# RESULTS

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## *IN VITRO* EXPERIMENTS

### A. Experiments on Guinea-Pig Tracheal Spiral Strip Preparation:

#### 1. Effect on histamine-induced contraction:

Verapamil (in doses from 2 to 32 ug/ml) produced inhibition in the resting tone of the isolated guinea-pig tracheal spiral strip when incubated for 10 minutes. The inhibition of the base line was greatest with the highest dose used (32 ug/ml) (Fig. 6). Furthermore, it caused inhibition of the histamine (7 ug/ml)-induced contraction in a dose dependent manner (Fig. 6).

Verapamil (in doses from 8 to 64 ug/ml) added on top of histamine-induced contraction of the isolated guinea-pig tracheal spiral strip produced inhibition of the contraction (Fig. 7 A&B). This inhibition was dose dependent and the degree of inhibition varied with different doses of verapamil. Histamine-induced contraction was nearly abolished by the addition of verapamil in a dose of 64 ug/ml (Fig. 7 B).

Cumulative doses of verapamil (from 4 to 32 ug/ml) on top of the histamine-induced contraction also caused inhibition of the contraction (Fig. 8).

2. **Effect on acetylcholine-induced contraction:**

Verapamil (in doses from 2 to 32 ug/ml) induced inhibition in the resting tone of the isolated guinea-pig tracheal spiral strip when incubated for 10 minutes. The inhibition of the base line was greatest with the highest dose used (32 ug/ml)(Fig. 9). Furthermore, it caused inhibition of the acetylcholine (3 ug/ml)-induced contraction in a dose dependent manner (Fig. 9).

Verapamil (in doses from 8 to 512 ug/ml) added on top of acetylcholine-induced contraction of the isolated guinea-pig tracheal spiral strip produced inhibition of the contraction (Fig. 10 A, B & C). This inhibition was dose dependent and the degree of inhibition varied with different doses of verapamil. Acetylcholine-induced contraction was completely abolished by the addition of verapamil in a dose of 512 ug/ml (Fig. 10 C).

The inhibition of acetylcholine-induced contraction was also observed after the addition of verapamil in cumulative doses from 16 to 512 ug/ml on top of the contraction (Fig. 11).

B. **Experiments on Isolated Perfused Guinea-Pig Lung Preparation:**

1. **Effect of different doses of verapamil on isolated perfused guinea-pig lung preparation:**

Verapamil (in doses from 4 to 64 ug/ml) increased the volume of the perfusate in a dose dependent manner (Table 9 and Fig. 12).

2. **Effect of verapamil on histamine-induced decrease in the perfusate:**

Histamine induced a dose dependent decrease in the volume of the perfusate (Table 10 and Fig. 13).

The changes in the volume of the perfusate (ml/min.) in response to different doses of verapamil (4, 8, 16, 32 & 64 ug/ml) injected 4 minutes before histamine (4 ug/ml) at different time intervals were recorded in Table (11). Verapamil antagonized the decrease in the volume of perfusate,

caused by histamine, in a dose dependent manner. The volume of the perfusate at 5 minutes after histamine administration, in response to different doses of verapamil , was represented graphically in Fig. (14). The values recorded were 73%, 80%, 87%, 93% & 100% of the control value respectively.

The change in the volume of perfusate (ml/min.) of the isolated perfused guinea-pig lung preparation in response to different doses of verapamil (4, 8, 16, 32 & 64 ug/ml) injected 2 minutes after histamine (4 ug/ml) at different time intervals were recorded in table (12). Verapamil antagonized the decrease in the volume of perfusate, caused by histamine, in a dose dependent manner. The volume of the perfusate at 4 minutes after the addition of different doses of verapamil was represented graphically in Fig. (15). The values recorded were 67%, 70%, 80%, 87% & 93% of the control value respectively.

3. **Effect of verapamil on acetylcholine-induced decrease in the perfusate:**

Acetylcholine-induced a dose dependent decrease in the volume of the perfusate (Table 13 and Fig. 16).

The changes in the volume of the perfusate (ml/min.) of the isolated perfused guinea-pig lung preparation in response to different doses of verapamil (4, 8, 16, 32 & 64 ug/ml) injected 4 minutes before acetylcholine (4 ug/ml) at different time intervals were recorded in table (14). Verapamil inhibited the decrease in the volume of perfusate produced by acetylcholine, in a dose dependent manner. The volume of the perfusate at 3 minutes after acetylcholine administration, in response to different doses of verapamil, was represented graphically in Fig. (17). The values recorded were 69%, 75%, 81%, 89% & 94% of the control value respectively.

The changes in the volume of perfusate (ml/min.) in response to different doses of verapamil (4, 8, 16, 32 & 64 ug/ml) injected 2 minutes after acetylcholine (4 ug/ml) at different time intervals were recorded in Table (15). Verapamil antagonized the decrease in the volume of perfusate caused by acetylcholine in a dose dependent manner. The volume of the perfusate at 4 minutes, after the addition of different doses of verapamil, was represented graphically in Fig. (18). The values recorded were 63%, 66%, 75%, 81% % 88% of the control value respectively.

C. Experiments on Isolated Perfused Rat Hind Quarters Preparation:

1. Effect of different doses of verapamil on isolated perfused rat hind quarters preparation:

Verpamil (in doses from 2 to 16 ug/ml) increased the volume of the perfusate in a dose dependent manner (Table 16 and Fig. 19).

2. Effect of verapamil on KCl-induced decrease in the perfusate:

KCl-induced a dose dependent decrease in the volume of the perfusate (Table 17 and Fig. 20).

The changes in the volume of the perfusate (ml/min.) in response to different doses of verapamil (1, 2, 4, 8 & 16 ug/ml) injected 2 minutes before KCl (4 mg/ml) at different time itnervals were recorded in Table (18). Verapamil antagonized the decrease in the volume of perfusate, caused by KCl, in a dose dependent manner. The volume of the perfusate at 2 minutes after KCl administration, in response to different doses of verapamil, was represented graphically in Fig. (21).

The values recorded were 71%, 79%, 88%, 100% & 107% of the control value respectively.

The changes in the volume of perfusate (ml/min.) in response to different doses of verapamil (1, 2, 4, 8 & 16 ug/ml) injected 2 minutes after KCl (4 mg/ml) at different time intervals were recorded in table (19). Verapamil antagonized the decrease in the volume of the perfusate caused by KCl in a dose dependent manner. The volume of the perfusate at 2 minutes after the addition of different doses of verapamil was represented graphically in Fig. (22). The values recorded were 75%, 81%, 88%, 94%, 100% of the control value respectivelу.

D. **Experiemtns on Isolated Rabbit Aortic Strip:**

Verapamil (in doses from 0.25 to 8 ug/ml) produced inhibition in the resting tone of the isolated rabbit aortic strip when incubated for 10 minutes. The inhibition of the base line was greatest with the highest dose (8 ug/ml)(Fig. 23 A&B). Furthermore, it caused inhibition of the KCl (4 mg/ml)-induced contraction in a dose dependent manner (Fig. 23 A&B).

Verapamil (in doses from 0.25 to 4 ug/ml) added

on top of KCl (4 mg/ml)-induced contraction of the isolated rabbit aortic strip produced inhibition of the contraction (Fig. 24). This inhibition varied with different doses of verapamil and in general was dose dependent.

## *IN VIVO* EXPERIMENTS

### A. Experiments on Normal Unsensitized Guinea-Pigs:

#### 1. Effect of verapamil on normal guinea-pigs exposed to histamine aerosol:

The control group of unsensitized animals (injected with saline) exposed to 0.5% histamine aerosol showed dyspnea, urination, defecation, fall on one side and convulsions. The mean preconvulsive time (± standard error) recorded in the present experiments for the control group was 52.8 ± 4.67 seconds (Table 20). The test group injected with verapamil (3 mg/kg, i.p.) and exposed to histamine after half an hour showed significant increase in the preconvulsive time (Table 20). The mean preconvulsive time (± standard error) recorded for the test group was 68.5 ± 4.77

seconds. The calculated percentage protection was 22.9%.

2. **Effect of verapamil on normal guinea-pigs exposed to acetylcholine aerosol:**

The control group of unsensitized animals (injected with saline) exposed to 4% acetylcholine aerosol displayed similar signs to those exposed to histamine aerosol. The mean preconvulsive time (± standard error) recorded for the control group was 52.9 ± 3.96 seconds (Table 20). The test group injected with verapamil (3 mg/kg, i.p.) and exposed to acetylcholine after half un hour showed significant increase in the preconvulsive time (Table 20). The mean preconvulsive time (± standard error) recorded for the test group was 67.7 ± 6.3 seconds. The calculated percentage protection was 21.9%.

B. **Experiments on Ovalbumin Sensitized Guinea-Pigs:**

**Effect of verapamil on sensitized guinea-pigs exposed to ovalbumin aerosol:**

The control group of ovalbumin sensitized animals (injected with saline) exposed to 5% ovalbumin aerosol displayed similar signs to those exposed to histamine

or acetylcholine aerosol. The mean preconvulsive time (± standard error) recorded for the control group was 171.4 ± 6.02 seconds (Table 21). The test group injected with verapamil (3 mg/kg, i.p.) and exposed to ovalbumin after half un hour produced significant increase in the preconvulsive time (Table 21). The mean preconvulsive time (± standard error) recorded for the test group in this experiment was 299.2 ± 14.05 seconds. The calculated percentage protection was 42.7%.

Table (9): Effect of different doses of verapamil on the volume of perfusate (ml/min.) of the isolated perfused guinea-pig lung preparation*.

| Time (min.) | Verapamil (ug/ml) | | | | |
|---|---|---|---|---|---|
| | 4 | 8 | 16 | 32 | 64 |
| 1 | 10 | 10 | 10 | 11 | 11 |
| 2 | 11 | 11 | 11 | 12 | 12 |
| 3 | 11 | 11 | 11 | 13 | 13 |
| 4** | 11 | 12 | 12 | 13 | 13 |
| 5 | 10 | 12 | 12 | 13 | 13 |
| 6 | 10 | 12 | 12 | 13 | 13 |
| 7 | 10 | 11 | 12 | 12 | 13 |
| 8 | 10 | 11 | 12 | 12 | 13 |
| 9 | 10 | 11 | 12 | 12 | 13 |
| 10 | 10 | 11 | 12 | 12 | 13 |

* The control value was 10 ml/min.

