



^{99m}Tc -ENS vs. ^{99m}Tc -DTPA as Aerosol Lung Scintiscanning Agents.

Article N° AJ24-3

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Cita/Reference:

Mayosky, C. et al. ^{99m}Tc -ENS vs. ^{99m}Tc -DTPA as Aerosol Lung Scintiscanning Agents. Alasbimn Journal 6(24): April 2004. Article N° AJ24-3.

Introduction

In previous studies exogenous natural surfactant labeled with ^{99m}Tc (^{99m}Tc -ENS) and diethylenetriaminepentaacetate labeled with ^{99m}Tc (^{99m}Tc -DTPA) were compared in animals(1) and human volunteers (2), demonstrating that ^{99m}Tc -ENS has a higher lung specificity than ^{99m}Tc -DTPA and that the immediate images obtained with ^{99m}Tc -ENS have a similar quality as those obtained with ^{99m}Tc -DTPA. In the present study we compare ^{99m}Tc -ENS and ^{99m}Tc -DTPA on one healthy volunteer to evaluate the kinetics of lung uptake with either radiopharmaceutical as well as lung images taken at different times.

Key words: Ventilation scintigraphy, ^{99m}Tc -ENS, Lung tromboembolism.

Materials and Methods

An Elscint SPECT SPX gamma camera with the usual settings for ^{99m}Tc was used. One healthy non smoker female volunteer, having signed a written consent in the terms of the Helsinki declaration, was nebulized for 5 minutes with 1.11 GBq (30 mCi) of ^{99m}Tc -DTPA, the radiochemical purity of which was checked by a previously described method(3). A new (unused) nebulizer (Swirler™ from Amici) was used with a pressure of 9 Bars and a volume of 3 mL of the radiopharmaceutical. During the nebulization, lung uptake kinetic data were taken continuously with the patient under the camera and the obtained count rates were processed by means of linear and non-linear regression analysis. Immediately lungs, kidneys and bladder images were taken together with the count rate of each organ. The images and count rates of the same organs were taken also at 3 and 24 hours. After one week, in order to avoid cross

contamination or any interference, the same procedure using a new (unused) nebulizer (Swirler™ from Amici) was used to obtain the same data for ^{99m}Tc -ENS, the radiochemical purity of which was checked by a previously described method(4).

Results and Discussion

For the same nebulized activity, the left and right lung count rates are higher in the case of ^{99m}Tc -ENS than for ^{99m}Tc -DTPA at any of the studied times. The regression analysis of the left and right lung count rates vs. time curves for the initial 5 minutes, for ^{99m}Tc -ENS fits linearity ($r^2 = 0.9942$ and 0.9930 , respectively), being compatible with a first order kinetics, which can be explained as being due to the incorporation of ENS into the surfactant that lines the alveoli (5). In the case of ^{99m}Tc -DTPA, the curve could not be fitted into a linear regression but into an hyperbolic michaelian equation of count rate (A) vs. time (t) of the type $A = [A_{\text{max}} \cdot t / (K + t)]$, in which A_{max} is the maximal count rate and K is the concentration required to obtain half of A_{max} , r^2 being 0.9793 and 0.9801 for left and right lungs respectively. In this case the lungs may be considered to be a transit compartment, since uptake and clearance are taking place at the same time. Preliminary non published results in rats show a similar kinetic pattern.

Figure 1 shows the aerosol lung scintiscans carried out with ^{99m}Tc -ENS and ^{99m}Tc -DTPA at 5 minutes, 3 hours and 24 hours after nebulization. The figure also shows a scan of the lower lung portion, kidneys and bladder 3 hours after the nebulization of either radiopharmaceutical showing that the image obtained at 3 hours with ^{99m}Tc -DTPA has considerable activity in the bladder, which is not the case with ^{99m}Tc -ENS. The kidney radioactivity at 3 hours is 1.61 times higher for ^{99m}Tc -DTPA than for ^{99m}Tc -ENS.

Table 1 shows the actual mean count rates of both lungs as a function of time for ^{99m}Tc -ENS and ^{99m}Tc -DTPA. R is the ratio of the actual mean count rate with regard to this value obtained at 5 minutes for either radiopharmaceutical. R gives an estimation of the effective clearance of the radioactivity from the lungs for either radiopharmaceutical.

