

Original article

Evidence for allergen-specific IgE of maternal origin in human placenta

Background: Immunoglobulin E (IgE) has been identified on macrophage-like cells in the villi of human placenta, irrespective of the serum IgE levels or allergy status of the mother. The origin of placental IgE is debated and it is not known if it is spontaneously produced, so-called 'natural IgE', or if it has any specificity for certain allergens. The aim of this study was to investigate if placental IgE originates from mother or child and to analyse its specificity.

Methods: Immunoglobulin E was eluted from placenta by lowering the pH. Total and allergen-specific IgEs were measured in placenta eluate, maternal and cord blood plasma by means of ImmunoCAP (Phadia AB). The levels of natural antibodies were determined with an anti-phosphorylcholine (PC) enzyme-linked immunosorbent assay, as natural IgE has been shown in one previous publication with this assay.

Results: Detectable amounts of IgE were eluted from 11/12 full-term placentas. Natural (anti-PC) IgE antibodies were detected in low amounts in maternal plasma but not in the placental eluate or in cord blood plasma. There was a significant correlation between the amount of total IgE eluted from placenta and the levels of total IgE in maternal plasma; however, not between maternal and cord blood plasma. Allergen-specific IgE was only found in placental eluates from mothers with specific IgE towards these allergens. Furthermore, there was a significant correlation between the amount of allergen-specific IgE eluted from placenta and the levels of allergen-specific IgE in maternal plasma. Allergen-specific IgE could not be detected in cord blood.

Conclusion: These results suggest a maternal origin of placental IgE, which can be allergen-specific.

M. Joerink¹, E. Rindsjö¹, F. Stenius²,
J. Alm², G. Lilja², H. Grönlund³,
A. Scheynius¹

¹Clinical Allergy Research Unit, Department of Medicine Solna, Stockholm; ²Department of Clinical Science and Education, Sachs' Children's Hospital, Södersjukhuset; ³Clinical Immunology and Allergy Unit, Department of Medicine Solna, Karolinska Institutet, Stockholm, Sweden

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Maaïke Joerink
Clinical Allergy Research Unit
Karolinska University Hospital
Solna L2:04
SE-171 76
Stockholm
Sweden

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It is traditionally believed that immunoglobulin E (IgE) cannot cross the placental barrier. However, we and others have demonstrated IgE localized behind the trophoblast barrier in the villous stroma of human placenta (1–4). We have previously reported that the placental IgE, present on Hofbauer cells (the placental macrophages), is neither bound to the high affinity receptor (FcεRI) nor to the low affinity receptor (FcεRII/CD23); however, IgE had an identical staining pattern as for FcγRI (3).

Although the presence of IgE in the placenta is reported, neither its origin, nor its function or specificity is known. Immunoglobulin E can be produced by human foetal B cells from 20 weeks of gestation, although IgE

producing cells are rare until 9 months after birth (5). If placental IgE is of maternal origin, it would have to be transported over the trophoblast barrier. One suggested way for this transport of IgE is as an IgE–IgG complex (3). We have detected placental IgE independently of the allergy status (3), or malaria infection of the mother (4), suggesting a possible homeostatic function for placental IgE.

Placental IgE might be directed against bacteria, parasites or allergens, or it could have a so-called 'natural' specificity. Antibodies of natural specificity or 'natural antibodies' are spontaneously produced by innate-like B cells (6) with a low affinity for multiple self and nonself antigens (7). Anti-phosphorylcholine (PC) antibodies are the dominant clone of natural antibodies in adult mice (6) and have also been detected in human serum (8). Phosphorylcholine is a carbohydrate present on the surface of many microbes (6, 9) and on the surface of apoptotic cells (10). To date natural antibodies of the IgE class have only been

Abbreviations: ALADDIN, Assessment of Lifestyle and Allergic Disease During Infancy; BSA, bovine serum albumin; ELISA, enzyme-linked immunosorbent assay; Ig, immunoglobulin; PBS, phosphate-buffered saline; PC, phosphorylcholine; r_s , Spearman's r ; RT, room temperature.

described in mice and these natural IgE antibodies were directed against PC (11).

