Chlamydia pneumoniae Infection of Human Aortic Endothelial Cells Induces the Expression of FCγ Receptor II (FcγRII)

Silvana Vielma,* Gabriel Virella,† Adam J. Gorod,∗ and Maria F. Lopes-Virella∗

*Department of Medicine, Division of Endocrinology-Metabolism-Nutrition, Medical University of South Carolina, and Ralph H. Johnson VA Medical Center, Charleston, South Carolina 29425; †Department of Microbiology and Immunology, Medical University of South Carolina, Charleston, South Carolina 29425

Chronic endothelial infection is believed to be one of the factors able to cause endothelial cell damage and trigger the onset of human atherosclerosis. Chlamydia pneumoniae infects endothelial cells and has received special attention because of both epidemiological and experimental evidence supporting its role as a risk factor for atherosclerosis. It is also possible that otherwise independent risk factors for atherosclerosis may have synergistic effects. Immune phenomena, such as the formation of circulating immune complexes (IC) containing modified LDL and corresponding antibodies, have been linked to the development of coronary artery disease. The antibodies involved in the immune response to modified lipoproteins are predominantly of the pro-inflammatory IgG1 and IgG3 subclasses. However, it is difficult to understand how circulating IC could cause endothelial damage and initiate the atherosclerotic process, unless they were formed in the subendothelial space or immobilized by endothelial cells. The last hypothesis would be possible if endothelial cells expressed FCγ receptors. Healthy endothelial cells do not express FCγ receptors, but endothelial cells infected by a variety of infectious agents do. Thus we decided to investigate whether infection of endothelial cells with C. pneumoniae is also able to cause the expression of FCγ receptors. The expression of FCγ receptors (CD64, 32, and 16) on human aortic endothelial cells infected with C. pneumoniae for 4, 24, 36, and 48 h was studied by flow cytometry. Twenty-four hours after infection 30–40% of the endothelial cells had detectable inclusion bodies, 8–9% of the total number of cells (approximately 25% of the infected cells) expressed FCγRII, and about 1.5–2% (5% of infected cells) expressed FCγRI and FCγRII. Double-staining studies confirmed that the expression of FCγRII was limited to C. pneumoniae-infected endothelial cells. We conclude that C. pneumoniae infection induces primarily the expression of FCγRII by endothelial cells and this may be a significant link between two proposed pathogenic mechanisms involved in the pathogenesis of human atherosclerosis.

Key Words: Chlamydia pneumoniae; FCγ receptors; atherosclerosis; endothelial dysfunction.

INTRODUCTION

Chlamydia pneumoniae, originally known as the TWAR strain of Chlamydia, was first isolated in 1965 by Grayston and Wang (1). This organism was later identified as the cause of a human epidemic in 1985 and was isolated from affected patients for the first time also by Grayston and co-workers at the University of Washington in 1986 (see Ref. 2). In 1999 it was defined as a separate species of Chlamydia and recently was segregated as a member of a closely related new genus, Chlamydia pneumoniae (3). C. pneumoniae is an obligate intracellular gram-negative pathogen, unique in its biphasic developmental cycle that alternates between elementary and reticulate body formation. The bacteria is responsible for upper respiratory illnesses, including pneumonia, bronchitis, pharyngitis, and sinusitis. In recent years it has also been associated with the development of atherosclerosis (4).

Soon after its initial isolation, Saikku and co-workers published their seminal reports pointing to a connection between titers of antibody for C. pneumoniae and cases of acute myocardial infarction and coronary artery disease (5, 6). In the next 12 years, serological and pathological studies, cell culture experiments, studies in animal models, and studies of the effects of tetracyclines and macrolides on the evolution or incidence of arteriosclerosis were conducted and have provided suggestive, but not absolutely confirmatory, evidence supporting the role of C. pneumoniae as a risk factor (7–10).

Several pathogenic mechanisms by which C. pneumoniae may cause the onset or progression of atherosclerosis have been postulated. Most of them are based on the ability of C. pneumoniae to infect endothelial cells, as well as macrophages and smooth muscle cells in the arterial intima (9, 11). The direct consequences of such infection may include cell damage caused by...
endotoxin, increased expression of cell-adhesion molecules that may then attract inflammatory cells to the local of infection, (11), pro-inflammatory effects of HSP-60 (12, 13), increased expression of tissue factor on infected endothelial cells (14), and increased uptake of LDL and foam cell transformation of infected macrophages (15, 16). Indirect effects may be related to the immune response to this organism, directed against bacterial components such as endotoxin (17) and heat shock protein 60 (HSP 60), with the definite potential of affecting C. pneumoniae-infected cells (18, 19). The immune response to C. pneumoniae may also contribute to the inflammatory process associated with atheroma development, either through the activation of Chlamydia-reactive T lymphocytes (20, 21), or through the activation of phagocytic cells as a consequence of the uptake of antigen-antibody complexes (22).