** These values were represented graphically (Fig. 12).

Table (10): Effect of different doses of histamine on the volume of perfusate (ml/min.) of the isolated perfused guinea-pig lung preparation*.

| Time (min.) | Histamine (ug/ml) | | | |
|---|---|---|---|---|
| | 1 | 2 | 4 | 8 |
| 1 | 14.5 | 14 | 12 | 6 |
| 2 | 14 | 13 | 10 | 5 |
| 3 | 13 | 12 | 10 | 4 |
| 4 | 13 | 12 | 10 | 4 |
| 5** | 14 | 12 | 10 | 4 |
| 6 | 14 | 12 | 10 | 4 |
| 7 | 14 | 12 | 10 | 4 |
| 8 | 14 | 12 | 10 | 4 |
| 9 | 14 | 12 | 10 | 4 |
| 10 | 15 | 13 | 11 | 4 |

* The control value was 15 ml/minute.

** These values were represented graphically (Fig. 13).

Table (11): The changes in the volume of perfusate (ml/min.) of the isolated perfused guinea-pig lung preparation in response to different doses of verapamil injected 4 minutes before histamine (4 ug/ml) at different time intervals*.

| Time (min.) | Verapamil (ug/ml) | | | | |
|---|---|---|---|---|---|
| | 4 | 8 | 16 | 32 | 64 |
| 1 | 15 | 15 | 16 | 16 | 16 |
| 2 | 16 | 16 | 16 | 17 | 17 |
| 3 | 16 | 16 | 16 | 17 | 18 |
| 4 | 16 | 17 | 17 | 18 | 18 |
| | Histamine (4 ug/ml) | | | | |
| 1 | 15 | 16 | 16 | 16 | 16 |
| 2 | 12 | 14 | 14 | 15 | 15 |
| 3 | 11 | 12 | 13 | 14 | 15 |
| 4 | 11 | 12 | 13 | 14 | 15 |
| 5** | 11 | 12 | 13 | 14 | 15 |
| 6 | 11 | 12 | 13 | 14 | 15 |
| 7 | 11 | 12 | 13 | 14 | 15 |
| 8 | 12 | 12 | 13 | 14 | 15 |
| 9 | 12 | 12 | 13 | 14 | 15 |
| 10 | 13 | 13 | 14 | 14 | 15 |

* The control value was 15 ml/minute.

** These values were represented graphically (Fig. 14).

Table (12): The changes in the volume of perfusate (ml/min.) of the isolated perfused guinea-pig lung preparation in response to different doses of verapamil injected 2 minutes after histamine (4 ug/ml) at different time intervals*.

| Time (min.) | Histamine (4 ug/ml) | | | | |
|---|---|---|---|---|---|
| 1 | 12 | 12 | 12 | 12 | 12 |
| 2 | 10 | 10 | 10 | 10 | 10 |
| | Verapamil (ug/ml) | | | | |
| | 4 | 8 | 16 | 32 | 64 |
| 1 | 10 | 10 | 11 | 12 | 12.5 |
| 2 | 10 | 10.5 | 11.5 | 12.5 | 13 |
| 3 | 10 | 10.5 | 12 | 13 | 14 |
| 4** | 10 | 10.5 | 12 | 13 | 14 |
| 5 | 10 | 11 | 12 | 13 | 14 |
| 6 | 11 | 11 | 12.5 | 13 | 14 |
| 7 | 11 | 11 | 12.5 | 13 | 14 |
| 8 | 11 | 11 | 12.5 | 13 | 14 |
| 9 | 11 | 11 | 12.5 | 13 | 14 |
| 10 | 11 | 12 | 13 | 14 | 15 |

* The control value was 15 ml/minutes.

** These values were represented graphically (Fig. 15).

Table (13): Effect of different doses of acetylcholine on the volume of perfusate (ml/min.) of the isolated perfused guinea-pig lung preparation*.

| Time (min.) | Acetylcholine (ug/ml) | | | | |
|---|---|---|---|---|---|
| | 0.5 | 1 | 2 | 4 | 8 |
| 1 | 16 | 15 | 13 | 11 | 6 |
| 2 | 15 | 14 | 11 | 10 | 5 |
| 3* | 14 | 13 | 11 | 10 | 5 |
| 4 | 14 | 13 | 11 | 10 | 5 |
| 5 | 14 | 13 | 11 | 10 | 5 |
| 6 | 15 | 13 | 12 | 10 | 5 |
| 7 | 15 | 13 | 12 | 10 | 5.5 |
| 8 | 15 | 13 | 12 | 11 | 6 |
| 9 | 15 | 14 | 13 | 12 | 7 |
| 10 | 16 | 14 | 13 | 12 | 8 |

* The control value was 16 ml/minute.

** These values were represented graphically (Fig. 16).

Table (14): The changes in the volume of perfusate (ml/min.) of the isolated perfused guinea-pig lung preparation in response to different doses of verapamil injected 4 minutes before acetylcholine (4 ug/ml) at different time intervals*.

| Time (min.) | Verapamil (ug/ml) | | | | |
|---|---|---|---|---|---|
| | 4 | 8 | 16 | 32 | 64 |
| 1 | 15 | 15 | 16 | 16 | 16 |
| 2 | 16 | 16 | 16 | 17 | 17 |
| 3 | 16 | 16 | 16 | 17 | 18 |
| 4 | 16 | 17 | 17 | 18 | 18 |
| | Acetylcholine (4 ug/ml) | | | | |
| 1 | 15 | 16 | 16 | 16 | 16 |
| 2 | 12 | 14 | 14 | 15 | 15 |
| 3** | 11 | 12 | 13 | 14 | 15 |
| 4 | 11 | 12 | 13 | 14 | 15 |
| 5 | 11 | 12 | 13 | 14 | 15 |
| 6 | 11 | 12 | 13 | 14 | 15 |
| 7 | 11 | 12 | 13 | 14 | 15 |
| 8 | 12 | 12 | 13 | 14 | 15 |
| 9 | 12 | 12 | 13 | 14 | 15 |
| 10 | 13 | 13 | 14 | 14 | 15 |

* The control value was 16 ml/minute.

** These values were represented graphically (Fig. 17).

Table (15): The changes in the volume of perfusate (ml/min.) of the isolated perfused guinea-pig lung preparation in response to different doses of verapamil injected 2 minutes after acetylcholine (4 ug/ml) at different time intervals*.

| Time (min.) | Acetylcholine (4 ug/ml) | | | | |
|---|---|---|---|---|---|
| 1 | 11 | 11 | 11 | 11 | 11 |
| 2 | 10 | 10 | 10 | 10 | 10 |
| | Verapamil (ug/ml) | | | | |
| | 4 | 8 | 16 | 32 | 64 |
| 1 | 10 | 10 | 11 | 11.5 | 12.5 |
| 2 | 10 | 10 | 11.5 | 12.5 | 13.5 |
| 3 | 10 | 10.5 | 12 | 13 | 14 |
| 4** | 10 | 10.5 | 12 | 13 | 14 |
| 5 | 10 | 10.5 | 12.5 | 13 | 14 |
| 6 | 10 | 11 | 12.5 | 13 | 14 |
| 7 | 10 | 11 | 12.5 | 13 | 14 |
| 8 | 10 | 11 | 13 | 13 | 14 |
| 9 | 10.5 | 11 | 13 | 14 | 14 |
| 10 | 11 | 11.5 | 13 | 14 | 14 |

* The control value was 16 ml/minutes.

**These values were represented graphically (Fig. 18).

Table (16): Effect of different doses of verapamil on the volume of perfusate (ml/min.) of the isolated perfused rat hind quarters preparation.

| Time (min.) | Verapamil (ug/ml) | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 4 | 8 | 16 |
| 1 | 7 | 7.5 | 7.5 | 8 | 8 |
| 2** | 7 | 7.5 | 7.5 | 8 | 8 |
| 3 | 7 | 7.5 | 7.5 | 8 | 8 |
| 4 | 7 | 7.5 | 7.5 | 8 | 8 |
| 5 | 7 | 7.5 | 7.5 | 7.5 | 8 |
| 6 | 7 | 7.5 | 7.5 | 7.5 | 8 |
| 7 | 7 | 7.5 | 7.5 | 7.5 | 8 |
| 8 | 7 | 7 | 7.5 | 7.5 | 8 |
| 9 | 7 | 7 | 7.5 | 7.5 | 8 |
| 10 | 7 | 7 | 7 | 7.5 | 8 |

* The control value was 7 ml/min.

** These values were represented graphically (Fig. 19).

Table (17): Effect of different doses of KCl on the volume of perfusate (ml/min.) of the isolated perfused rat hind quarters preparation*.

| Time (min.) | KCl (mg/ml) | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 4 | 8 | 16 |
| 1 | 7 | 6.5 | 5.5 | 5 | 4 |
| 2** | 7 | 6.5 | 5.5 | 5 | 4 |
| 3 | 7 | 6.5 | 5.5 | 5 | 4 |
| 4 | 7 | 6.5 | 5.5 | 5 | 4 |
| 5 | 7 | 6.5 | 5.5 | 5 | 4.5 |
| 6 | 7.5 | 7 | 6 | 5.5 | 5 |
| 7 | 7.5 | 7 | 6.5 | 5.5 | 5 |
| 8 | 7.5 | 7 | 7 | 6 | 5.5 |
| 9 | 8 | 8 | 7 | 6 | 5.5 |
| 10 | 8 | 8 | 7 | 6 | 5.5 |

* The control value was 8 ml/minute.

** These values were represented graphically (Fig. 20).

Table (18): The changes in the volume of perfusate (ml-min.) of the isolated perfused rat bind quarters preparation in response to different doses of verapamil injected 2 minutes before KCl (4 mg/ml) at different time intervals*.

| Time (min.) | Verapamil (ug/ml) | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 4 | 8 | 16 |
| 1 | 7 | 7.5 | 7.5 | 8 | 8 |
| 2 | 7 | 7.5 | 7.5 | 8 | 8 |
| | KCl (4 mg/ml) | | | | |
| 1 | 5 | 5.5 | 6 | 7 | 7.5 |
| 2** | 5 | 5.5 | 6 | 7 | 7.5 |
| 3 | 5 | 5.5 | 6 | 7 | 7.5 |
| 4 | 5 | 6 | 6.5 | 7.5 | 7.5 |
| 5 | 5.5 | 6 | 7 | 7.5 | 7.5 |
| 6 | 5.5 | 6 | 7 | 7.5 | 7.5 |
| 7 | 5.5 | 6 | 7 | 7.5 | 8 |
| 8 | 5.5 | 6 | 7 | 7.5 | 8 |
| 9 | 6 | 7 | 7 | 7.5 | 8 |
| 10 | 6 | 7 | 7 | 7.5 | 8 |

* The control value was 7 ml/minute.