The aim of this study was to elute human placental IgE to determine its specificity and origin. This knowledge might help to understand the biological function of placental IgE.

Materials and methods

Subjects

Mothers ($n = 12$) included in this study were between 23 and 50 years of age (median 32), and participated in a prospective study: Assessment of Lifestyle and Allergic Disease During INfancy (ALADDIN). Mothers were selected based on their Phadiatop value; such that approximately half had a Phadiatop value ≥ 0.35 kU_A/l. Maternal blood samples were collected between weeks 28 and 36 of pregnancy. All deliveries were full-term normal vaginal deliveries and the children were born between December 2006 and October 2007. Cord blood samples were collected directly after delivery by needle aspiration. Placentas were transported on ice to the laboratory and sampled as described below. This study was approved by the Research Ethical Committee South of the Huddinge University Hospital, Stockholm, Sweden. All parents gave their written informed consent.

IgE elution from placenta

Immunoglobulin E elution was performed based on a method described before for elution of IgG from human placenta (12). Foetal membranes and decidual cells were dissected away from the fresh placenta. The remaining was cut into pieces of approximately $2 \times 2 \times 2$ cm, washed twice with ice-cold phosphate-buffered saline (PBS) containing 20 mM EDTA (PBS-EDTA), weighed and frozen at -20°C . Frozen placenta pieces were homogenized in an equal volume of ice-cold PBS-EDTA containing protease inhibitors (cOmplete Protease Inhibitor Cocktail Tablets; Roche, Basel, Switzerland), using an ordinary kitchen blender (Braun 400 W; Braun GmbH, Kronberg/Ts., Germany). The homogenate was washed six

times with four volumes of PBS-EDTA. To elute IgE, the homogenate was incubated with five volumes of 0.1 M glycine buffer (0.1 M glycine, 0.9% NaCl, pH 2.5) for 30 min at room temperature (RT), centrifuged at 18 592 g for 10 min at 4°C and the supernatant was neutralized to pH 7.5 by adding solid Tris [tris(hydroxymethyl)aminomethane]. Following a second centrifugation, the supernatant was filtered through a $0.45 \mu\text{m}$ filter (Advantec, Dublin, CA, USA). The final solution was concentrated by ultrafiltration using an Amicon stirred cell (Millipore, Bedford, MA, USA) with a PL-3 membrane (Millipore). Protein content was measured using the Bio-Rad DC protein assay (Bio-Rad Laboratories, Hercules, CA, USA).

IgE measurement

Immunoglobulin E measurements (total IgE, allergen-specific IgE and Phadiatop) were performed using the ImmunoCAP System [Phadia AB, Uppsala, Sweden (13)]. Phadiatop contains a mix of 11 common inhalant allergens and values ≥ 0.35 kU_A/l are regarded as positive. When Phadiatop was ≥ 0.35 kU_A/l, allergen-specific IgEs against eight components of the Phadiatop test (cat, horse, and dog dander, birch, timothy grass, mugwort, *Cladosporium herbarum* and house dust mite extract from *Dermatophagoides pteronyssinus*) were separately analysed. In addition, all placental eluates were analysed for allergen-specific IgE against egg-white, egg-yellow, cow's milk and for five recombinant allergens from birch pollen, cat dander and timothy grass pollen (14) (Bet v 1, Feld 1, Phl p 1, Phl p 2 and Phl p 5b). For total IgE in placental eluate and maternal plasma, the lower limit of detection was 2.0 kU/l. For the total IgE in cord blood plasma and all allergen-specific IgE measurements an extended standard curve was used, with a detection limit of 0.1 kU/l and 0.1 kU_A/l, respectively.

