Introduction

Teicoplanin is a glycopeptide antibiotic, similar to vancomycin in terms of structure and activity. It is effective against Gram-positive organisms, including methicillin-resistant Staphylococcus aureus (MRS A). 1-4 Intravenous administration of vancomycin has been associated with 'red man syndrome'. 5-13 This adverse reaction is characterized by erythema, pruritus and, in severe cases, hypotension and cardiovascular complications. Reaction severity has been correlated with the elevation of histamine concentration in peripheral blood by some researchers. 12,13 However, other studies have reported that intravenous infusion of teicoplanin was not associated with such side effects. 14

Aerosolized antibiotics are effective against organisms causing persistent respiratory tract infections in patients with chronic pulmonary diseases. 15 Weathers et al. 16 reported that aerosolized vancomycin effectively eradicated MRS A colonization of the airways. However, aerosolized antibiotics can cause bronchospasm. 17,18 Therefore, Weathers et al. 16 gave vancomycin mist in combination with a nebulized β-agonistic bronchodilator (albuterol). It is therefore very important to evaluate experimentally the effects of teicoplanin and vancomycin on airway tissue at the time of inhalation therapy trials of these drugs.

In the present study, we evaluated whether teicoplanin and vancomycin induce pulmonary tissue contraction and histamine release in human, monkey and guinea pig specimens in vitro. The effects of these drugs on the release of histamine from monkey blood leucocytes and mouse bone marrow-derived mast cells (BMMC) were also studied. Neither teicoplanin nor vancomycin (10^-6–10^-3 g/mL) induced contractions of guinea pig trachea or lung parenchyma. Similarly, these drugs induced no appreciable change in the resting tonus of cynomolgus monkey bronchus or lung parenchyma. The tonus of monkey trachea was not influenced by teicoplanin, whereas 10^-3 g/mL vancomycin caused contraction. The spontaneous tonus of human lung parenchyma was not altered by teicoplanin or vancomycin, and that of the bronchus was not influenced by teicoplanin; however, 10^-3 g/mL vancomycin elicited obvious contraction of the bronchus. Neither drug promoted the release of significant amounts of histamine from these pulmonary tissues or from monkey blood leucocytes and BMMC. These results suggest that, compared with vancomycin, teicoplanin may be associated with a lower risk of inducing bronchospasm when used for inhalation therapy.

To assess the safety of teicoplanin and vancomycin with respect to airway tissue, we evaluated whether these two antibiotics induce pulmonary tissue contraction and histamine release in human, monkey and guinea pig specimens in vitro. The effects of these drugs on the release of histamine from monkey blood leucocytes and mouse bone marrow-derived mast cells (BMMC) were also studied. Neither teicoplanin nor vancomycin (10^-6–10^-3 g/mL) induced contractions of guinea pig trachea or lung parenchyma. Similarly, these drugs induced no appreciable change in the resting tonus of cynomolgus monkey bronchus or lung parenchyma. The tonus of monkey trachea was not influenced by teicoplanin, whereas 10^-3 g/mL vancomycin caused contraction. The spontaneous tonus of human lung parenchyma was not altered by teicoplanin or vancomycin, and that of the bronchus was not influenced by teicoplanin; however, 10^-3 g/mL vancomycin elicited obvious contraction of the bronchus. Neither drug promoted the release of significant amounts of histamine from these pulmonary tissues or from monkey blood leucocytes and BMMC. These results suggest that, compared with vancomycin, teicoplanin may be associated with a lower risk of inducing bronchospasm when used for inhalation therapy.

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In the present study, we evaluated whether teicoplanin and vancomycin induce pulmonary tissue contraction and histamine release in pulmonary tissue specimens obtained from several species including humans, and compared these responses with anaphylactic reactions. We also studied the ability of these antibiotics to promote histamine release from monkey blood leucocytes and mouse bone marrow-derived mast cells (BMMC).
Materials and methods

Drugs

Teicoplanin (Hoechst Marion Roussel, Frankfurt, Germany) and vancomycin hydrochloride (Sigma Chemical Co., St Louis, MO, USA) were used. Teicoplanin was dissolved in and diluted with distilled water. Vancomycin was suspended in distilled water at $1.6 \times 10^{-1} \, \text{g/mL}$ and dissolved by adding $1 \, \text{N NaOH}$ to the suspension, followed by dilution with distilled water to the required concentration. These preparations were prepared just before use, under shielding from light.