** These values were represented graphically (Fig. 21).

Table (19): The changes in the volume of perfusate (ml/min.) of the isolated perfused rat hind quarters preparation in response to different doses of verapamil injected 2 minutes after KCl (4 mg/ml) at different time intervals*.

| Time (min.) | KCl (4 mg/ml) | | | | |
|---|---|---|---|---|---|
| 1 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 |
| 2 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 |
| | Verapamil (ug/ml) | | | | |
| | 1 | 2 | 4 | 8 | 16 |
| 1 | 6 | 6.5 | 6.5 | 7 | 7.5 |
| 2** | 6 | 6.5 | 7 | 7.5 | 8 |
| 3 | 6 | 6.5 | 7 | 7.5 | 8 |
| 4 | 6 | 6.5 | 7 | 8 | 8 |
| 5 | 6 | 6.5 | 7 | 8 | 8 |
| 6 | 6.5 | 7 | 7 | 8 | 8 |
| 7 | 7 | 7 | 7.5 | 8 | 8 |
| 8 | 7 | 7 | 7.5 | 8 | 8 |
| 9 | 7 | 7 | 7.5 | 8 | 8 |
| 10 | 7 | 8 | 8 | 8 | 8 |

* The control value was 8 ml/minute.

** These values were represented graphically (Fig. 22).

Table (20): Effect of verapamil pretreatment (3 mg/kg i.p.) on the mean preconvulsive time (seconds) of guinea-pig exposed to histamine (0.5%) and acetylcholine (4%) aerosol . Each value represents the mean of 10 observations ± SE.

| Histamine aerosol | | Acetylcholine aerosol | |
|---|---|---|---|
| **Saline control** | **Verapamil pretreatment** | **Saline control** | **Verapamil pretreatment** |
| 52.80 ± 4.67 | 68.50 ± 4.77 | 52.90 ± 3.96 | 67.7 ± 6.2 |
| $P < 0.025$ | | $P < 0.05$ | |
| Percentage protection 22.9% | | Percentage protection 21.9% | |

Table (21): Effect of verapamil pretreatment (3 mg/kg i.p.) on the mean preconvulsive time (seconds) of ovalbumin sensitized guinea pigs exposed to the antigen aerosol (5%). Each value represents the mean of 10 observations ± SE.

| Ovalbumin aerosol (5%) | |
|---|---|
| **Saline control** | **Verapamil pretreatment** |
| 171.40 ± 6.02 sec. | 299.20 ± 14.05 sec. |
| $p < 0.001$ | |
| Percentage protection 42.7% | |

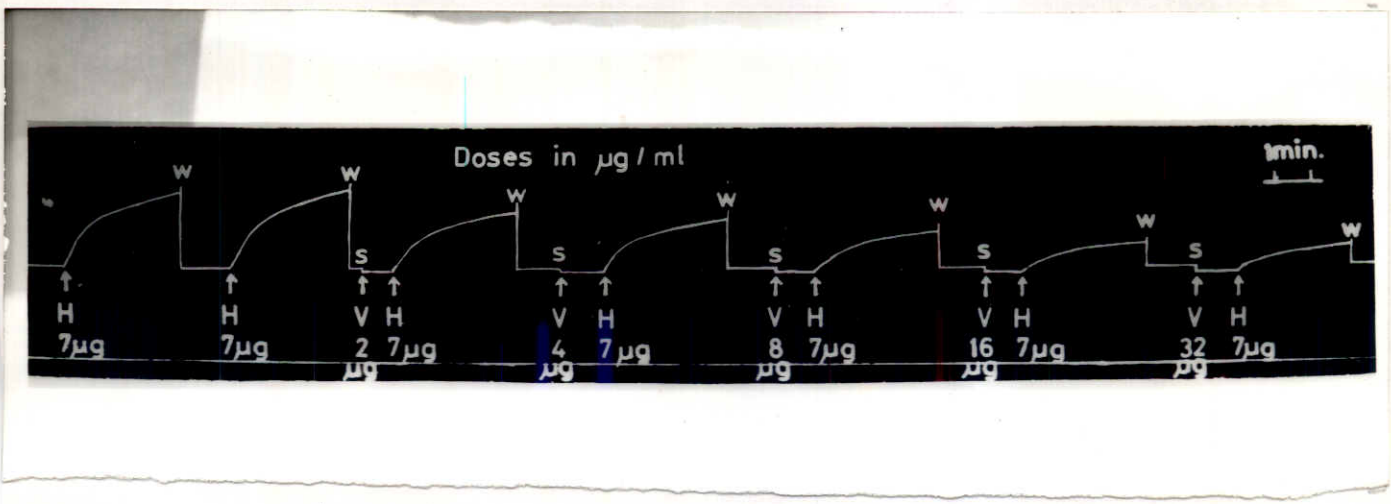


Fig. (6): Effect of incubation with different doses of verapamil (V) for 10 minutes on the histamine (H)-induced contraction of the isolated guinea-pig tracheal strip .
W = wash.
S = stop the kymograph for 10 minutes.
Doses are expressed as ug/ml of the bath solution.

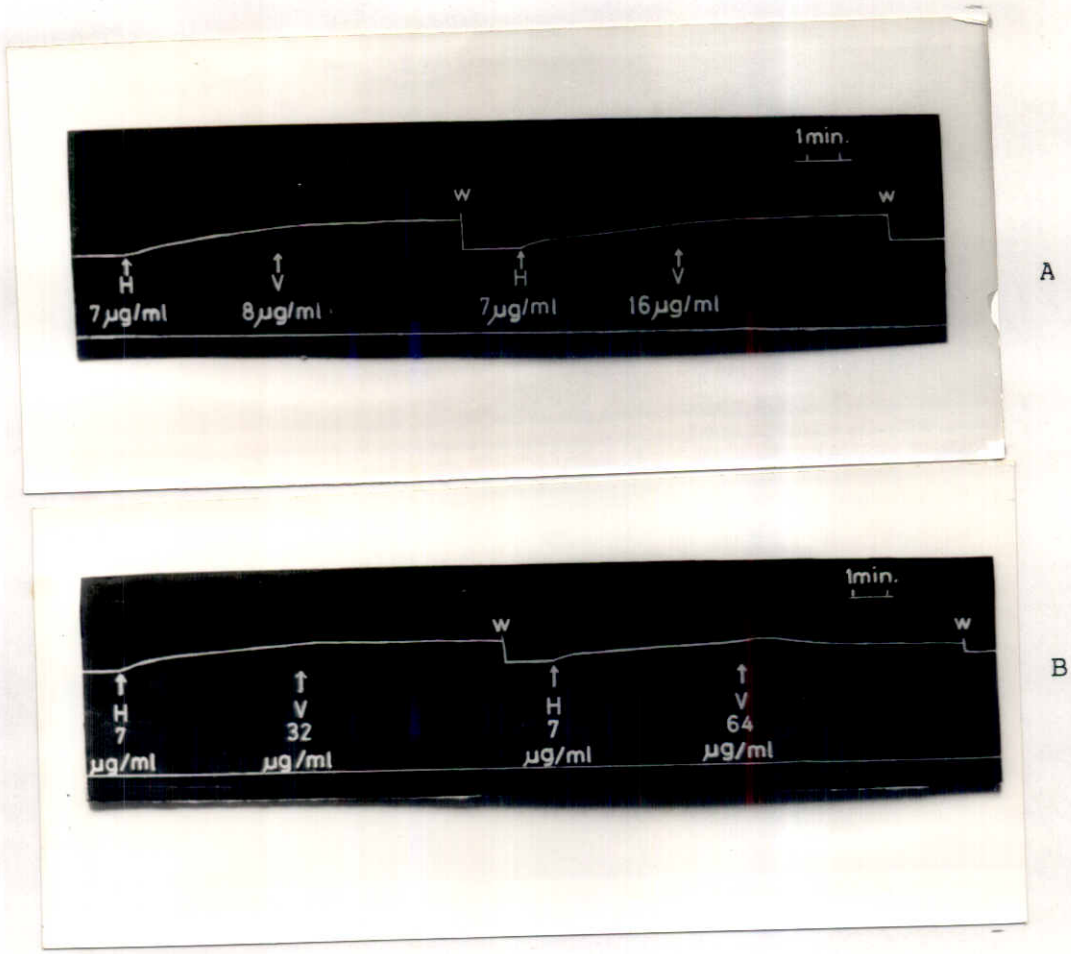


Fig. (7 A&B): Effect of different doses of verapamil (V) added on top of histamine (H)-induced contraction of the isolated guinea-pig tracheal strip.
W = wash
Doses are expressed as ug/ml of the solution.

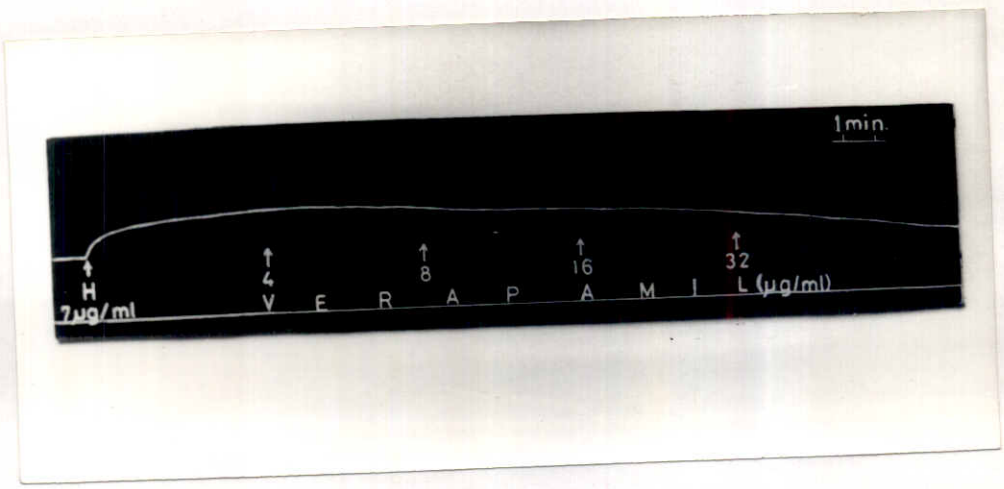


Fig. (8): Effect of cumulative doses of verapamil on the histamine (H)-induced contraction of the isolated guinea-pig tracheal strip.

Doses are expressed as ug/ml of the bath solution.