Effect of pH treatment and proteases on total and allergen-specific IgE

The influence of pH treatment and proteases released by placenta when homogenized on the measured values of the different specific IgE antibodies was investigated. For pH treatment of plasma, 2.2 ml of 0.1 M glycine buffer pH 2.5 was added to 0.5 ml of plasma from mother No. 11 (Table 1). After 30-min incubation at RT 2 ml

Table 1. Total IgE and Phadiatop from maternal and cord blood plasma and placental eluate

Mother no.	Total IgE maternal plasma (kU/l)	Phadiatop* maternal plasma (kU _A /l)	Total IgE cord blood plasma (kU/l)	Placenta sample wet weight (g)	Placental eluate end volume (ml)	Eluted protein† (mg/g wet placenta)	Total IgE placental eluate (kU/l)	Total IgE placental eluate (U/g wet placenta)	Phadiatop* placental eluate (kU _A /l)
1	8	<0.1	<0.1	187	4.3	0.78	<2	<0.046	<0.1
2	12	<0.1	<0.1	277	5.0	1.32	2.9	0.053	<0.1
3	24	<0.1	0.2	138	4.0	0.02	4.8	0.139	0.2
4	24	<0.1	0.4	271	3.3	0.45	6.1	0.074	<0.1
5	37	<0.1	—	173	3.8	0.97	6.6	0.144	<0.1
6	42	0.5	—	199	5.0	0.86	3.3	0.084	0.1
7	44	4.4	0.3	259	6.4	1.44	4.2	0.103	0.5
8	53	7.2	0.5	180	4.6	0.83	4.4	0.112	0.3
9	97	11.5	<0.1	264	2.5	0.48	5.2	0.049	0.5
10	150	11.7	0.2	209	3.0	0.73	13	0.187	1.0
11	160	41.4	0.3	187	2.2	0.35	29.2	0.344	6.0
12	1621	12.4	1.5	242	3.6	0.95	135	2.008	1.0
Median (range)	43 (8–1621)	2.5 (<0.1–41.4)	0.3 (<0.1–1.5)	204 (138–277)	3.9 (2.2–6.4)	0.81 (0.02–1.44)	5.0 (<2–135)	0.108 (<0.046–2.008)	0.3 (<0.1–6)

—, no sample available.

*Phadiatop (Phadia AB) detects allergen-specific IgE against a mix of 11 common inhalant allergens. Phadiatop values ≥ 0.35 kU_A/l are regarded as being positive.

†Total levels of protein in the placental eluate were measured using the Bio-Rad DC protein assay (Bio-Rad Laboratories).

0.5 M Tris, pH 10.5 was added to increase to pH 7. Plasma samples from before and after pH treatment were analysed for total and allergen-specific IgE levels. In a spiking experiment, we added a known amount of IgE to a placental homogenate to determine the influence of pH treatment and placental proteases. Therefore, a placental homogenate was divided into two prior to IgE elution and 10 ml plasma (total IgE of 36 kU/l and Phadiatop value of 3.3 kU_A/l) was added to one of the two halves; both samples were incubated for 30 min at RT, spun and concentrated as described above. Concentrated placental eluate with and without spiking and a sample of the plasma used for spiking were analysed separately for total and allergen-specific IgE levels. These levels in the plasma sample and the nonspiked placental eluate were used to calculate the expected IgE levels in the spiked placental eluate.

IgE antibody staining

Samples of placenta and placental homogenate before and after IgE elution were stored at -20°C . From these samples acetone-fixed, 6 μm thick cryostat sections were immunohistochemically stained using ABC-ELITE method (Vector Laboratories, Burlingame, CA, USA) (3). To stain for IgE a mouse monoclonal anti-IgE antibody (clone B3102E8; SouthernBiotech, Burlingame, CA, USA) was used. Sections were counterstained with Mayer's haematoxylin. An irrelevant isotype-matched mouse IgG₁ (Dako, Glostrup, Denmark) was used as negative control.