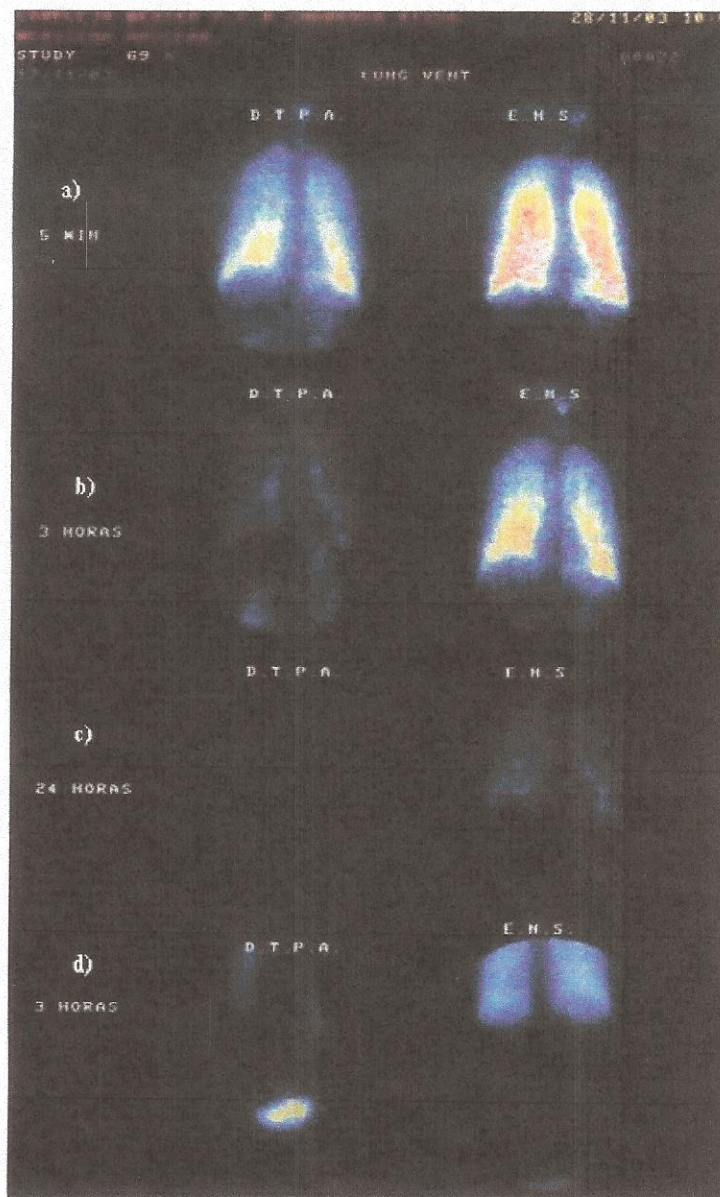


Figure 1: Lung images obtained with ^{99m}Tc -DTPA and ^{99m}Tc -ENS at: a) 5 minutes; b) 3 hours; c) 24 hours and d) base of the lungs, kidneys and bladder images obtained with ^{99m}Tc -DTPA and ^{99m}Tc -ENS at 3 hours

Table 1

Count rates vs. time for ^{99m}Tc -ENS and ^{99m}Tc -DTPA

^{99m}Tc -ENS		
Time (min)	Counts (cpm)	R
5	130348	1.000
180	79234	0.608
1440	4704	0.036

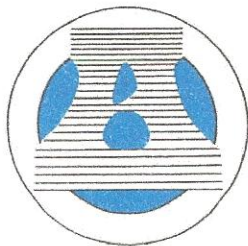
$^{99m}\text{Tc-DTPA}$		
5	73300	1.000
180	11148	0.152
1440	215	0.003

