Artificial Coughing,
A New Apparatus for Paralyzed Patients*

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Patients with respiratory paralysis (for example in poliomyelitis) are unable to cough. Bronchial secretions may accumulate and cause atelectasis, bronchopneumonia, decreased gaseous exchange, blood vessel shunt phenomena, and other undesirable effects. Such complications are responsible for a large percentage of the deaths associated with prolonged artificial respiration. Coughing is the best way to keep the bronchial tree clean and to prevent pulmonary complications. Patients with tracheotomy or endotracheal intubation are unable to cough because they can not close the glottis, and coughing is possible only when contraction of the abdominal wall works against a closed upper airway.

Barach, Beck, Bickerman and co-workers, have recently reported good results with mechanical coughing by means of the "coughing chamber" (essentially a modified iron lung) and of the "Cof-flator," the first real coughing machine. Another coughing apparatus was developed in 1955 by Stoffregen and Oehmig and reported at the 1955 World Congress of Anesthesia at Scheveningen, Netherlands.1

Description of Apparatus:

This apparatus consists of a manually operated valve, which opens suddenly connecting the bronchial tree to a source of negative pressure. This sudden large pressure difference between the inside of the lungs through the upper airways to the coughing apparatus simulates normal coughing. The required pressure difference is achieved by means of a surgical as-

FIGURE 1: The artificial coughing apparatus, consisting of a surgical aspirator and a pistol-like valve.

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pirator (suction machine) with a vacuum flask of five liters capacity. A relief valve maintains a flask pressure of minus 200 centimeters of water. By means of a new three-way valve and a rubber hose the trachea of the intubated or tracheotomized patient can be exposed suddenly to the vacuum (Fig. 1). This new valve (Fig. 2) is a pistol-like, manually operated instrument, consisting of a trigger mechanism, a blocking lever, and a three-way valve. One arm leads to the room air, to an anesthesia machine, or to a mechanical respirator. When the trigger is pressed, the blocking lever opens the rotary valve in about 0.05 second. The patient's lungs are

\[ \begin{align*}
\text{Drehschieber} & \quad \text{rotary valve} \\
\text{zum Patienten} & \quad \text{to the patient} \\
\text{zum Vakuumbehälter} & \quad \text{to the vacuum flask} \\
\text{verstellbarer Bypass} & \quad \text{variable bypass} \\
\text{Abzugbügel} & \quad \text{trigger} \\
\text{Sperre} & \quad \text{blocking lever}
\end{align*} \]

\[ \begin{align*}
\text{PRESSURE RIGHT ATRIUM} & \quad \text{Tracheal Pressure}
\end{align*} \]

\[ \text{FIGURE 2A} \quad \text{FIGURE 2B} \]

\text{Figure 2: The pistol-like valve.}

\[ \text{FIGURE 3: Pressures in the trachea and in the right atrium during artificial coughing.} \]
now suddenly connected to the suction apparatus and artificial coughing is produced.

It might appear that a preliminary insufflation of the lungs in order to dilate the bronchial tree would give a more efficient cough. However, experiments proved this to be unnecessary, the coughing by means of negative pressure only is practically as good.

Figure 3 shows the pressure changes in the trachea and in the right atrium, measured by means of a cardiac catheter. The difference in the pressures and in the time is due to various resistances, mainly the elasticity of the lungs and thoracic wall. Figure 4 are pneumotachograms showing that the artificial coughing is practically identical with spontaneous cough.

The danger of pulmonary edema as a result of repeated negative pressure was feared by Scandinavian clinicians who hesitated to apply even much.

![Pneumotachogram](image)

**FIGURE 4**: The curves for spontaneous and artificial coughing are practically identical.

![X-ray](image)

**FIGURE 5A**, *left*: X-ray of the chest of an anesthetized, intubated, curarized dog. The right middle and lower lobes are filled with a contrast medium.—**FIGURE 5B**, *right*: The contrast medium has been removed by artificial coughing. The same findings have been demonstrated by cinematographical technique.
less suction than this apparatus uses during artificial breathing. Fortunately, this complication has not appeared. Hoernicke and Stoffregen tested the present instrument on a large number of guinea pigs, and produced brief endotracheal pressures up to 300 cm. H₂O suction. In some cases, this was repeated 20 times in 10 minutes. No change of the lungs are found by histological examination and estimations of the fluid content in the lungs by weighing and dessication. This technique of artificial coughing was also used in a few hundred patients, in poliomyelitis, and in curarized tetanus patients but mainly during or at the end of anesthesia. No sign of pulmonary edema was found in any of these patients.

**SUMMARY**

A new artificial coughing device is described. It removes secretions from the lungs of intubated or tracheotomized patients. The device consists of a pistol-like valve connected to a vacuum source and is efficient, inexpensive, and easy to operate.*

*This artificial coughing device is now manufactured by the Draegerwerk Luebeck, West Germany, under the name "Tussomat."

**Note:** Figures 2 and 5 are published with the permission of Springer-Verlag, Heidelberg, Germany.

**RESUME**

L’auteur décrit un nouvel appareil provoquant la toux artificielle. Il permet ainsi d’évacuer les sécrétions des poumons chez les malades intubés ou trachéotomisés. L’appareil consiste en une valve semblable à un pistolet reliée à une source de vide; c’est un appareil efficace, peu couteux et facile à manier.

**ZUSAMMENFASSUNG**


**REFERENCES**


