

Anatomical Reperere-Based Abdominal Bell Design to Reduce Intra-Abdominal Hypertension with ABDOPRE

S. Díaz^{1,2}, M. González-Franco¹, L. Urruty^{1,2}, F. Peirano^{1,2}, F. Pracca³, A. Biestro³ & F. Simini¹

1 Núcleo de Ingeniería Biomédica, Schools of Medicine and Engineering; 2 Industrial Design; 3 Intensive Care Department, Hospital de Clínicas; Universidad de la República, URUGUAY

BACKGROUND

ABDOPRE is a minimally invasive method to increase abdominal volume thus reducing intra-abdominal pressure (IAP). **ABDOPRE** is an interdisciplinary University effort which includes clinical trials and several re-designs of mechanical parts affixed to the patient and a new design of electronic IAP control. A key component of **ABDOPRE** is the bell to be affixed on the patient's abdomen.

MATERIALS AND METHODS

We took 7 anatomical dimensions in 32 intensive care patients, with the only selection criterion of not being obese (BMI < 30). We used statistical analysis of the distribution of the dimensions to determine standard bell sizes, based on single dimension histograms. We followed industrial design procedure to shape the bells so as to have them rest on the proper bone footholds, allowing for abdominal wall soaring.

RESULTS

We designed two bell sizes in transparent metacrilate (PMMA). Special attention was paid to the gasket material to reduce skin irritation. The pressure requirements led us to select 6mm 93% transparency PMMA, impact- alcohol- and iodine-resistant. After shaping, the bell thickness was reduced to 2.5 mm. The highest point of the bell is 19 cm for size 1 and 22 cm for size 2 with volumes of 14 and 20 liters respectively. Measurements of 32 ICU patients allowed to estimate an abdominal volume proxy to help select the bell. Presentation of bells onto the abdomen of six subsequent patients confirmed the size was appropriate in all cases.

SPECIFICATION OF THE BELLS

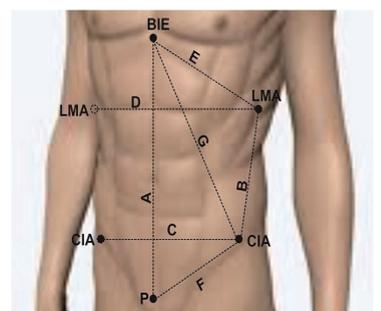
- Resistant to negative pressures so as to lower IAP
- Light enough to be easily handled in clinical settings
- Resistant to disinfection with alcohol or hydrogen peroxide
- Transparent to see the skin of the patient during treatment
- Bell internal pressure accessible for measurement
- Connected to the void pump
- Anatomically adapted to different abdomen sizes

BELL DIMENSIONS

	original	size 1	size 2
Surface (cm ²)	637	540	803
Height (cm)	19	19	22
Volume (l)	16	14	20
Weight (g)	302	255	378

DIMENSIONS TAKEN WITH A *compas d'épaisseur*

- a - sternum to pelvic bone
- b - medial axillary line to iliac crest
- c - right to left iliac crests
- d - right to left medial axillary lines
- e - sternum to medial axillary line
- f - pelvic bone to iliac crest
- g - sternum to iliac crest



Size 1 bell with polyfoam gasket.



Size 1 bell with Armaflex foam gasket.



Size 2 bell with viscoelastic foam gasket covered with silicone.

CONCLUSIONS

We have designed anatomically adapted transparent bells to be affixed onto the abdomen of mechanically ventilated patients (BMI < 30). The bells rest on bone footholds so as to allow abdominal wall soaring, thus reducing IAP when the bell is connected to a microprocessor controlled vacuum pump. Several textures and materials are available for the gaskets.

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