Animals

Male Hartley guinea pigs weighing 800–950 g, 8-week-old male BALB/c mice weighing 22–27 g, and male and female cynomolgus monkeys (Macaca irus) weighing 2.8–4.4 kg (Japan SLC, Hamamatsu, Japan) were used. The animals were used after being held in stock for 3–6 weeks in an air-conditioned room at a temperature of 22 $\pm 1.5^\circ\text{C}$ and a relative humidity of 55 $\pm 15\%$. Artificial illumination was provided from 8.00 a.m. to 8.00 p.m. The animals were fed a standard laboratory diet and given water ad libitum.

The study protocol was approved by the Experimental Animal Research Committee of Kyoto Pharmaceutical University.

Human lung

Macroscopically normal portions of human lungs, which were obtained from patients undergoing resection for carcinoma, were used in experiments as soon as possible. Informed consent was obtained from all patients.

Antigens

Benzylpenicilloyl bovine $\gamma$-globulin (BPO-BGG) was prepared according to the method of Levine & Redmond. Mite extracts (from Dermatofagoides farinae) were kindly donated by Dr H. Nagai of Gifu Pharmaceutical University (Gifu, Japan). Dinitrophenylated Ascaris suum extracts (DNP-As) were prepared according to the method of Tada & Okumura.

Antisera

Anti-BPO-BGG guinea pig serum was obtained by immunizing 5-week-old female guinea pigs (Japan SLC, Hamamatsu, Japan) with BPO-BGG containing Al(OH)$_3$ as an adjuvant according to the method of Levine et al. (7 day passive cutaneous anaphylaxis (PCA) titre: 1:2500). For antisera against mite extracts, mite-sensitive human atopic serum with a radioallergosorbent test value of $>30\%$ was used. A nti-DNP-A s rat serum was prepared by immunizing 8-week-old male Brown Norway rats (Seac Yoshitomi, Fukuoka, Japan) with DNP-A s containing Bordetella pertussis adjuvant (Kaken Pharmaceutical Co., Tokyo, Japan) according to the method of Tada & Okumura ($48 \, \text{h PCA titre: 1.3500}$).

Preparation of isolated pulmonary tissues

Guinea pigs. Guinea pigs were passively sensitized by iv injection of anti-BPO-BGG guinea pig serum (1 mL/animal). Two days later, the animals were killed by exsanguination under ketamine hydrochloride (Sigma Chemical Co., 13 mg/kg, ip) and pentobarbital (10–20 mg/kg, ip) anaesthesia. The lung and trachea were removed, and tissue strips were prepared as described previously. In brief, the procedures were as follows. The isolated trachea was split longitudinally through the ventral cartilage; segments (two cartilage rings in width) were cut, and ligatures were tied to the cartilage end. The isolated tracheal preparation consisted of three segments. Lung parenchymal strips consisted of a piece of the lung surface cut into a cylindrical strip.

Monkey. Animals were killed by exsanguination from the cervical artery under ketamine hydrochloride (Sigma Chemical Co., 13 mg/kg, ip) and pentobarbital (10–20 mg/kg, ip) anaesthesia. The lung was then perfused via a pulmonary artery with Ca$^{2+}$-free Tyrode's solution (50 mL/animal). The lung and trachea were removed, and strips of trachea, bronchus, and lung parenchyma were prepared as follows. The isolated trachea was split longitudinally through the ventral cartilage; segments (one cartilage ring in width) were cut, and the isolated tracheal preparation consisted of one segment. Bronchial strips, 1.5 mm in width and 2 cm in length, were prepared by cutting the primary bronchus spirally. Ater removing the pleura, cylindrical lung strips, 3 mm in diameter and 2 cm in length, were prepared from the peripheral lung. These preparations were passively sensitized with a ten-fold dilution of human atopic serum (1 mL/preparation for trachea and bronchi, and 2 mL/preparation for lung parenchyma) for 1.5 h at 37$^\circ$C. After completion of sensitization, the preparation was washed with Ca$^{2+}$-free Tyrode's solution before suspension in a Magnus bath.