Another mechanism by which antigen-antibody complexes may contribute to atherosclerosis is by binding to the endothelium and thus mediating the anchoring and activation of pro-inflammatory cells. Although normal endothelial cells do not express Fc or CRI receptors (23), both of which can mediate the binding of immune complexes, these two receptors may be expressed when endothelial cells are damaged (23). Infectious agents such as cytomegalovirus and herpes virus induce endothelial damage and these were among the first infectious agents shown to induce the expression of Fc and CRI receptors (24, 25) in endothelial cells. In 1990, Bengaulid et al. found that human umbilical vein endothelial cells would express Fcγ receptors after infection with Staphylococcus aureus (26). More recently, in 1996, MacCormac and Grundy demonstrated the ability of human cytomegalovirus to induce a unique form of FcγR distinct from human cellular Fcγ receptors (27). The above observations appeared to provide a basis for the decision to investigate whether or not C. pneumoniae infection of human aortic endothelial cells induced the expression of Fcγ receptors.

If the expression of Fcγ receptors is elicited by C. pneumoniae infection, two possible mechanisms contributing to the development of atherosclerosis, C. pneumoniae infection by itself and increased levels of immune complexes (IC) containing modified LDL and corresponding antibodies (LDL-IC) (28–30), may become synergistic. Modified LDL-IC are predominantly composed of IgG1 and IgG3 antibodies, capable of fixing complement and of interacting with Fcγ receptors (31). The pathogenicity of circulating IC is believed to involve either egress to the subendothelial space or binding to cellular or tissue substrates that would enable stable interactions of these IC with pro-inflammatory cells (32). These two mechanisms can be interrelated, because the interaction of immobilized IC with inflammatory cells may result in the release of vasoactive amines that increase vascular permeability and facilitate their extravascular deposition (32).

MATERIALS AND METHODS

Cell Culture

Hep-2 cells (ATCC CCL23) were maintained in minimal essential medium (Sigma–Aldrich Co., St. Louis, MO) containing Earle’s salts (EMEM) and supplemented with 10% heat-inactivated fetal bovine serum (FBS Gibco BRL, Rockville, MD), 2 mM L-glutamine (Gibco BRL), 1% (vol/vol) nonessential amino acids, 10 mM Heps (Gibco BRL), 10 μg/ml of gentamicin (Gibco BRL), and 25 μg/ml of vancomycin (Sigma–Aldrich). Cells were maintained at 37°C and 5% CO2 in 75-cm² culture flasks and subcultured into either 25-cm² flasks or shell vials containing glass coverslips (22 mm in diameter) prior to infection with C. pneumoniae (33).

Human aortic endothelial cells (HAEC, Cascade Biologics, Inc., Portland, OR) were maintained in Medium 200 containing low-serum growth supplement (LSGS, Cascade Biologics) and penicillin–streptomycin–amphotericin B (Cascade Biologics). Cells were maintained at 37°C and 5% CO2 in gelatin-coated 75-cm² culture flasks. Prior to infection, cells were seeded onto gelatin-coated 100-mm plates or glass coverslips and allowed to become a confluent monolayer for 5–7 days.

C. pneumoniae Propagation

C. pneumoniae AR-39 was obtained from the American Type Culture Collection (ATCC 53592). This strain is the first respiratory isolate for C. pneumoniae and was obtained from a university student in Seattle with pharyngitis in 1983 (35). The sequence of the PCR-amplified rRNA gene product from strains isolated from coronary atheroma plaques was identical to that of AR-39 (36).