Our results demonstrate that the $^{99m}\text{Tc-ENS}$ image at 5 minutes exhibits a more homogeneous lung distribution pattern than that obtained with $^{99m}\text{Tc-DTPA}$, which shows a higher activity concentration in the base of the lungs. $^{99m}\text{Tc-ENS}$ count rate at 5 minutes after administration is 1.78 times the count rate obtained with $^{99m}\text{Tc-DTPA}$. On the same account, the relationship between the R values 3 hours after nebulization is 4, whereas at 24 hours it is 12. This indicates a longer lung persistence of $^{99m}\text{Tc-ENS}$, which allows that patients in intensive care units may be analyzed some time after nebulization. At the same time these results demonstrate that this radiopharmaceutical would allow a shorter nebulization time, which is especially important in non-cooperative patients and children. It is also important to point out that $^{99m}\text{Tc-ENS}$ exhibited a much lower count rate in the higher airways (trachea and bronchi) than $^{99m}\text{Tc-DTPA}$. Aerosol lung scintiscanning is an important diagnostic procedure for lung tromboembolism, which requires a second i.v. administration of ^{99m}Tc labeled macroaggregates, the image obtained with which does not interfere with the previous aerosol image, as the injected activity is much higher. Since patients in this condition may often have difficulties being nebulized, it would be interesting to carry out further work in order to collect statistical information confirming that $^{99m}\text{Tc-ENS}$ can improve this diagnostic study.

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AMICI



Lung ventilation images of the same person comparing Tc99m-DTPA to Tc99m-ENS using the Swirler Aerosol System.

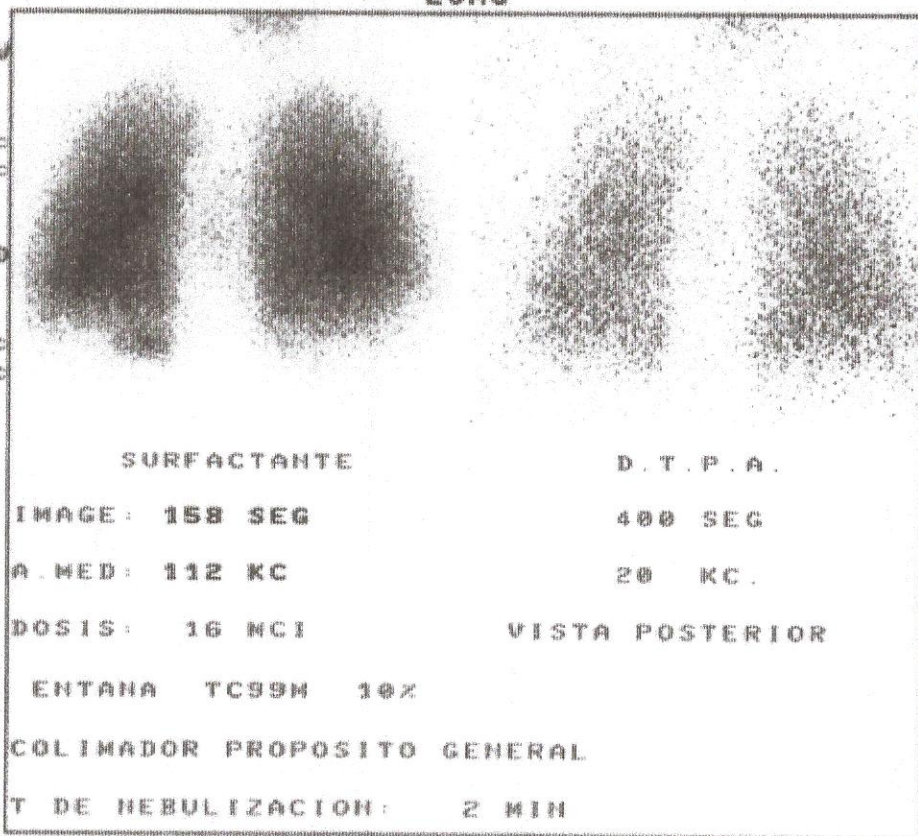
STUDY 02 SWIRLER
18/10/96

NICOLINI

LUNG

17:10 POST V
R 0 Z 1.5
TIME 158.
TCNT 112. kc
RATE 0 kc

18:04 POST D
R 0 Z 1.5
TIME 400.
TCNT 20.0 kc
RATE 0 kc



EQUIPO

APEX SPX

ELSCINT

NEBULIZADOR

SWIRLER

SURFACTANTE

IMAGE: 158 SEG

A.MED: 112 KC

DOSES: 16 MCI

ENTANA TC99M 10%

COLIMADOR PROPOSITO GENERAL

T DE NEBULIZACION: 2 MIN

D.T.P.A.

400 SEG

20 KC.

VISTA POSTERIOR