Humans. Bronchial and lung parenchymal strips were prepared as described elsewhere. Bronchial spiral strips, 1.5 mm in width and 2 cm in length, were prepared. Lung cylindrical strips were prepared as described for the monkey. These preparations were passively sensitized with human atopic serum as described above.
Measurement of movement of isolated pulmonary tissue preparation

The isolated airway tissue preparations were suspended in a 5 mL Magnus bath. The temperature was 37 ± 0.1°C and the loading weight 300 mg. Movement of the smooth muscle was recorded isotonically using a TD-112S isotonic transducer and RGJ 4124 recorder (Nihon Kohden, Tokyo, Japan) through amplification (AA-601H amplifier and EG-650H isotonics coupler; Nihon Kohden). Before beginning the experiments, 5 × 10^-6 M acetylcholine chloride (Ovisot; Daiichi Pharmaceutical Co., Tokyo, Japan) was repeatedly applied to the isolated preparations until almost equal contractions were observed, indicating that the sensitivity had stabilized. In preparations from guinea pigs and humans, 10^-5 M histamine dihydrochloride (Wako Pure Chemical Industries, Osaka, Japan) was then also applied, and the induced contraction was recorded.

Effects of teicoplanin and vancomycin on the resting tonus of the trachea, the bronchus, or lung parenchyma were assessed as follows: Teicoplanin or vancomycin, both at 10^-6-10^-3 g/mL, was applied cumulatively at 10 min intervals. After drug application, preparations were washed with Tyrode’s solution and the induced contraction was recorded. The reaction solutions in the bath were collected just before and after the cumulative application of teicoplanin or vancomycin and antigen application. The collected medium was then centrifuged (4°C, 15,000 g, 2 min) and the resulting supernatant was stored at -20°C until measurement of histamine concentration.

Preparation of lung fragments

Guinea pig. Conditions for passive sensitization of the guinea pig and preparation of lung fragments are described elsewhere. In brief, the isolated lung, obtained from guinea pigs passively sensitized as described above, was cut into pieces measuring 0.25 mm. After washing the lung fragments with Ca^2+ free Tyrode’s solution, Tyrode’s solution (1 mL/100 mg wet tissue) was added to the fragments.

Monkey. As reported previously, the isolated lung was cut into pieces measuring 0.7 × 0.7 × 1–2 mm and washed with Ca^2+ free Tyrode’s solution. The fragments were passively sensitized by incubation with five-fold diluted human atopic serum for 1.5 h at 37°C. After antigen challenge, KCl was applied (10^-2 g/mL) to determine maximum contractions. Reaction solutions in the bath were collected just before and after the cumulative application of teicoplanin or vancomycin and antigen application. The collected medium was then centrifuged (4°C, 15,000 g, 2 min) and the resulting supernatant was stored at -20°C until measurement of histamine concentration.

Histamine release from lung fragments or cells

The suspension of lung fragments or cells was preincubated at 37°C for 10 min, then 10^-6-10^-3 g/mL of teicoplanin or vancomycin, or the appropriate antigen (final concentration 10^-5 g/mL, except for BMMC (10^-7 g/mL)) was added to the suspension followed by 30 min incubation at 37°C. The reaction was terminated by filtration of the fragments on gauze or by cooling the cell suspension. The reacted solution was centrifuged (4°C, 1700 g, 10 min), and the resulting supernatant was stored at -20°C until assay of histamine.

Histamine assay

Histamine in the supernatant was assayed fluorimetrically by HPLC over a cation exchange column (TSK gel SP-25W, 4.6 × 50 mm, Tosoh, Tokyo, Japan) as described by Itoh et al., who modified the method of Yamatodani et al. To estimate the histamine contents of tissues or cells...
that had not been treated with drug or antigen, specimens were placed in a boiling water bath for 10 min after addition of perchloric acid at the final concentration of 3%. After centrifugation at 15,000 g for 2 min at 4°C, histamine in the supernatant was measured as described above.

Statistical analyses
Statistical analysis was performed by one-way analysis of variance. If a significant difference was detected, the individual group difference was determined by Bonferroni’s multiple test. A P value of <0.05 was considered to indicate statistical significance.