C. pneumoniae was propagated in Hep-2 cell monolayers by centrifuging the diluted stock at 759g for 60 min at 25°C. After centrifugation, 4.0 ml of EMEM growth medium containing 2 μg/ml of cycloheximide and 5 mg/ml of glucose was added to each flask and incubated from 48 to 72 h at 37°C in the presence of 5% CO2 (33, 37). After 72 h of incubation, the medium was replaced with fresh cycloheximide-free EMEM and C. pneumoniae was harvested by scraping Hep-2 cells into the original maintenance medium and disrupting the cells with glass beads followed by sonication and centrifugation at 250 g, 4°C to remove cellular debris. Supernatants containing C. pneumoniae were used for subsequent infection of Hep-2 cells and/or HAEC.
Infection of HAEC by C. pneumoniae

Confluent HAEC were seeded in 100-mm dishes (~1.6 x 10⁶ cells/dish) and before infection, the culture medium was removed, and the cells were washed twice with Hanks’ balanced salt solution (HBSS, Sigma) and resuspended in fresh Medium 200 lacking cycloheximide, antibiotics, and amphotericin B (34). C. pneumoniae suspensions were diluted in Medium 200 (Cascade Biologics) and inoculated onto HAEC prepared as described above (inoculum sizes from 4 x 10⁴ to 6 x 10⁴ IFU/ml). Inocula were spread over the cell layers on a rocker platform for 2 h at 37°C. Cells were incubated and processed at variable times, depending on the experiment. At the end of the incubation with C. pneumoniae, the culture medium was removed, the cells were washed with HBSS, and fresh Medium 200 lacking cycloheximide, antibiotics, and amphotericin B was added to the cultures.

Quantification of Infection

HAEC monolayers grown on coverslips were fixed for 10 min in absolute methanol, air-dried, and used to monitor the course of infection by immunofluorescence staining using a genus-specific fluorescein isothiocyanate (FITC)-labeled monoclonal antibody (Pathfinder Chlamydia Confirmation System; Bio-Rad, Redmond, WA). Titration in cycloheximide-treated Hep-2 cells and infected HAEC was performed by counting total numbers of inclusions in cells in 10 random fields at 400× magnification. The infectivity titers in terms of inclusion-forming units per milliliter were adjusted for dilution factor and inoculum size. Counts were expressed as inclusion-forming units per milliliter (34, 38).

Flow Cytometry

Endothelial cells were infected at 4, 24, 36, and 48 h with C. pneumoniae suspensions. At the end of the infection period the cells were washed twice with warm HBSS and then enzymatically detached with 5 ml of cell dissociation solution (Sigma–Aldrich). The cell suspension was collected into FACS tubes (Becton Dickinson, Franklin Lakes, NY), transferred onto ice, and washed with FACS solution (PBS, 2% human serum, 0.05% sodium azide). Cells were counted, and 2 x 10⁵ cells were incubated with 4 µl of 1:100 dilutions of FITC-labeled antibodies to CD16, CD32, and CD64 (BD Pharmingen, San Diego, CA) or isotype controls for 25 min on ice. After one wash with FACS solution, a second wash was performed with propidium iodine added (10%). Cells were resuspended in 300 µl of FACS solution and immediately processed using a FACSCaliber (Becton Dickinson) and analyzed with the CellQuest program (Becton Dickinson).

Flow cytometry analysis of two-color immunofluorescence staining for intracellular C. pneumoniae and cell surface FcγRII was carried out with HAEC (1 x 10⁶ cells per dish) exposed for 24 h to C. pneumoniae. At the end of infection period the cells were processed as described above. A total of 2 x 10⁵ cells were initially stained for FcγRII using an allophycocyanin-conjugated monoclonal anti-human CD32 (BD Pharmingen) or isotype controls for 30 min on ice. After one wash with FACS solution, cells were permeabilized with 100 µl of 75% ethanol (in sterile distilled water) for 15 min at 4°C, washed, sedimented by centrifugation, and re-suspended in 50 µl of fluorescein-conjugated monoclonal antibody against the lipopolysaccharide of elementary bodies and reticulate bodies of Chlamydia species (Pathfinder Chlamydia Culture Confirmation System, Bio-Rad) for 30 min at 4°C. After this second staining, cells were washed and resuspended in 300 µl of FACS solution and immediately processed and analyzed as described above.

Immunocytochemistry Analysis of Two-Color Staining for Intracellular C. pneumoniae and Cell Surface FcγRII

Immunocytochemistry studies were performed to document the expression of FcγRII on C. pneumoniae-infected cells. HAEC infected with C. pneumoniae for 24 h were washed with warm PBS and incubated with blocking buffer (1% BSA in PBS) for 15 min. Cells were stained for FcγRII using the same antibody used for flow cytometry (see above) for 30 min in the dark and then washed with blocking buffer. Immediately after being washed, the cells were fixed and permeabilized by incubation in methanol:acetone (1:1) solution for 10 min and then stained with the fluorescein-conjugated monoclonal antibody against Chlamydia LPS, also described above, for 30 min in the dark. After they were washed with distilled water, slides were dried and visualized in glycerol with an epifluorescence microscope (Nikon Eclipse TE300, Nikon Inc., Melville, NY) using an Endow GFP longpass emission filter (Nikon Inc.). Pictures were taken using a Spot RT color camera (Diagnostic Instruments, Inc., Sterling Heights, MI).

