## * AN ESTIMATE OF COMPUTARIZED RADIOLOGY OF THE TOTAL PULMONARY CAPACITY (PULMO - RX).*

ING.MARCOS A. DOMINGUEZ PEREZ, CENTRO DE INVESTIGACIONES CLINICAS,CALLE 34 # 4501 ENTRE 45 Y 47 REPARTO KOLHY. PLAYA,C.HABANA 13 APARTADO POSTAL 607. HABANA CUBA.

INTRODUCCION.

FOR MORE THAN 70 YEARS SCIENTISTS HAVE TRIED TO FIND OUT HOW MUCH AIR IS CONTAINED OR STORED IN THE LUNGS.THEIR PROCEDURE CONSISTED IN MEASURING THE BODY AROUND THE THORAX.LATER THEY TRIED TO REACH THEIR OBJETIVE BY MEANS OF THORAX RADIOGRAPHY.LATER THEY USED FRONTAL AND LATERAL X-RAYS.CIMEQ DOCTORS AND THE SCIENTIST FROM CENTRAL INSTITUTE OF DIGITAL INVESTIGATIONS (ICID) BEGAN THIS WORK IN 1991. THE TECHNIQUE DEVELOPED OUR MEDICAL POTENCIALS AS WELL AS IT REDUCED COSTS AND SAVED MONEY HOWEVER THIS NEW SYSTEM WAS FED INTO A PACKAGE OF MEDICAL IMAGINOLOGY CALLED ORTOPACK.IT GIVES US THE POSSIBILITY TO DETERMINE THE TOTAL LUNGS CAPACITY BESIDES OTHER MEASUREMENTS.

MATERIAL AND METHODS.

THIS STUDY CONSIST OF A COMPUTARIZED TECHNIQUE FOR PROCESSING THE IMAGES OF THORAXIC RADIOGRAPHY.THE USEFULNESS OF THIS PROCEDURE IS THAT IT CAN CARRY OUT MEASUREMENTS AND CALCULATE AN ESTIMATE PARAMETER OF FUNCTION (TOTAL PULMONARY CAPACITY).IT IS IMPORTANT FOR THE DIAGNOSIS OF PATOLOGIES OF THE DIFERENT STRUCTURES IN THE THORAXIC REGION SUCH AS THE LUNGS, PLEURA, HEART AND DIAPHRAGM ETC.WHATEVER MALFUNTIONS OCCUR IN THE REGION MAY BE FELT IN ONE WAY OR ANOTHER IN THE TOTAL PULMONARY CAPACITY.BEFORE THE INTRODUCTION OF THIS TECHNIQUE IN OUR COUNTRY THIS PARAMETER WAS DETERMINATED ONLY WITH SOPHISTICATED EQUIPMENTS SUCH AS SPIROMETERS WITH GAS ANALYSERS.

DESCRIPTION OF TECHNIQUE.

THE TECHNIQUE CONSISTS ON ENGRAVING, BY MEANS OF A TV CAMERA ADJUSTED TO A COMPUTER, THE IMAGIES OF LUNG RADIOGRAPHIES IN P.A. VIEW MAXIMUM INSPIRATION AS WELL AS LATERAL LEFT VIEW OR PICTURE;AND LATER USING ITS MOUSE MAKE THE CONTOUR OF THE THORAX.AFTER THAT CERTAIN ANATOMIC REFERENCES THAT THE COMPUTER DEMANDS AND ANATOMICALLY TRACES LINES WHICH DEVIDES THE THORAX IN VARIOUS ELLIPSOIDES ONE ON TOP OF THE OTHER;AND CARRIES OUT IN LESS THAN FRACTIONS OF SECONDS,MORE THAN 35 ARITHMETICAL OPERATIONS.IT USES THE DATA PREVIOUSLY INTRODUCED SUCH AS AGED,WEIGHT AND HEIGHT.IT TAKES THE VALUES INCORPORATED IN THE MEMORY OF THE PROGRAM AS NORMAL ONES IN REFERENCE TO VOLUMES SUCH AS PULMONARY BLOOD, PULMONARY TISSUE AND ADDS THEM AS NON GASEOUS VOLUME.THIS IS SUBSTRACTED FROM THE TOTAL THORAXIC CAPACITY, AND THE RESULT IS THE TOTAL PULMONARY CAPACITY.