Results
Contractions of isolated trachea, bronchus and lung parenchyma, and histamine release from these tissues
Guinea pig trachea and lung parenchyma. As shown in Figure 1 and Table I, neither teicoplanin nor vancomycin induced contraction of, or histamine release from, guinea pig trachea or lung parenchyma. In contrast, antigen provoked both contraction of, and histamine release from, both preparations.

Table I. Amounts of histamine released from isolated guinea pig tracheal and lung parenchymal strips before and after treatment with teicoplanin, vancomycin or antigen (benzylpenicilloyl bovine y-globulin) in a Magnus bath

<table>
<thead>
<tr>
<th></th>
<th>Concentration (g/mL)</th>
<th>before addition</th>
<th>after addition</th>
<th>before addition</th>
<th>after addition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>trachea</td>
<td>lung parenchyma</td>
<td>trachea</td>
<td>lung parenchyma</td>
</tr>
<tr>
<td>Teicoplanin</td>
<td>10^{-3}</td>
<td>62 ± 10 (20.0)</td>
<td>65 ± 16 (20.9)</td>
<td>104 ± 23 (6.3)</td>
<td>131 ± 20 (7.2)</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>10^{-3}</td>
<td>59 ± 15 (19.9)</td>
<td>71 ± 9 (22.8)</td>
<td>84 ± 9 (4.6)</td>
<td>90 ± 11 (4.5)</td>
</tr>
<tr>
<td>Antigen</td>
<td>10^{-5}</td>
<td>35 ± 15 (11.3)</td>
<td>128 ± 37 (44.4)^b</td>
<td>54 ± 21 (3.0)</td>
<td>913 ± 244 (40.6)^c</td>
</tr>
</tbody>
</table>

Histamine contents in tracheal and lung parenchymal strips were 322 ± 44 and 2897 ± 1149 ng/g wet tissue, respectively.

Statistically significant difference from the value before drug addition at P < 0.05 and 0.01, respectively.

Figure 1. Influence of teicoplanin (○), vancomycin (■) and antigen (▲) on resting tonus of passively sensitized isolated guinea pig tracheal (a) and lung parenchymal (b) strips. Each point represents the mean ± s.e. of six experiments.
Effect of teicoplanin on pulmonary tissues

Bronchus was unaltered by teicoplanin, whereas $10^{-3}$ g/mL vancomycin elicited obvious contraction of the bronchus. Bronchial tension after addition of $10^{-3}$ g/mL vancomycin was significantly higher than that after addition of $10^{-3}$ g/mL teicoplanin. Such contractions were seen in specimens obtained from four of ten humans. Figure 4 shows an example of the pattern of contraction induced by vancomycin. Of the four preparations, the one shown here is the one that responded most strongly: the bronchus started to contract approximately 1 min after addition of $10^{-3}$ g/mL vancomycin, and the reaction plateaued 10 min after addition. The contraction height at the plateau level was virtually equivalent to the height after application of $10^{-5}$ M histamine or $10^{-5}$ g/mL mite antigen. Nevertheless, neither antibiotic significantly increased the amount of histamine released in the Magnus bath (Table III). In antigen-challenged preparations, both contractions and increased histamine release were observed (Figure 3 and Table III).

### Histamine release

**Lung fragments.** Lung fragments from guinea pigs, monkeys and humans spontaneously released about 1% of their total histamine content. Neither teicoplanin nor vancomycin promoted spontaneous histamine release, whereas anaphylactic stimulation significantly increased such release (Table IV).

**BMMC.** No concentration of teicoplanin and vancomycin tested increased spontaneous histamine release. However, anaphylactic release was noted (Table V).

**Monkey peripheral blood leucocytes.** Neither teicoplanin nor vancomycin increased spontaneous histamine release, which was equivalent to about 13% of the total content. In contrast, leucocytes challenged with the appropriate antigen released large amounts of histamine (Table V).

### Discussion

Although vancomycin induced considerable contraction of monkey trachea and human bronchus at $10^{-3}$ g/mL, which is equivalent to the concentration in airway tissues in patients receiving aerosolized vancomycin therapy, teicoplanin caused no contraction of any pulmonary tissue obtained from several species, including humans. These differences in activity between teicoplanin and vancomycin suggest that teicoplanin has a lower risk of inducing bronchospasm than vancomycin. Neither teicoplanin nor vancomycin had a significant effect on histamine release from these tissues. Histamine release from BMMC and monkey blood leucocytes was not affected by either antibiotic.