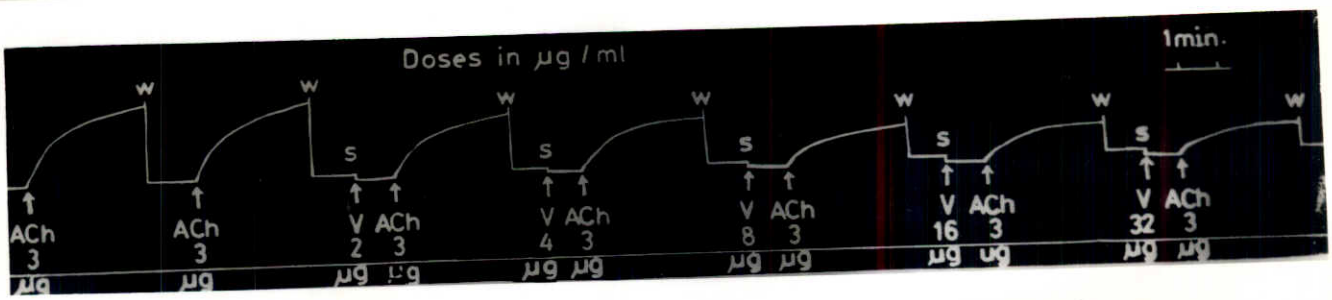


Fig. (9): Effect of incubation with different doses of verapamil (V) for 10 min. on the acetylcholine (ACh)-induced contraction of the isolated guinea-pig tracheal strip.
W = wash.
S = stop the kymograph for 10 minutes.
Doses are expressed as ug/ml of the bath solution.

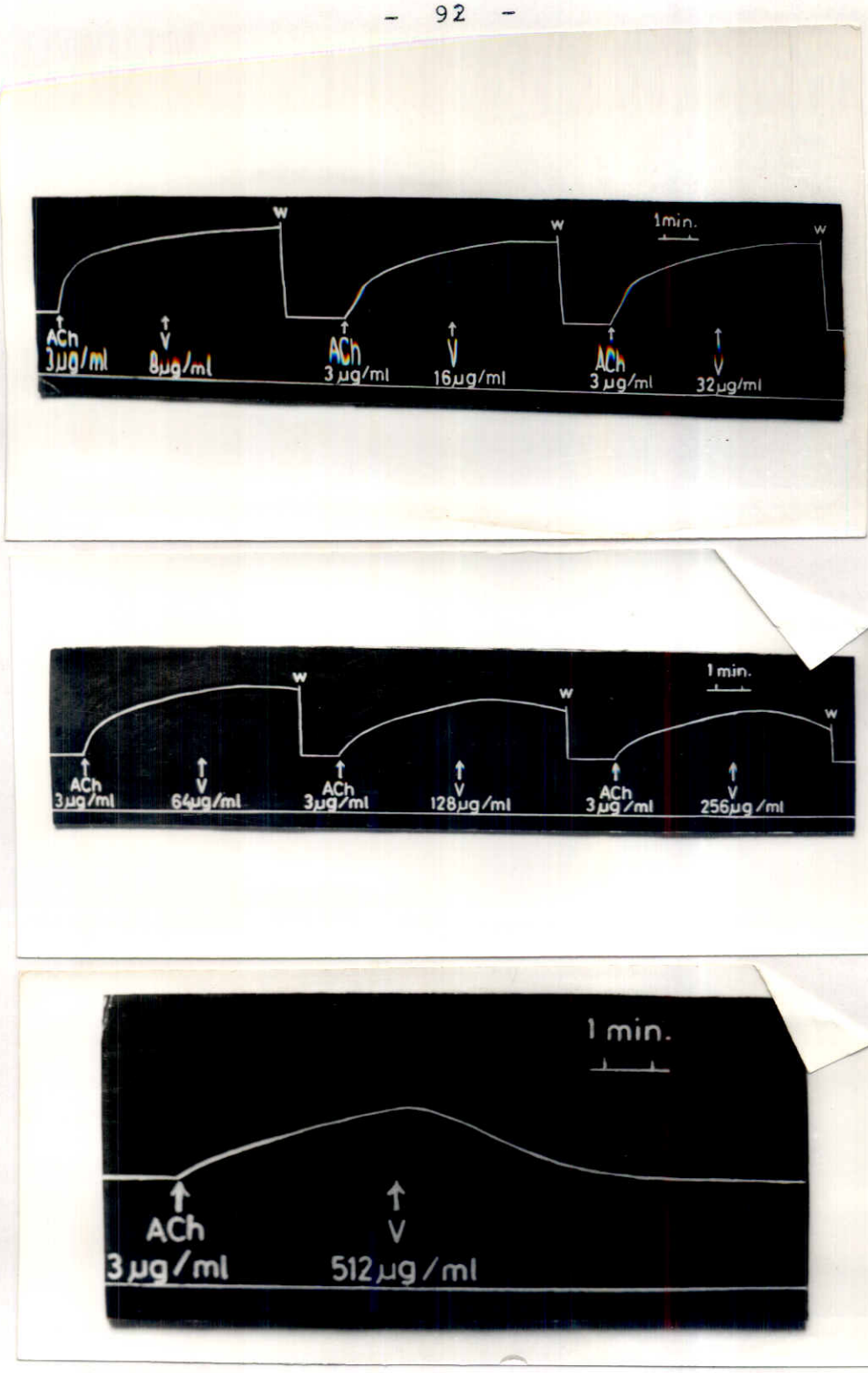


Fig. (10 A,B&C): Effect of different doses of verapamil (V) added on top of acetylcholine (ACh)-induced contraction of the isolated guinea-pig tracheal strip.
W = wash.
Doses are expressed as ug/ml of the bath solution.

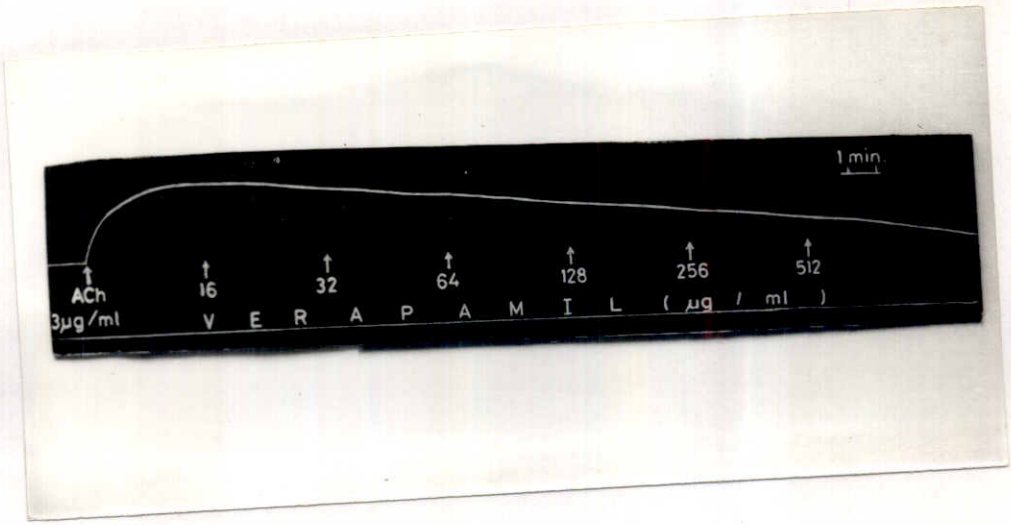


Fig. (11): Effect of cumulative doses of verapamil on the acetylcholine (ACh)-induced contraction of the isolated guinea-pig tracheal strip.

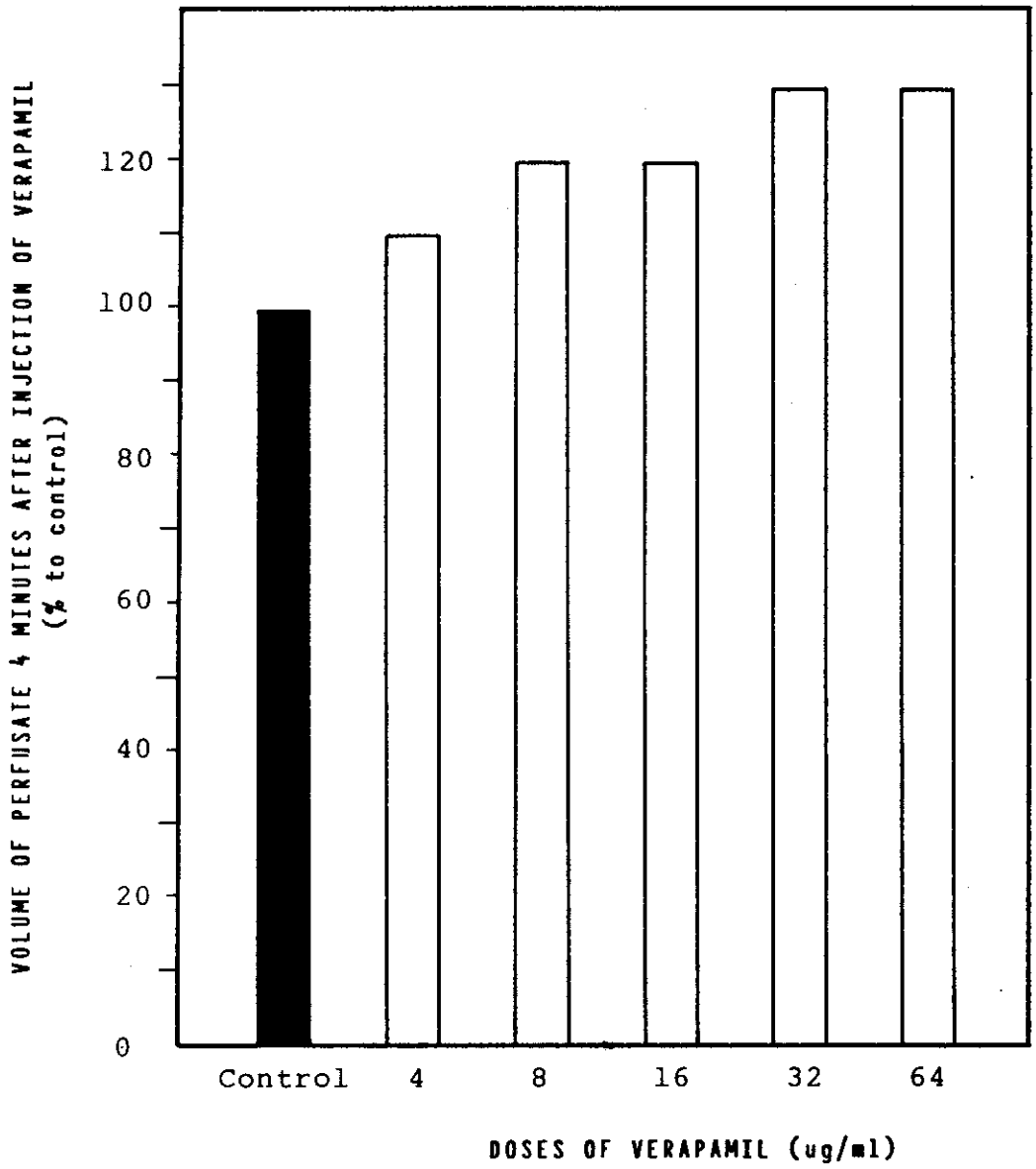


Fig. (12): Effect of different doses of verapamil (ug/ml) on the volume of perfusate of the isolated perfused guinea-pig lung preparation, 4 minutes after injection of the drug. The values are expressed as percentage of the control value.