RESULTS

C. pneumoniae harvested from Hep-2 cells was diluted in Medium 200 in order to obtain a concentration of approximately 4-6 x 10⁴ IFU/ml. Higher inoculum sizes were found to produce cytotoxicity. Under the experimental conditions outlined after exposure of the HAEC monolayers to C. pneumoniae for 24 h, about
FIG. 1. Infection of HAEC by C. pneumoniae at an inoculum size of $2 \times 10^4$. C. pneumoniae suspensions were diluted in Medium 200 lacking cycloheximide, antibiotics, and amphotericin B and inoculated onto confluent HAEC grown on coverslips. Inocula were spread over the cell layers on a rocker platform for 2 h at 37°C. Cells were incubated for 24 h, fixed in absolute methanol, and IF stained using a genus-specific FITC-labeled monoclonal antibody (Pathfinder Chlamydia Confirmation System, Bio-Rad). (A) Uninfected HAEC (4× magnification). (B) C. pneumoniae-infected HAEC monolayer visualized at 2× magnification. (C) Perinuclear localization of inclusion bodies in C. pneumoniae-infected cells (10× magnification).

FIG. 4. Flow cytometry analysis of two-color immunofluorescence staining for intracellular C. pneumoniae and cell surface FcγRII. Infected HAEC (1 × 10^6 cells per dish) were stained for FcγRII using an allophycocyanin-conjugated monoclonal anti-human CD32 (BD Pharmingen) and with a fluorescein-conjugated monoclonal antibody against the lipopolysaccharide of elementary bodies and reticulate bodies of Chlamydia species (Pathfinder Chlamydia culture Confirmation system, Bio-Rad). Stained cells were processed and analyzed as described in the legend to Fig. 1. (A) The microscopic examination of cells stained for Chlamydia LPS (green arrows). (B) The microscopic aspect of cells stained for surface CD32 (orange arrows). (C) A double-stained cell.
30–40% of the cells were infected (Fig. 1). When HAEC were analyzed after 36 and 48 h of infection, the percentage of infected HAEC on coverslips (22 mm in diameter) rose to 70–80%.

The expression of Fcγ receptors was first analyzed by flow cytometry. C. pneumoniae-infected HAEC were harvested at different times, and the expression of the three types of Fcγ receptors was investigated. In parallel, THP-1 cells (resting) and neutrophils (freshly isolated from a volunteer) were also tested for expression of Fcγ receptors, as positive controls (Table 1).

Of the three types of Fcγ receptors, FcγRII was found to be clearly upregulated in infected HAEC (Fig. 2). FcγRI and FcγRIII were minimally expressed—about 5% of infected HEAC stained positively for CD16 and CD64 after a 24-h exposure to C. pneumoniae (Table 1). The peak expression of FcγRII was observed 24 h after infection (Fig. 3). At that time, the percentage of HAEC

<table>
<thead>
<tr>
<th>Cell type</th>
<th>Time after infection</th>
<th>% of gated cells expressing FcγRI</th>
<th>% of gated cells expressing FcγRII</th>
<th>% of gated cells expressing FcγRIII</th>
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<tbody>
<tr>
<td>HAEC</td>
<td>4 h</td>
<td>0.35</td>
<td>0.52</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>24 h</td>
<td>0.23</td>
<td>1.71</td>
<td>0.30</td>
</tr>
<tr>
<td></td>
<td>36 h</td>
<td>n.d.*</td>
<td>1.23</td>
<td>4.63</td>
</tr>
<tr>
<td></td>
<td>48 h</td>
<td>n.d.</td>
<td>0.35</td>
<td>1.73</td>
</tr>
<tr>
<td>THP-1</td>
<td>4 h</td>
<td>91.6</td>
<td>n.d.</td>
<td>n.d.</td>
</tr>
<tr>
<td></td>
<td>24 h</td>
<td>77.8</td>
<td>n.d.</td>
<td>n.d.</td>
</tr>
<tr>
<td></td>
<td>36 h</td>
<td>90.5</td>
<td>n.d.</td>
<td>n.d.</td>
</tr>
<tr>
<td>Neutrophils</td>
<td>4 h</td>
<td>n.d.</td>
<td>67.3</td>
<td>n.d.</td>
</tr>
<tr>
<td></td>
<td>24 h</td>
<td>n.d.</td>
<td>53.9</td>
<td>n.d.</td>
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* n.d., not done.