Total IgA determination

Immunoglobulin A concentration was determined using an enzyme-linked immunosorbent assay (ELISA) according to the manufacturer's instruction (Bethyl Laboratories, Montgomery, TX, USA). Standard and sample were measured in duplicate. For detection plates were incubated with 0.4 mg/ml *o*-Phenylenediamine dihydrochloride substrate (Sigma, St Louise, MO, USA) in phosphate-citrate buffer. After 20-min reactions were stopped by adding 3 M H₂SO₄. Absorbance was read at 492 nm employing a 620 nm reference filter. A human reference serum was used as a standard with a concentration range between 7.8 and 500 ng/ml.

Natural antibody ELISA

Levels of natural IgE, IgA, IgM and IgG antibodies were assayed using a PC-bovine serum albumin (BSA) ELISA. Microtitre plates were coated overnight at 4°C with 5 $\mu\text{g}/\text{ml}$ PC-BSA (kindly provided by Athera Biotechnologies, Stockholm, Sweden) and blocked with 1% BSA. A dilution series, ranging from 2 to 20 000 times, of a standard plasma sample was included on every plate to normalize the data. The standard dilution giving an absorbance twice the background value was set to a concentration of 1 ELISA unit and this was used as the cut-off value. Samples and standard were measured in duplicate. Alkaline phosphatase-conjugated detection antibodies were used followed by colour development with phosphatase substrate (Sigma). Absorbance was read at 405 nm employing a 620 nm reference filter.

Statistical analysis

Statistical analysis was conducted using GRAPHPAD PRISM software (GraphPad Software Inc., La Jolla, CA, USA). The D'Agostino and Pearson's omnibus normality test was used to test for Gaussian distribution. Most data sets were not normally distributed and Spearman's rank correlation test was used to assess the relationship

between the different samples. Total IgE values < 2.0 kU/l were set to be 2.0 kU/l, allergen-specific IgE and Phadiatop values < 0.1 kU_A/l were set to be 0.1 kU_A/l for statistical analysis. $P \leq 0.05$ was accepted as being significant.

Results

IgE can be eluted from placenta

We eluted IgE from 12 placentas through low pH treatment. The median starting amount of wet weight placenta was 204 g (range 138–277 g) and the amount of protein eluted ranged between 0.02 and 1.44 mg/g wet placenta (median 0.81 mg/g wet placenta). Total IgE levels > 2.0 kU/l could be detected in 11/12 placental eluates (Table 1). In the case, where we were unsuccessful in eluting a detectable amount of total IgE the mother had the lowest plasma total IgE level (mother No. 1 Table 1). Five placental eluates had a Phadiatop value ≥ 0.35 kU_A/l and these all originated from mothers with a Phadiatop value ≥ 0.35 kU_A/l (Table 1).

Immunohistochemical staining clearly demonstrated the presence of IgE in placenta and placental homogenate before pH treatment (Fig. 1A,C), while no IgE could be detected following the pH treatment (Fig. 1D). No positive staining was observed in samples stained with an isotype control (Fig. 1B). Together these data indicate that IgE can be eluted from placental homogenates by decreasing the pH.

We continued to assess the influence of pH changes. We measured the total and allergen-specific IgE levels ($n = 5$) of a plasma sample with a Phadiatop ≥ 0.35 kU_A/l before and after pH treatment. Indeed, total and specific IgE levels after pH treatment were lower than before, but around 50% of the antibodies could still be detected. However, a significant correlation between IgE levels before and after pH treatment was found ($P = 0.017$, $r_s = 1.0$) (data not shown).