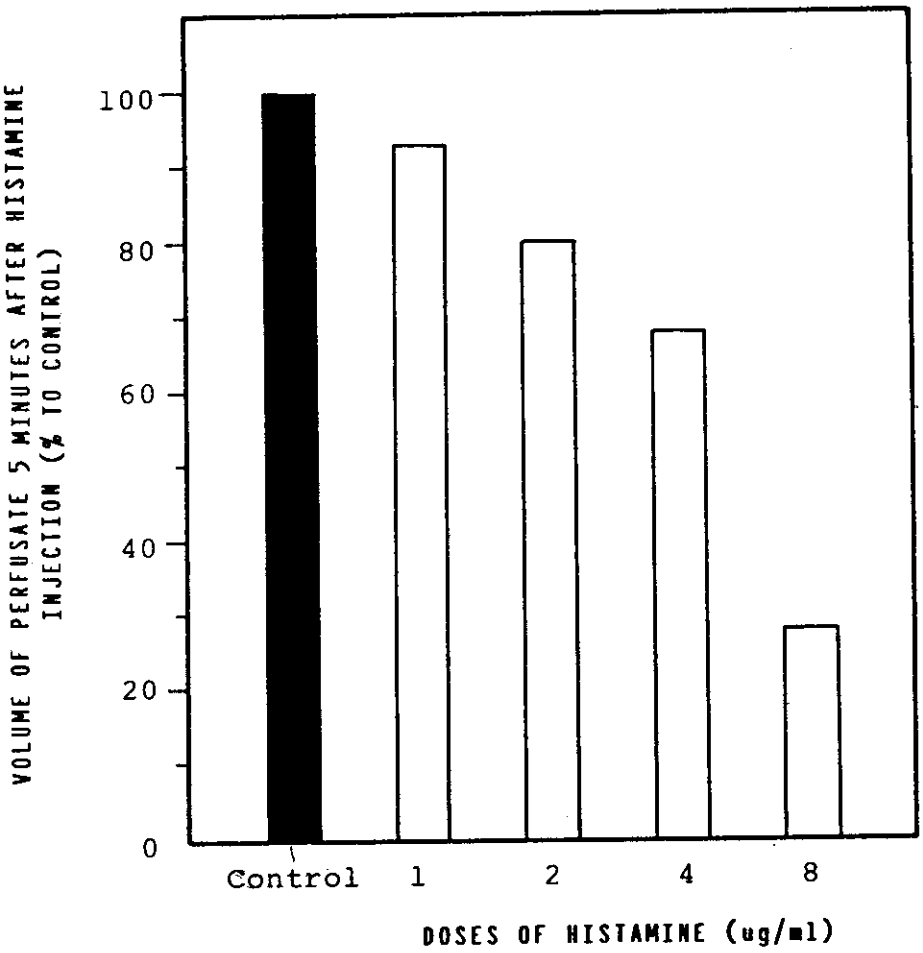


Fig. (13): Effect of different doses of histamine (ug/ml) on the volume of perfusate of the isolated perfused guinea-pig lung preparation, 5 minutes after injection of the drug. The values are expressed as percentage of the control value.

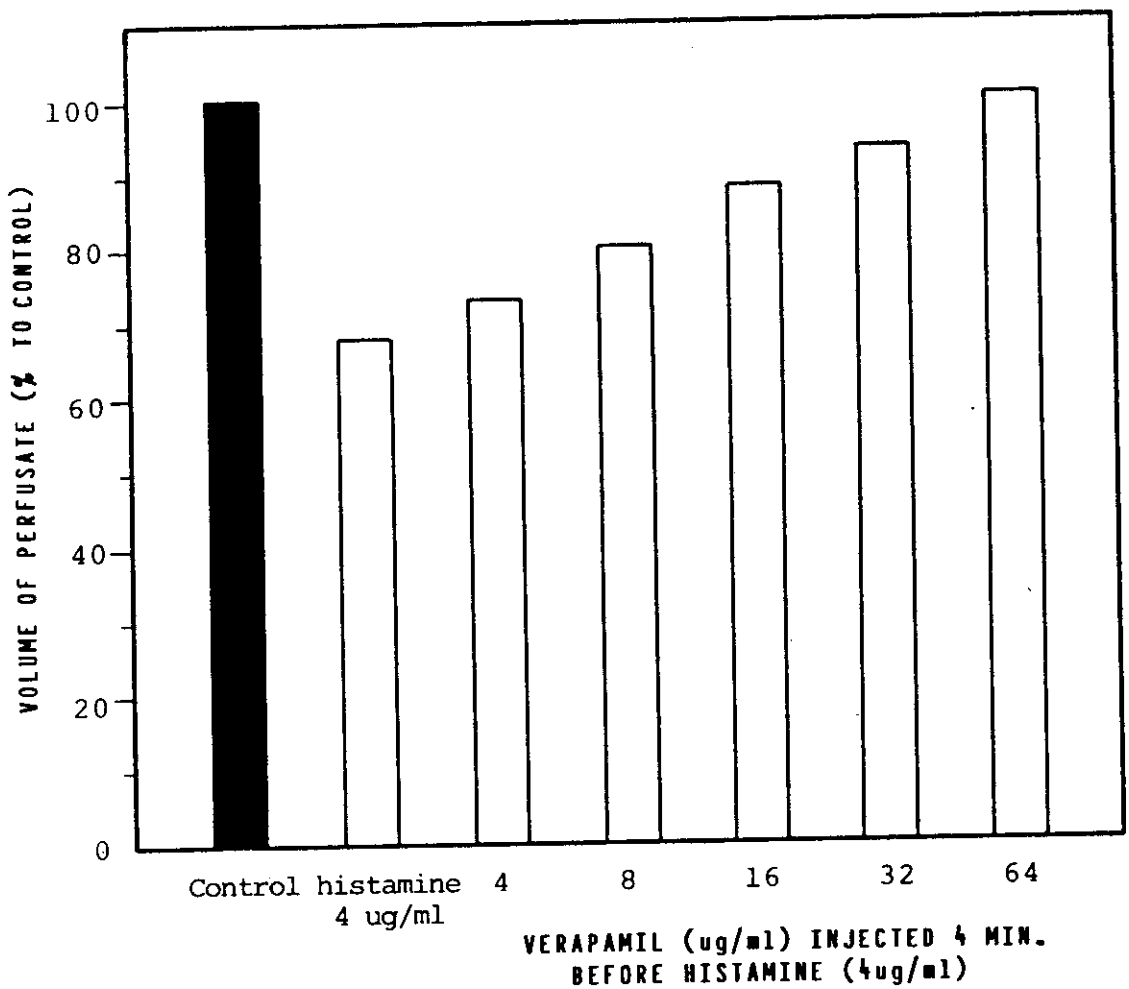


Fig. (14): Effect of different doses of verapamil on the volume of perfusate-of the isolated perfused guinea-pig lung preparation-when injected 4 minutes before histamine. The volume was measured 5 minutes after histamine administration and is expressed as percentage of the control value.

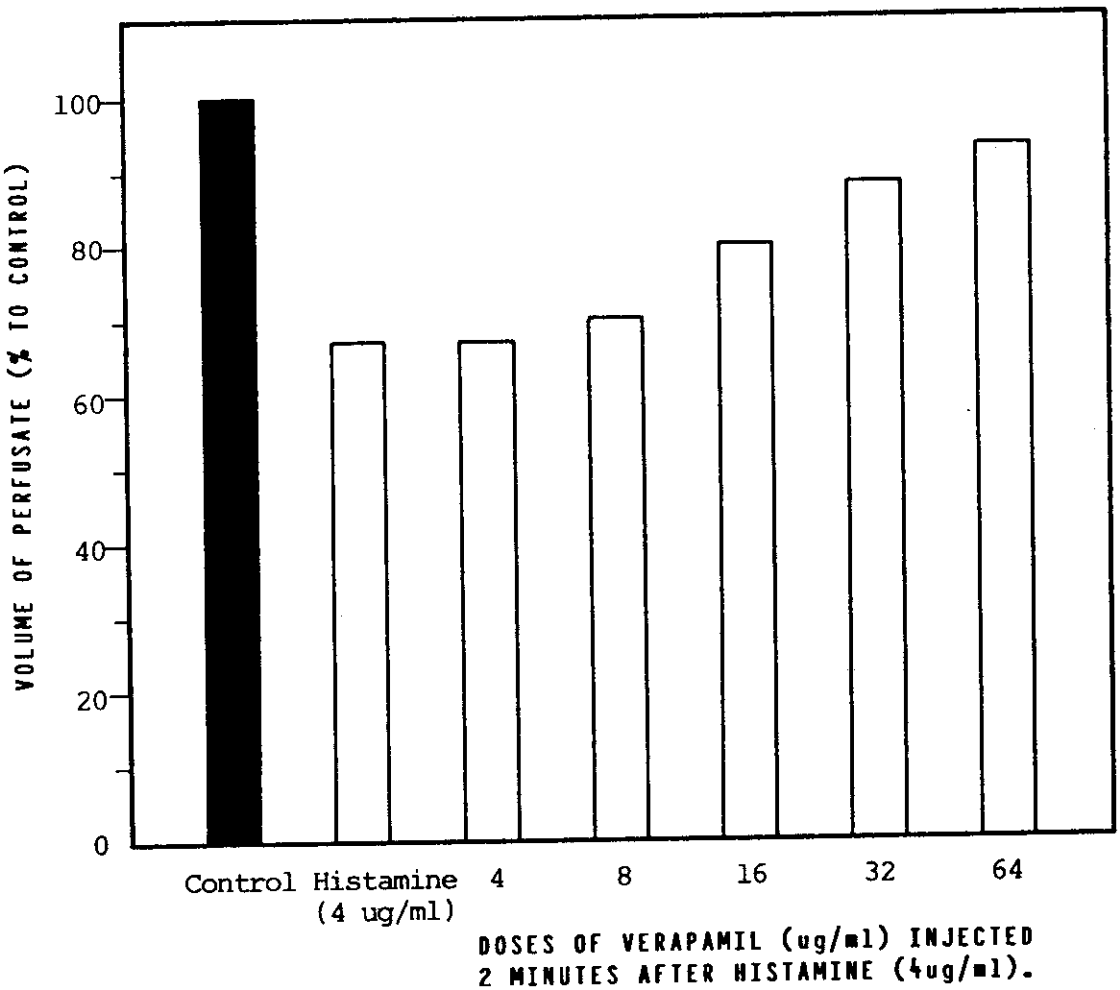


Fig. (15): Effect of verapamil on the volume of perfusate - of the isolated perfused guinea-pig lung preparation - when injected 2 minutes after histamine. The volume was measured 4 minutes after verapamil administration,and is expressed as percentage of the control value.