Sahai et al. reported that intravenous infusion of vancomycin to humans is associated with a high frequency of "red man syndrome", the severity of which is positively

### Table II. Amounts of histamine released from isolated monkey, tracheal, bronchial and lung parenchymal strips, before and after treatment with teicoplanin, vancomycin or antigen (mite extract) in the Magnus bath

<table>
<thead>
<tr>
<th>Histamine, ng/g wet tissue (% of total content)</th>
<th>Lung parenchyma</th>
<th>Bronchus</th>
<th>Trachea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration (g/mL) before addition</td>
<td>$10^{-2}$</td>
<td>119 ± 49 (4.2)</td>
<td>145 ± 30 (1.5)</td>
</tr>
<tr>
<td></td>
<td>$10^{-3}$</td>
<td>110 ± 23 (1.2)</td>
<td>327 ± 62 (3.1)</td>
</tr>
<tr>
<td></td>
<td>$10^{-5}$</td>
<td>82 ± 33 (1.8)</td>
<td>128 ± 33 (1.6)</td>
</tr>
</tbody>
</table>

Histamine contents in the isolated bronchial and lung parenchymal strips were 10.986 ± 980.14 ± 944 ± 233 μg/g wet tissue, respectively.
Figure 2. Influence of teicoplanin (○), vancomycin (■) and antigen (▲) on resting tonus of passively sensitized isolated monkey tracheal (a), bronchial (b) and lung parenchymal (c) strips. Each point represents the mean ± s.e. of five or six experiments.

Figure 3. Influence of teicoplanin (○), vancomycin (■) and antigen (▲) on resting tonus of passively sensitized isolated human bronchial (a) and lung parenchymal (b) strips. Each point represents the mean ± s.e. of ten experiments. *: Significant difference at $P < 0.05$.

Table III. Amounts of histamine released from isolated human bronchial and lung parenchymal strips before and after treatment with teicoplanin, vancomycin or antigen (mite extract) in a Magnus bath

<table>
<thead>
<tr>
<th></th>
<th>Concentration (g/mL)</th>
<th>bronchus before addition</th>
<th>bronchus after addition</th>
<th>lung parenchyma before addition</th>
<th>lung parenchyma after addition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teicoplanin 10^-3</td>
<td>256 ± 37 (8.1)</td>
<td>321 ± 34 (10.6)</td>
<td>265 ± 57 (2.8)</td>
<td>396 ± 75 (4.1)</td>
<td></td>
</tr>
<tr>
<td>Vancomycin 10^-2</td>
<td>228 ± 31 (7.2)</td>
<td>322 ± 21 (10.8)</td>
<td>256 ± 53 (2.9)</td>
<td>562 ± 227 (6.7)</td>
<td></td>
</tr>
<tr>
<td>Antigen 10^-5</td>
<td>99 ± 26 (2.6)</td>
<td>665 ± 149 (22.6)b</td>
<td>203 ± 33 (2.5)</td>
<td>2243 ± 435 (25.6)b</td>
<td></td>
</tr>
</tbody>
</table>

Histamine contents in bronchial and lung parenchymal strips were 4023 ± 725 and 22,632 ± 11,957 ng/g wet tissue, respectively.

Each value represents the mean ± s.e. of ten experiments.

Statistically significant difference from the value before drug addition at $P < 0.01$. 

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Effect of teicoplanin on pulmonary tissues correlated with the increment in histamine concentration in peripheral blood. The occurrence of vancomycin-induced ‘red man syndrome’ has been reported to be inhibited by treating patients with an H\textsubscript{1}-receptor antagonist.\textsuperscript{30} O’Sullivan et al.,\textsuperscript{31} however, found no relation between this adverse effect and increased blood histamine concentrations, suggesting that other mediators might participate in the development of ‘red man syndrome’. Not only histamine\textsuperscript{32–34} but also cholinergic agonists,\textsuperscript{33,34} cysteinyll leukotrienes,\textsuperscript{34–36} thromboxane A\textsubscript{2},\textsuperscript{37,38} prostaglandin D\textsubscript{2},\textsuperscript{38} prostaglandin F\textsubscript{2\alpha},\textsuperscript{38} and endothelins\textsuperscript{39,40} cause marked contraction of human bronchi. Monkey trachea is known not to respond to histamine.\textsuperscript{41,42} These previous results and those of the present study suggest that the vancomycin-induced contractions of human bronchus and monkey trachea might be caused primarily by the release or production of mediators other than histamine. However, we cannot rule out the possibility that vancomycin directly

