9 – 2,2]	1,8 [1,4 – 2,6]	0,3	0,009
RV, %	96 [86 – 100]	106 [86 – 139]	22	0,006
FRC, L	3,36 [2,6 – 3,7]	3,4 [2,7 – 3,8]	0,1	0,088
FRC, %	78 [70 – 100]	79 [74 – 105]	4	0,065
DLCO, %	76 [73 – 83]	84 [79 – 92]	3	0,154

FEV1: forced expiratory volume in 1 s; VC: vital capacity; TLC: total lung capacity; RV: residual volume; FRC: functional residual capacity; DLCO: lung diffusion capacity for CO; Δ: difference before and after MBS.

DIAGHRAGM STRENGHT

	Pre-MBS	Post-MBS	Δ	P-value
Pdi (cmH_2O)	14,7 [14,2-16,1]	14,2 [13,9-15,9]	-0,5 [-0,1– -0,7]	0,033



DIAGHRAGM CONFIGURATION

	Pre-MBS	Post-MBS	Δ	P-value
Muscle fibre lenght				
saggital (mm)	288 [257–291]	283 [256–289]	-4,1 [0,8–5,1]	0,027
coronal left (mm)	175 [162-187]	170 [149-181]	-8 [5–11]	<0,001
coronal right (mm)	183 [158-184]	170 [149-182]	-10 [8–13]	<0,001
Radius of muscle curvature				
coronal left (mm)	75 [53–76]	59 [53–63]	-15 [6 - 19]	0,19
coronal right (mm)	59,4 [50,26 – 73,6]	64,4 [52 – 71,7]	4,7 [-3,4 – 2,6]	0,45
oblique left (mm)	91,3 [65,0 - 104,4]	95,8 [67,8 - 105,7]	1,6 [1,3 - 4,0]	0,41
oblique right (mm)	80,1 [76,79 - 92,35]	82,5 [74,52 – 103,7]	3,2 [0,11- 7,9]	0,4
Muscle surface area				
Total area (cm^2)	1200 [1119–1440]	1035 [846 – 1124]	-158 [89 – 278]	0,008
Dome area (cm^2)	355 [298 – 457]	268 [212– 393]	-143 [193 - 211]	0,16
Apposition zone area (cm^2)	921 [743 – 962]	614 [593 – 856]	-93 [61 - 196]	0,14

The diaphragm strength was reduced after MBS by -2%.

In terms of diaphragm conformation, domes kept the same shape after MBS but diaphragmatic muscle fibre length were reduced: -0.5% sagittal, -6% right coronal and -4% left coronal.

The total muscle area decreased of -13%

CONCLUSION

☺ **The MBS induced a loss of thoracic and visceral fat mass associated with an increase in lung volumes**

☹ **This positive effect is counterbalanced by a slight decrease in diaphragmatic strength (-2%) linked to a reduction in the muscle fibre length in the 3 dimensions and a reduced total muscular area**

⇨ **However, these changes, although statistically significant, are of low amplitude and with probable little clinical impact at rest**

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