**FIG. 2.** Flow cytometry analysis of the expression of Fcγ receptors in HAEC 24 h after infection with C. pneumoniae. Confluent HAEC (1.5 × 10⁶) were infected (B) or not (A) with approximately 4–6 × 10⁴ IFU/ml and incubated on a rocker platform at 37°C for 2 h. After 2 h the inoculum was removed, the cells were washed with HBSS, and the medium was replaced with Medium 200 lacking cycloheximide, antibiotics, and amphotericin B. Infected and uninfected cells were incubated for 24 h at 37°C, 5% CO₂. At the end of infection period the cells were washed with HBSS and enzymatically detached and 2 × 10⁶ cells were incubated with 4 µl of CD16, CD64, CD32 (1:100 dilution), or isotype controls for 25 min on ice (see Materials and Methods). Cells were processed the same day using a FACSCalibur (Becton Dickinson) and analyzed with the CellQuest program (Becton Dickinson).
cells positive for CD32 was about 8.9% of the total number of cells (approximately 25% of the infected cells). The same antiserum used to screen FcγR in HAEC yielded the expected results in THP-1 cells and neutrophils. Seventy-five to 91% of THP-1 cells expressed FcγRI; 69 to 93% of the same cells expressed FcγRII. FcγRII was detected in 54 to 67% of neutrophils and FcγRIII was expressed by 33 to 86% of neutrophils. All isotype controls were below 1.5%.

To determine whether the expression of FcγRII was limited to C. pneumoniae-infected cells we performed double-staining studies, both microscopically and by flow cytometry. As shown in Fig. 4, we were able to demonstrate CD32 staining in C. pneumoniae-positive cells, with the stain often concentrated in a small area of the cell surface. By flow cytometry (Table 2), 9% of the cells showed double-staining for C. pneumoniae and CD32, confirming that the expression of FcγRII was limited to C. pneumoniae-infected cells.

**DISCUSSION**

Three classes of human Fcγ receptors have been extensively characterized and shown to have both common and unique characteristics (39–42). FcγRI (CD64) is constitutively expressed on monocytes, macrophages, and dendritic cells and can be induced by IFN-γ on neutrophils, eosinophils, and glomerular mesangial cells (39). CD64 binds with high affinity to both monomeric and aggregated IgG1 and IgG3 immunoglobulins. This unique property of FcγRI is determined by a third extracellular domain not found in class II or III receptors (39). FcγRII is the most widely expressed Fcγ receptor. It can be detected on almost all leukocytes, including neutrophils, monocytes, and macrophages, as well as on platelets, Langerhans cells, B cells, and some T cell subpopulations (39). Endothelial cells from dermal microvasculature and activated umbilical vein endothelial cells have also been shown to express FcγRII through their reactivity with CD32 (43, 44). Because of their lower affinity for monomeric IgG, FcγRII predominantly binds immune complexes containing IgG1 and IgG3 antibodies (41). The human FcγRII receptor family has been shown to be polymorphic, with at least six known isotypes (a1, a2, b1, b2, b3, and c) (40). The expression of FcγRIIa on neutrophils and macrophages initiates phagocytosis, antibody-dependent cellular cytotoxicity (ADCC), and cellular activation, whereas FcγRIIb expressed on B cells and mast cells delivers a negative signal modulating the responses to specific ligands initiated by occupancy of surface immunoglobulin of FcγRI (39, 42). Human FcγRIII (CD16) receptors have an intermediate affinity for monomeric IgG and, like all other Fc receptors, tend to bind predominantly IC containing IgG1 and IgG3 while those IC containing IgG4 and/or IgG2 are only weakly bound.