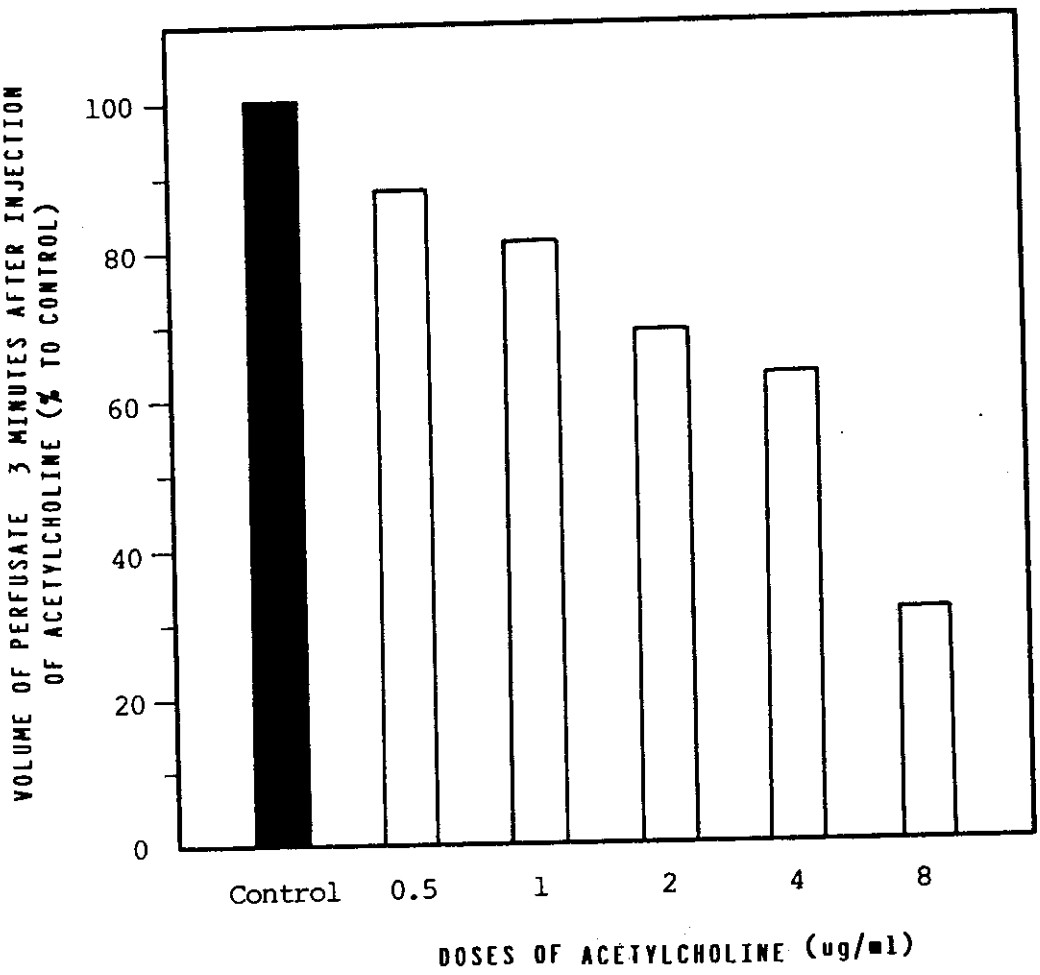


Fig. (16): Effect of different doses of acetylcholine (ug/ml) on the volume of perfusate, of the isolated perfused guinea-pig lung preparation, 3 minutes after injection of the drug. The values are expressed as percentage of the control value.

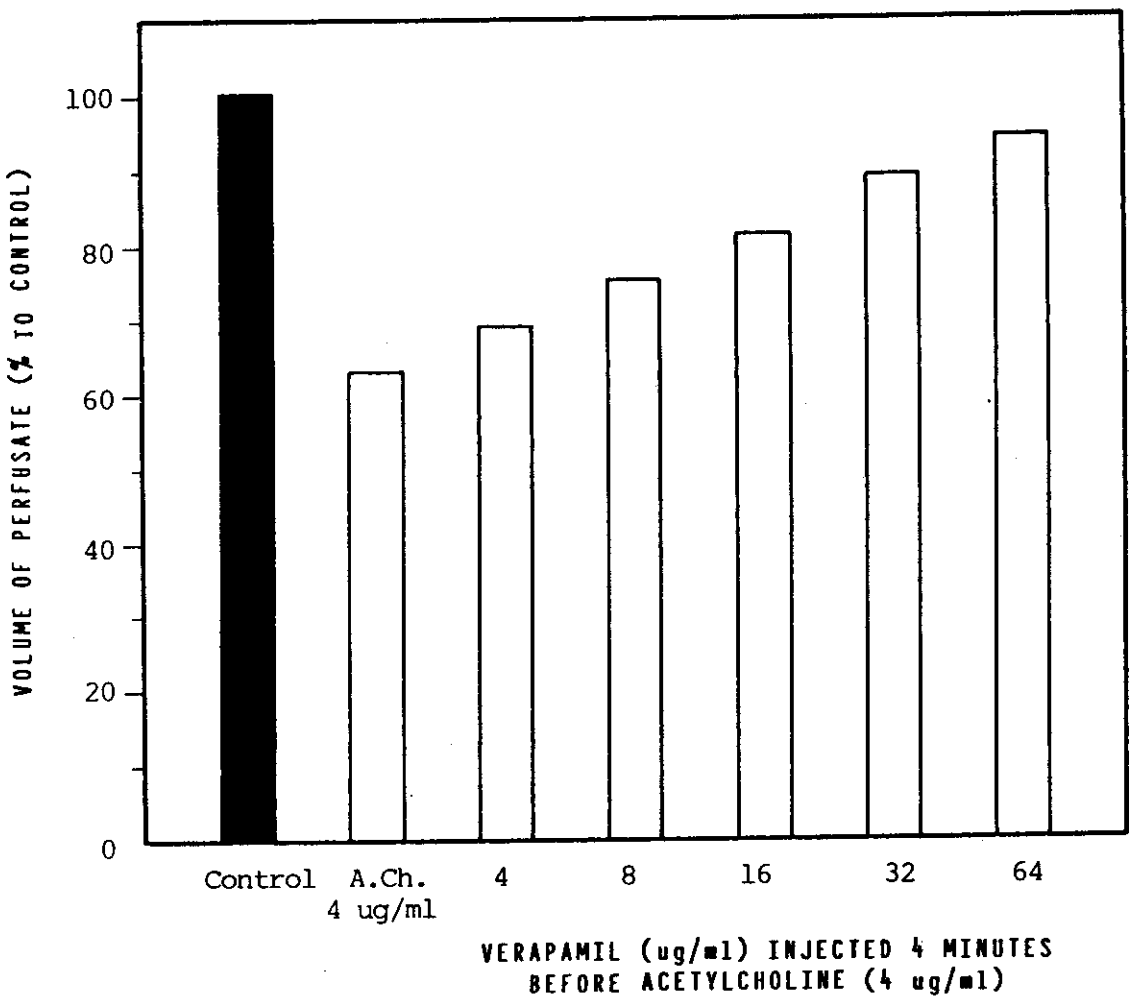


Fig. (17): Effect of different doses of verapamil on the volume of perfusate, of the isolated perfused guinea-pig lung preparation, when injected 4 minutes before acetylcholine (A.Ch.). The volume was measured 3 minutes after acetylcholine administration and is expressed as percentage of the control value.

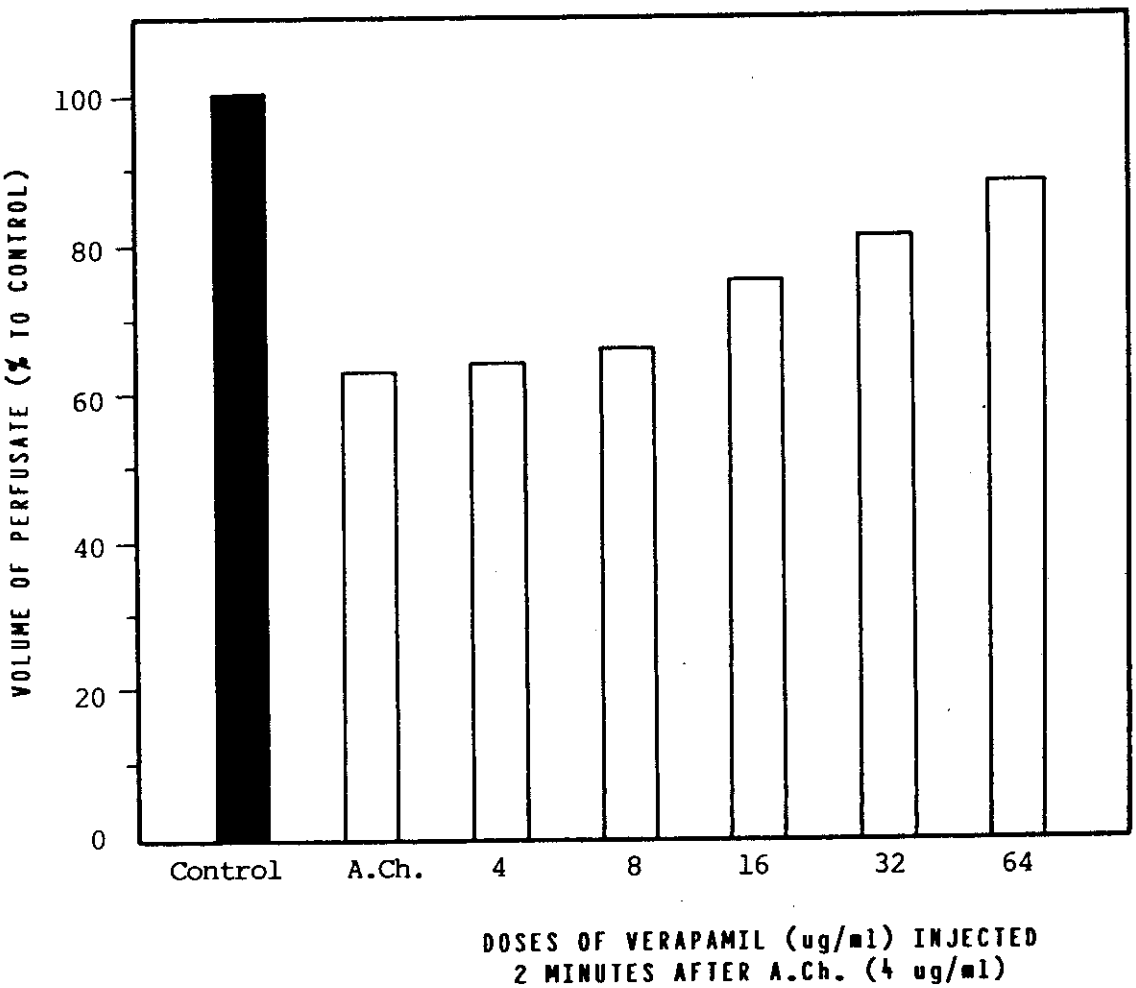


Fig. (18): Effect of verapamil on the volume of perfusate, of the isolated perfused guinea-pig lung preparation when injected 2 minutes after acetylcholine (A.Ch.). The volume was measured 4 minutes after verapamil administration, and is expressed as percentage of the control value.