\section*{Table IV. Influence of teicoplanin and vancomycin on spontaneous histamine release from lung fragments of guinea pig, monkey and human}

<table>
<thead>
<tr>
<th>Concentration (–log, g/mL)</th>
<th>Histamine release (% of total content)\textsuperscript{a}</th>
<th>guinea pig</th>
<th>monkey</th>
<th>human</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spontaneous</td>
<td></td>
<td>1.0 ± 0.20</td>
<td>0.6 ± 0.15</td>
<td>1.2 ± 0.11</td>
</tr>
<tr>
<td>Teicoplanin 5</td>
<td></td>
<td>1.2 ± 0.13</td>
<td>0.5 ± 0.15</td>
<td>1.1 ± 0.17</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1.3 ± 0.27</td>
<td>0.5 ± 0.15</td>
<td>1.1 ± 0.14</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1.3 ± 0.17</td>
<td>0.6 ± 0.20</td>
<td>1.2 ± 0.13</td>
</tr>
<tr>
<td>Vancomycin 5</td>
<td></td>
<td>1.1 ± 0.18</td>
<td>0.5 ± 0.15</td>
<td>1.1 ± 0.11</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1.3 ± 0.16</td>
<td>0.5 ± 0.16</td>
<td>1.2 ± 0.14</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1.3 ± 0.14</td>
<td>0.5 ± 0.18</td>
<td>1.2 ± 0.13</td>
</tr>
<tr>
<td>Antigen\textsuperscript{b}</td>
<td></td>
<td>20.9 ± 3.94\textsuperscript{c}</td>
<td>15.2 ± 5.47\textsuperscript{c}</td>
<td>12.9 ± 2.52\textsuperscript{c}</td>
</tr>
</tbody>
</table>

Histamine contents in lung fragments of guinea pig, monkey and human were 37.4 ± 4.9, 18.5 ± 5.9 and 51.4 ± 23.4 μg/g wet tissue, respectively.

\textsuperscript{a}Each value represents the mean ± s.e. of five (guinea pig), five or six (monkey) or ten experiments.

\textsuperscript{b}Antigen: benzylpenicilloyi bovine \(\gamma\)-globulin (guinea pig) or mite extract (monkey and human).

\textsuperscript{c}Statistically significant difference from the spontaneous release at \(P < 0.01\).
causes contraction of smooth muscle. Further studies are needed to elucidate the mechanism of vancomycin-induced contractions.

Polk et al. attempted to predict the severity of ‘red man syndrome’ after intravenous infusion of vancomycin on the basis of the cutaneous response to intradermally administered vancomycin in healthy adults, but noted no significant correlation between the vancomycin-induced flare and the severity of ‘red man syndrome’. Consistent with the results of that study, we found that vancomycin did not cause the contraction of monkey bronchus, monkey lung parenchyma or human lung parenchyma. In general, relatively central airway tissue is known to contract more in response to neurotransmitters, such as cholinergic agonists, than in response to chemical mediators, such as histamine and arachidonic acid metabolites; the opposite holds true for relatively peripheral airway tissue. These characteristics of airway tissues considered with the organ-specific action of vancomycin lead us to speculate that vancomycin may potently induce contractions of human trachea, although such tissue was not available for the present study.

Neither teicoplanin nor vancomycin induced histamine release from lung fragments of three species, or from BMMC or monkey peripheral blood leucocytes. Results of the lung fragment studies agree with those of the experiments using a Magnus bath. The lack of histamine release from BMMC and monkey leucocytes indicates that the sensitivity of these cells to vancomycin differs substantially from that of unidentified cells that are thought to release histamine after intravenous infusion of vancomycin.

In conclusion, our results suggest that, compared with vancomycin, teicoplanin may be associated with a lower risk of bronchoconstriction when used for inhalation therapy and a lower risk of ‘red man syndrome’ when used for infusion therapy.

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References


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