**TABLE 2**

<table>
<thead>
<tr>
<th>% of gated cells expressing FcγRII&lt;sup&gt;a&lt;/sup&gt;</th>
<th>% of gated cells staining for Chlamydia LPS&lt;sup&gt;b&lt;/sup&gt;</th>
<th>% double-staining gated cells</th>
</tr>
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<tbody>
<tr>
<td>Infected (24 h)</td>
<td>14&lt;sup&gt;c&lt;/sup&gt;</td>
<td>35%</td>
</tr>
<tr>
<td>Uninfected controls</td>
<td>0.6%</td>
<td>1%</td>
</tr>
</tbody>
</table>

<sup>a</sup> Stained for FcγRII using allophycocyanin-conjugated monodonal anti-human CD32 (BD Pharmingen)

<sup>b</sup> Stained with fluorescein-conjugated monoclonal antibody against the lipopolysaccharide of elementary bodies and reticulate bodies of Chlamydia species (Pathfinder Chlamydia Culture Confirmation System, Bio-Rad).

<sup>c</sup> Isotype control readings were subtracted from all values; values correspond to the mean of two experiments.
minimally bound. FcγRIII is constitutively expressed on macrophages, NK cells, and γδ T cells and can be induced by IFN-γ on monocytes and glomerular mesangial cells (39).

Several bacteria and viruses are able to induce Fcγ receptors as part of their pathological effect on different cell types. Infection with cytomegalovirus and herpes virus induces the expression of receptors for the Fc portion of IgG (24, 25). These Fcγ receptors may protect the infected cells from antibody-mediated destruction by binding the Fc portion of non-virus-specific antibody, thereby interfering with the attachment of specific antiviral IgG to the cell surface. However, expression of FcγR might also result in the binding of immune complexes to the infected cell surface, a phenomenon that could contribute to tissue injury or to the initial lesion involved in the development of atherosclerotic plaques (27).

The present study investigated whether HAEC infected with C. pneumoniae expressed Fcγ receptors (I, II, or III). Using commercially available antibodies to the three types of Fcγ receptors and flow cytometry we have shown that C. pneumoniae was able to induce the expression of CD32 (FcγRII) in about 8.9% of the total number of cells. By double-staining studies, we were able to confirm that the expression of CD32 was limited to C. pneumoniae-infected cells. Thus, it appears that approximately 25% of the C. pneumoniae-infected endothelial cells expressed FcγRII. This can be interpreted in at least two different ways: either the expression of FcγRII is limited to a subpopulation of HAEC or, alternatively, the multiplication cycle of C. pneumoniae progressed to the optimal stage for the induction of FcγRII in only a fraction of the infected cells after a 24-h exposure. The results of the time-response curve, showing that the expression of FcγRII was short-lived, peaking 24 h after infection and disappearing 36 h after infection, suggest that the first hypothesis might be true, i.e., that only a fraction of the C. pneumoniae-infected EC expressed FcγRII. What other characteristics may define this fraction of C. pneumoniae-infected HAEC is not known.

The expression of FcγRII, even if limited to 25% of infected endothelial cells, may have significant implications in the pathogenesis of atherosclerosis. On one hand, these receptors represent anchoring points that may bind pro-inflammatory IC and promote their interaction with circulating phagocytic cells, as exemplified in an in vitro model of leukocytic vasculitis developed by Moser et al. (45) and by other in vitro models using IgG-containing IC adsorbed to red blood cells, which have shown that neutrophils are strongly activated by cell-bound IC but not by soluble IC (46, 47). As a consequence of the recognition of RBC-bound IC, neutrophils release large quantities of platelet-activating factor (46, 47), and this could certainly initiate changes associated with a vascular inflammatory response (32).

On the other hand, the known expression of FcγRII, FcγRIIIA is the most ubiquitous and is also able to deliver activating signals to the cells that express it (40, 42). Although the CD32 antibody used in our studies reacts equally with the a and b isoforms of FcγRII, the fact that FcγRIIIA has been shown to be expressed by resting and activated endothelial cells in the epidermal microvasculature (44, 48) suggests that the same type of receptor is likely to be upregulated in cultured aortic endothelial cells. Therefore, the interaction with circulating IC may further accentuate the EC dysfunction associated with C. pneumoniae infection.

In conclusion, we have shown that about 25% of endothelial cells infected with C. pneumoniae transiently express FcγRII and a smaller proportion (5%) express FcγRI and/or FcγRIII. The expression of Fcγ receptors creates ideal conditions for the interaction with circulating IC, such as those formed by modified LDL and corresponding antibodies. As such, this represents a possible mechanism allowing the synergistic effect of two risk factors for atherosclerosis: C. pneumoniae infection and the immune response elicited by modified lipoproteins.

ACKNOWLEDGMENTS

The research reported in this paper was supported by the Research Service of the Ralph H. Johnson Department of Veteran Affairs Medical Center.

REFERENCES


Received March 7, 2002; accepted with revision May 10, 2002