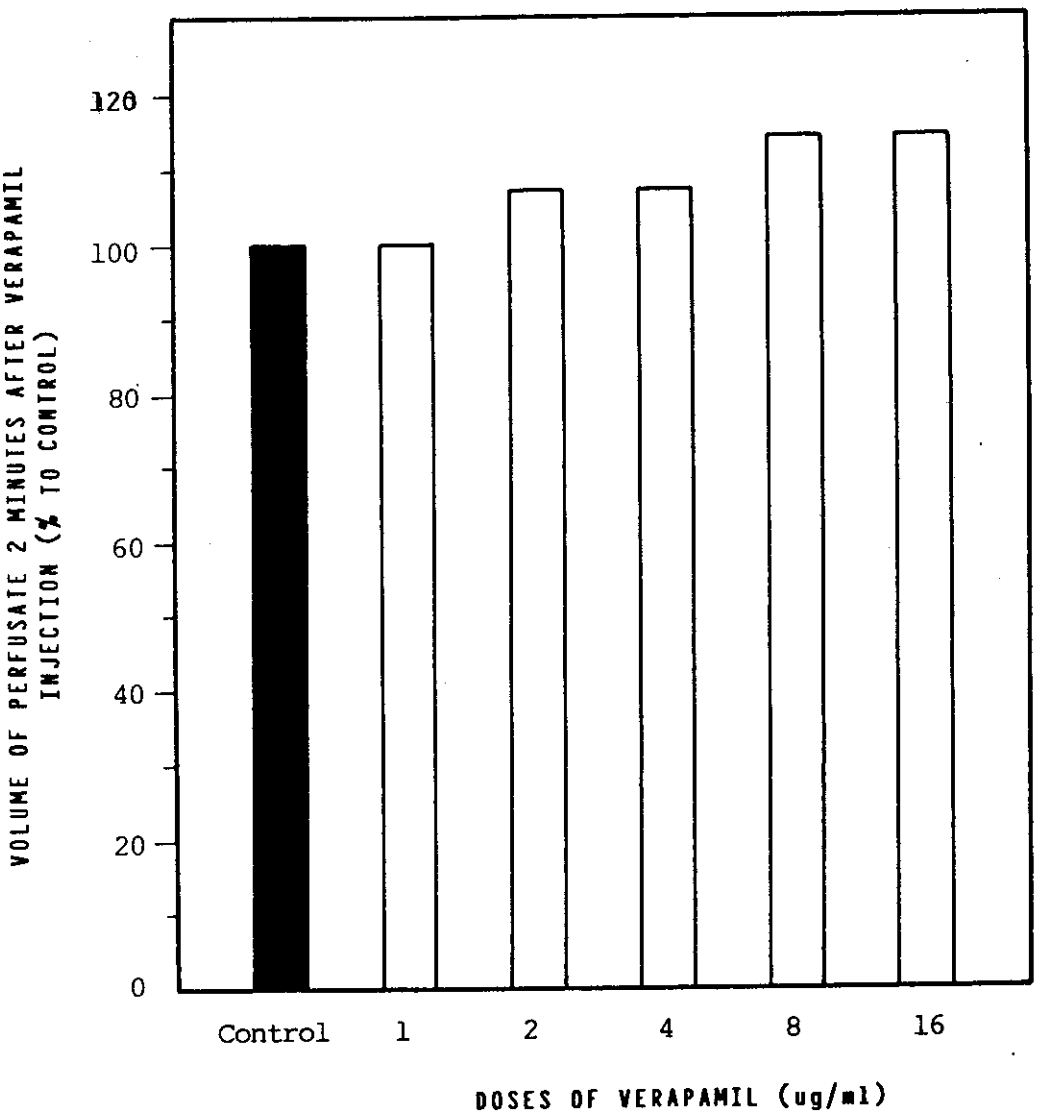


Fig. (19): Effect of different doses of verapamil (ug/ml) on the volume of perfusate, of the isolated perfused rat hind quarters preparation, 2 minutes after injection of the drug. The values are expressed as percentage of the control value.

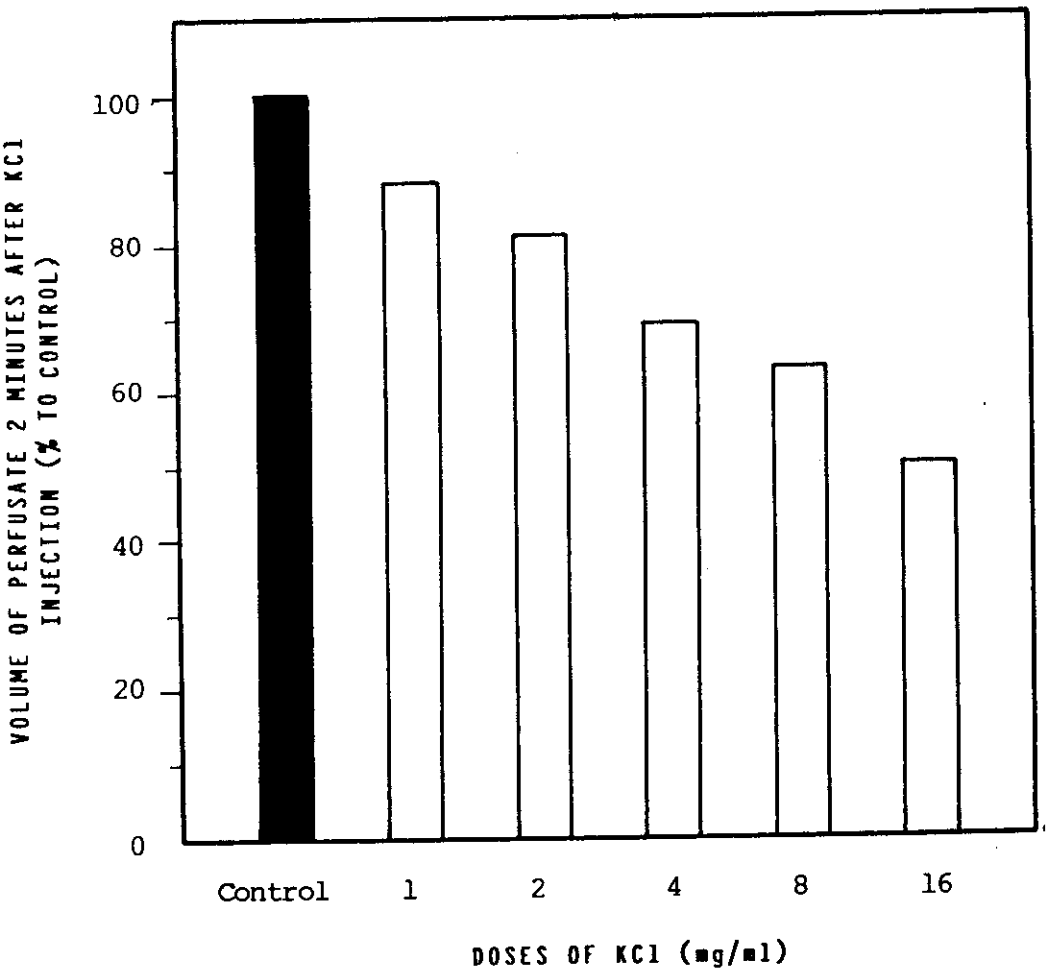


Fig. (20): Effect of different doses of KCl (mg/ml) on the volume of perfusate - of the isolated perfused rat hind quarters preparation - 2 minutes after injection of the drug. The values are expressed as percentage of the control value.

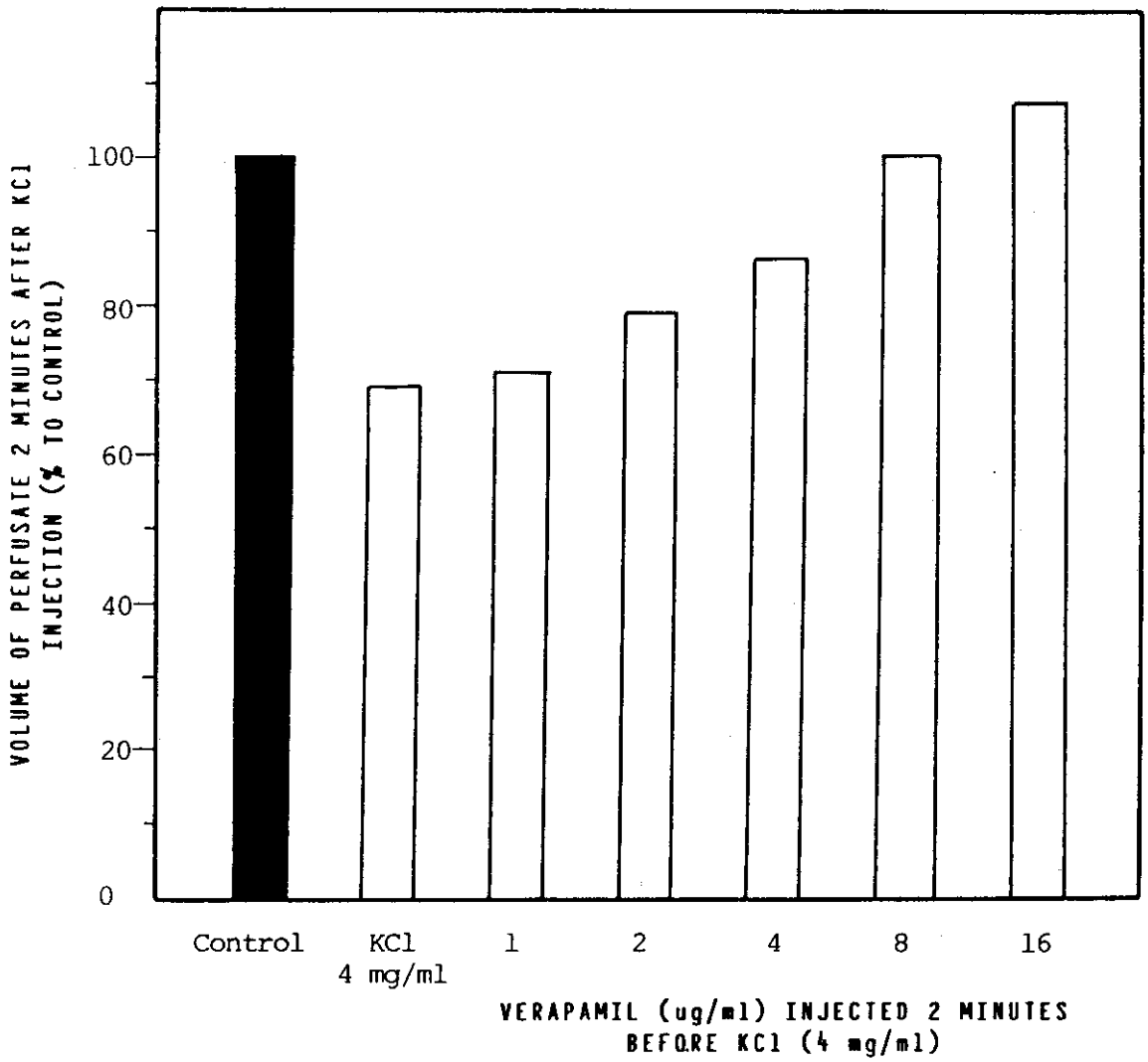


Fig. (21): Effect of different doses of verapamil on the volume of perfusate - of the isolated perfused rat hind quarters preparation - when injected 2 minutes before KCl. The volume was measured 2 minutes after KCl administration and is expressed as percentage of the control value.

