AN IMPROVED DESIGN OF POWDER INHALER

Duncan, Paterson, Harris & Crompton (1977) describe the use of a new powder inhaler for the effective administration of a bronchodilator, salbutamol, to asthmatic patients. The device has been designed to obtain reliable and complete emptying of a hard gelatin cartridge during a single inhalation. Notable features of the design are the low resistance to airflow through the apparatus and the exceptionally low air current needed to deliver the drug. Both these features are advantageous to asthmatic patients.

Drug discharge and dispersion are achieved by cutting the cartridge in two by means of a sharp knife in the device, and then vigorously agitating the cut halves of the cartridge in a turbulent spiral airstream. This effectively empties the cartridge and ensures adequate dispersion of the contents. A fine gauze (0.5 mm aperture) in the mouthpiece prevents the inhalation of fragments of the cut cartridge. The device illustrated in Figure 1 consists of a transparent chamber A having four tangential air slots B, which slides to and fro in an outer case C. A mouthpiece D, contains a stainless steel gauze filter E. At the rear of the chamber is a unit for holding F, cutting G, and ejecting H the cartridge. The cutting blade is coupled to the chamber by a sliding spline so that rotation of the mouthpiece/chamber assembly causes the blade to sever the stationary cartridge.

The cartridge which contains the medicament consists of a Number 3 hard gelatin capsule. Potent drugs such as salbutamol are finely divided and intimately mixed with sufficient coarser inert powder excipient such as lactose to permit satisfactory filling of the cartridges.

In vitro *assessment of the powder inhaler*

The efficiency of the powder inhaler was assessed using cartridges containing 200 μg or 400 μg of salbutamol (as the sulphate) mixed with 25 mg of lactose. The drug particles were mostly less than 2 μm diameter whereas the lactose were mostly greater than 10 μm diameter with a mean of about 80 μm. The

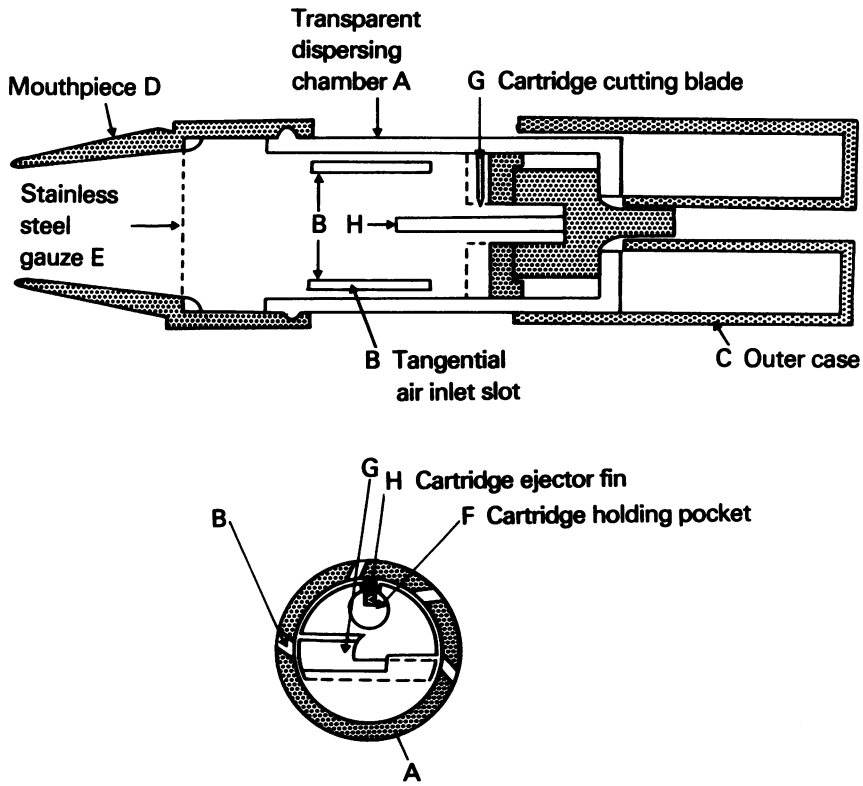

Figure 1 The design of the powder inhaler.

Table 1 Salbutamol deposited in the multistage liquid impinger. The results are expressed as mean percentage of total emitted drug at an airflow of 60 l/min

	Effective cut off size (μm)	*200 μg cartridge*	*400 μg cartridge*	*Ventolin inhaler*
Throat		70.8	64.5	47.0
Stage 1	12.6	3.1	4.8	0.7
Stage 2	7.4	6.7	6.8	2.2
Stage 3	3.8	9.8	9.9	9.4
Stage 4	1.0	8.9	13.8	38.3
Filter	–	0.6	0.4	2.0

9.4% (200 μg cartridge) and 9.1% (400 μg cartridge) of the total dose in the cartridge were retained in the inhaler and emptied shell.

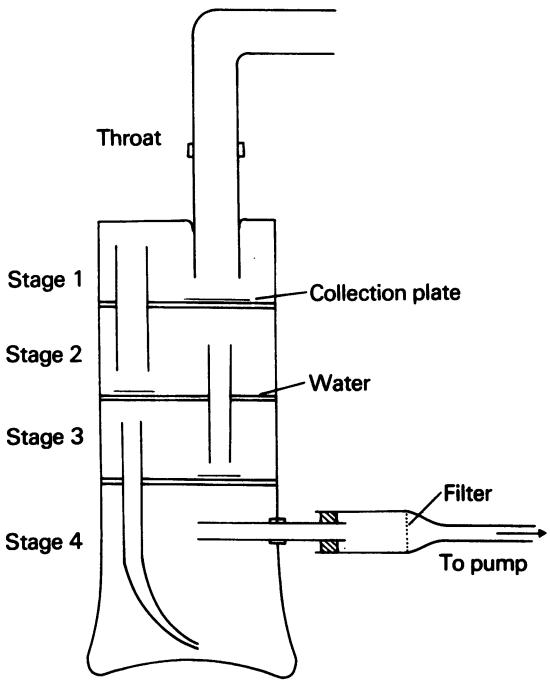

Figure 2 The multistage liquid impinger.

particle size distribution of the powder discharged from the inhaler was estimated using a Multistage Liquid Impinger (Figure 2). The use of this instrument for inhalation aerosols has been described elsewhere (Bell, Hartley & Cox, 1971; Bell, Brown & Glasby, 1973; Hallworth & Andrews, 1976).

Particles depositing in stages 3 and 4 can be regarded as likely to enter the lungs. The airflow used in the instrument is 60 l/min and can be regarded as well below the inspiratory rate of all but the severest asthmatics. The results expressed in Table 1 suggest the powder inhaler delivery is approximately half the inhaled dose of the Ventolin Inhaler, thus an adult dose of 400 μg of salbutamol is suggested. However, in this test situation the Ventolin Inhaler is discharged into a continuous airstream unlike the clinical situation where correct synchronization of actuation of the aerosol with brief inspiration can be variable. The powder inhaler is operated by the inspired air which eliminates this problem and should thus be of great benefit to patients who experience difficulty in co-ordination. The ability of the powder inhaler to discharge most of the dose at low airflow is shown in Table 1, it is likely that virtually all patients will achieve satisfactory operation of the inhaler.

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