CONCLUSIONS

THIS METHOD IS OF GREAT USE TO DOCTORS SPECIALIZED IN THE PULMONARY SYSTEM AND ITS FUNTIONS.THE MEASUREMENT OF TOTAL PULMONARY CAPACITY BY ORTOPACK IS MORE PRECISE IN PATIENTS WHO SUFFER FROM EMPHYSEMA OR BRONCHITIS THAN WITH THE USE OF HELIO GAS TECHNIQUE OF DILUSION. THIS METHOD IS FASTER AND MORE REPRODUCIBLE THAN THE CONVENTIONAL SPIROMETERS WITH GAS ANALYSERS.

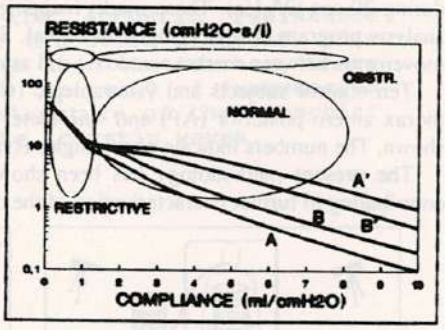


## SYSTEMATIC ERRORS IN PULMONARY MECHANICS PARAMETER EXTRACTION WITH THE LEAST MEAN SQUARE (LMS) METHOD

**Sergio BASALO, Franco SIMINI & Paul ESTOL**
Latinamerican Center for Perinatology and Human Development (CLAP PAHO/WHO), P.O. Box 627, 11000 Montevideo, URUGUAY, Tel. +598 2 472929, Fax +598 2 472593, e-mail: basalo@clap.edu.uy

**METHOD:** Ventilatory mechanics signals were simulated to evaluate the systematic errors of PULMOSYS, described elsewhere. Air flow signal was generated as a sinus wave; pulmonary resistance (R) and compliance (C) values were chosen with which intrapleural pressure signals were deduced. 100 pairs of flow and pressure signals were obtained with different values of R, C, respiratory frequency ($f_r$), sampling frequency ($f_s$), signal range (SR) and word length ($W_l$). These pairs of signals were submitted to PULMOSYS that calculates R and C in floating point with 64 bits. The relative error was estimated comparing the set and calculated values of R and C. Simulation parameters were: R = 0, 1, 10, 50 cmH2O*s/l; C = 0.1, 1, 2, 4 ml/cmH2O; $f_r$ = 0.25, 0.5, 1.00 Hz; $f_s$ = 40, 80 samples/s/channel; SR = 25, 75 %; $W_l$ = 10, 12 bits.

**RESULTS:** Systematic error behaves differently for R than for C. In all simulations the compliance error was smaller than 1% while for R we found a complex function: $e_l = f(R,C,f_r,f_s,SR,W_l)$. The $e_l$ decreases as compliance values increase. The link between $e_l$ and R and C is plotted in the figure where ellipses of normal neonates are shown (centiles 5 to 95). Obstructive Pattern (high R), Restrictive Pattern (low C) and of Combined Pattern (both high R and low C). In the figure the loci of $e_l$=1% are shown for 4 sets of parameters. The set labeled A ($f_s$=40Hz, SR=75%, $W_l$=12 bits) produces $e_l$<1% for all normal values of R and C; the set A' represents signals of lower amplitude (SR=25%) and $e_l$ exceeds 10% for some normals. The set of parameter labeled B ($f_s$=40Hz, SR=75%, $W_l$=10 bits) is the least expensive in terms of $f_s$ and $W_l$: shows a satisfactory performance. By increasing the frequency to 80Hz (B') there is a increase in error.




**CONCLUSION:** The most critical parameter for error reduction appears to be the signal range which must be kept at 75%, followed by the word length which must be 12 bits. Increasing the sampling frequency has no substantial effect on systematic error.