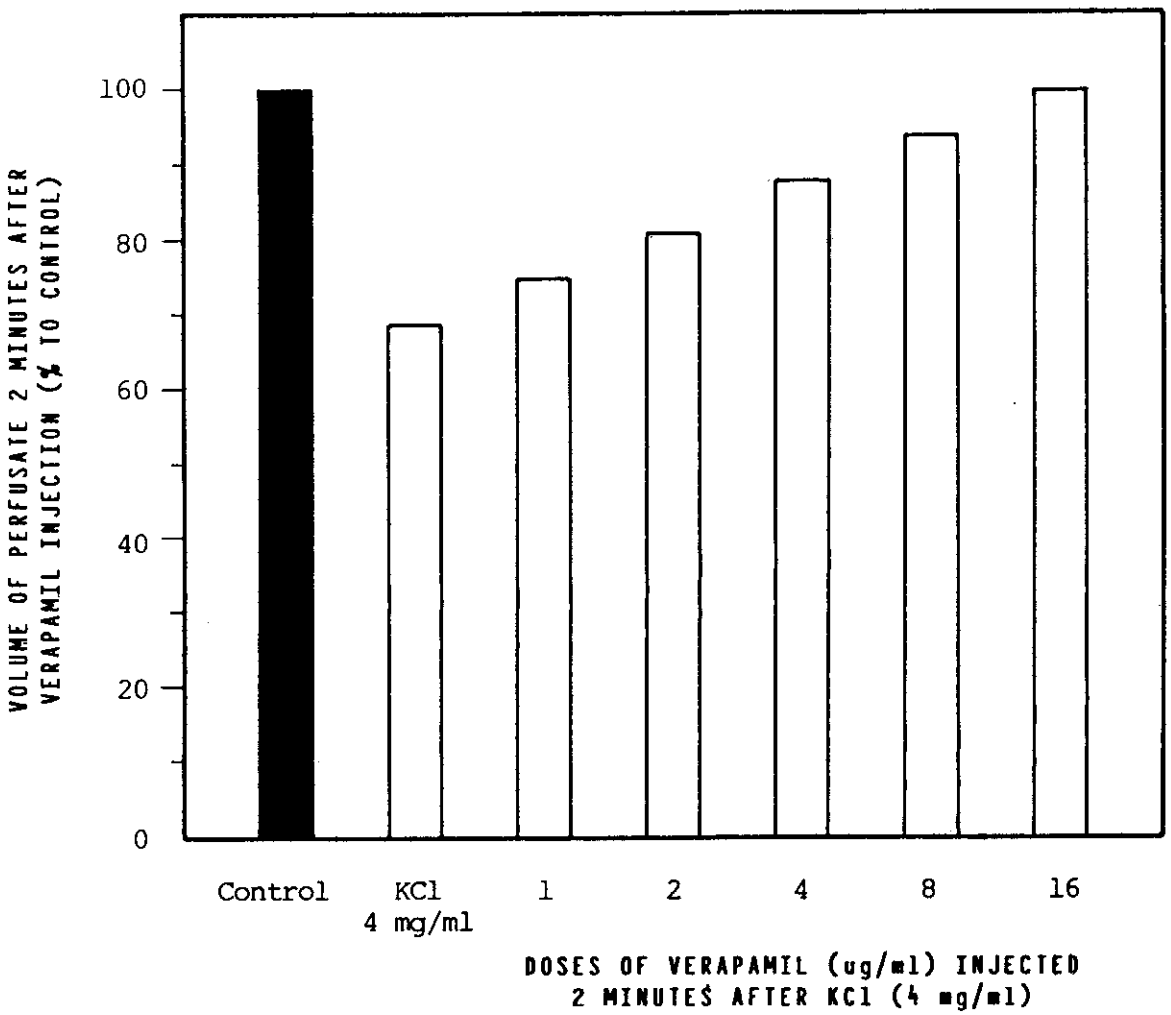


Fig. (22): Effect of verapamil on the volume of perfusate-of the isolated perfused rat hind quarters preparation - when injected 2 minutes after KCl. The volume was measured 2 minutes after verapamil administration and is expressed as percentage of the control value.

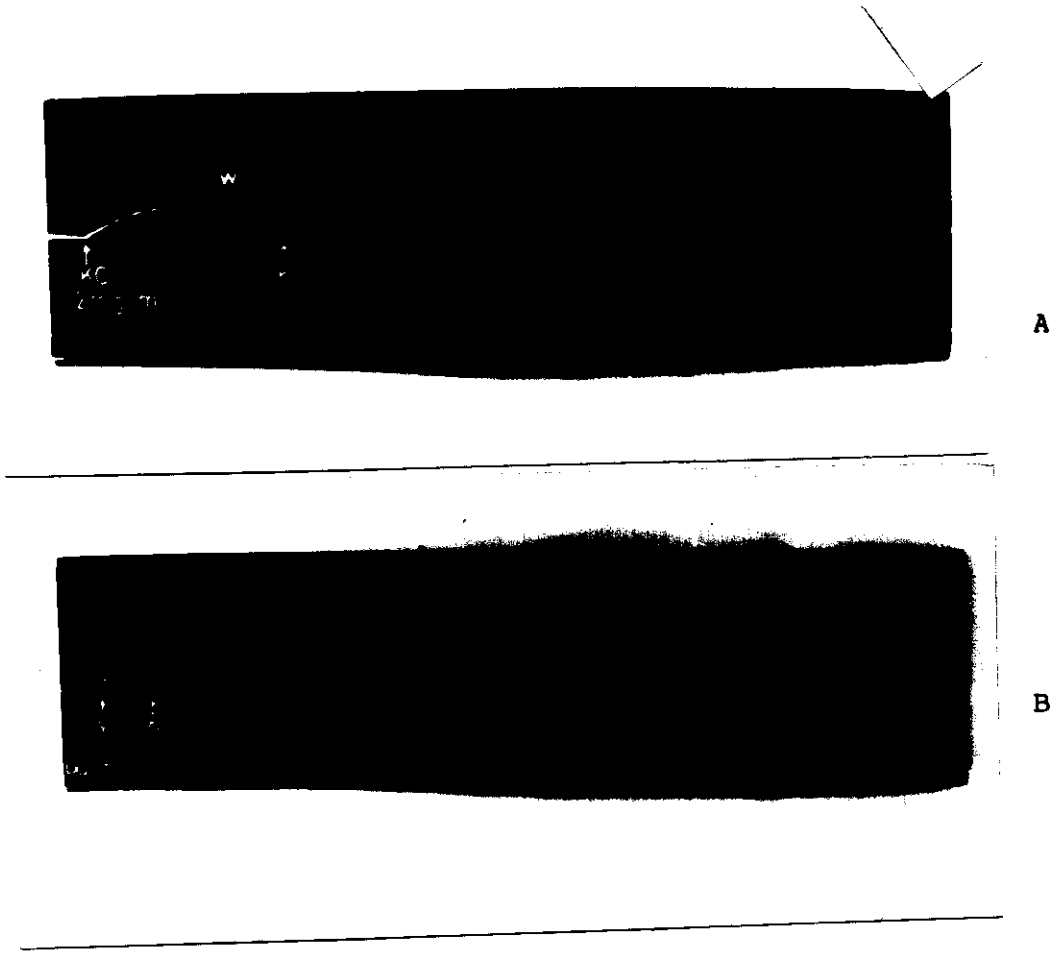


Fig. (23 A&B): Effect of incubation with different doses of verapamil (V) on KCl-induced contraction of the isolated rabbit aortic strip.
W = wash.
S = stop the kymograph for 10 minutes.
Doses are expressed as ug/ml of the bath solution.

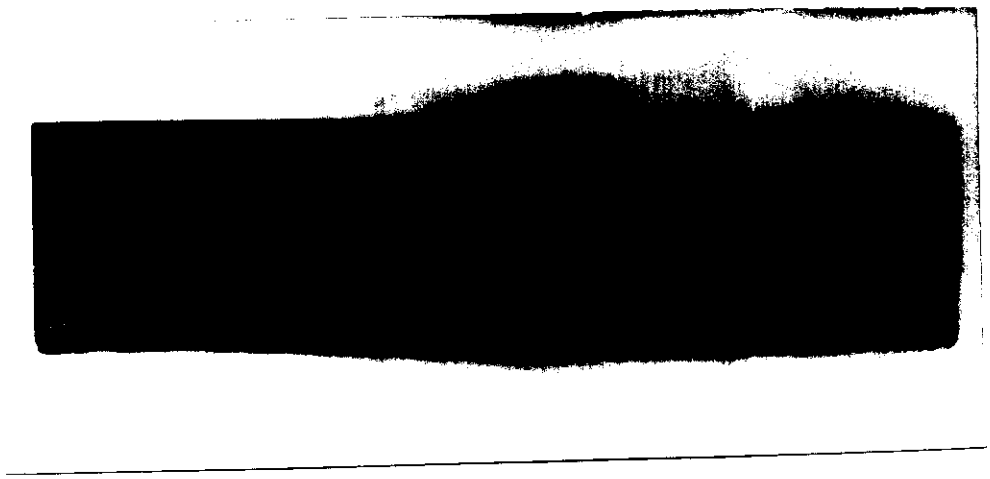

Fig. (24): Effect of different doses of verapamil(V) added on top of KCl-induced contraction of the isolated rabbit aortic strip.
W = wash.
Doses are expressed as ug/ml of the bath solution.