Further, the influence of the combination of pH treatment and placental proteases on the breakdown of IgE was investigated. A placental homogenate was divided into two and one half was spiked before lowering the pH. Measured IgE levels ($n = 5$) in the spiked eluate were lower than that of calculated; around 30% of the antibodies could still be detected. A significant correlation between calculated and measured IgE levels was still found ($P = 0.017$, $r_s = 1.0$) (data not shown). Absolute IgE values are thus decreased following the elution from the placenta because of both pH treatment and the presence of proteases from the placental homogenate; however, relative IgE levels remain unchanged.

Total and allergen-specific IgE levels in placenta correlate well with those in maternal plasma

When comparing total IgE levels a significant correlation of total IgE levels between maternal plasma and placental

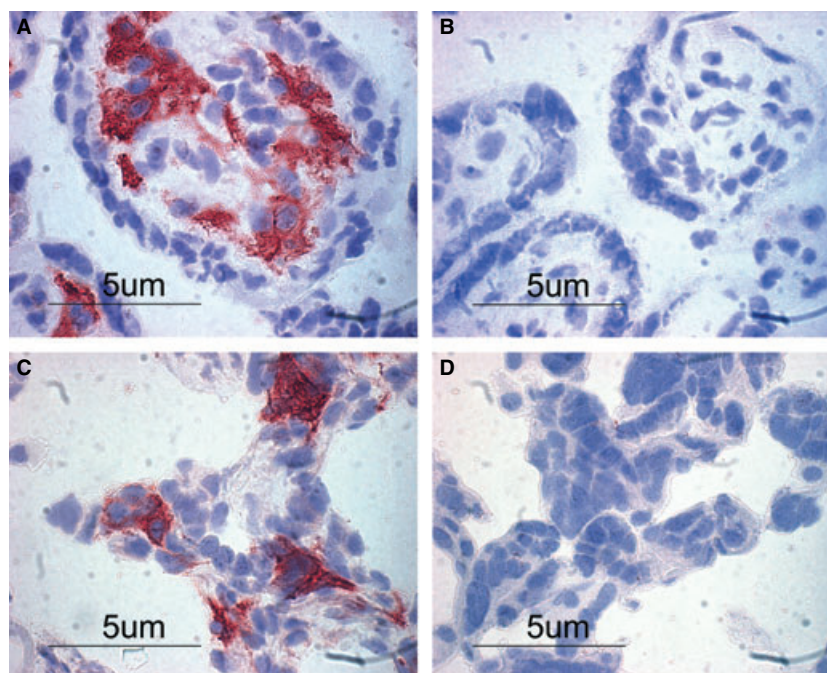


Figure 1. Immunostaining for IgE in placenta and placental homogenate. Acetone-fixed cryostat sections of snap-frozen placentas and placental homogenates were stained with the ABC ELITE method using a mouse monoclonal anti-IgE antibody (clone B3102E8, Southern Biotechnology Assoc.) (A, C and D) or an isotype-matched control mouse IgG1 (Dako) (B). Representative examples of a placental section and a placental homogenate, (A) placental section anti-IgE, (B) placental section isotype control, (C) placental homogenate before elution anti-IgE and (D) placental homogenate after elution anti-IgE. The sections were counterstained with haematoxylin (blue). Positive staining is brownish-red. Scale bars: 5 µm.

eluate was evident ($P = 0.014$, $r_s = 0.69$) (Fig. 2A). There was no significant correlation in total IgE levels between cord blood plasma and placental eluate ($P = 0.054$, $r_s = 0.63$) or between cord blood plasma and maternal plasma ($P = 0.179$, $r_s = 0.47$) (Fig. 2B,C).

In the five placental eluates with a Phadiatop value ≥ 0.35 kU_A/l (Table 1), allergen-specific IgEs were measured. Nine measurements of allergen-specific IgE values ≥ 0.35 kU_A/l were recorded (Table 2). In the corresponding five maternal plasma samples, we decided to measure the allergen-specific IgE towards the allergens detected in any of the placental eluates. All specificities detected in placental eluate could also be detected in the respective maternal plasma samples and always at higher concentrations. There were more allergen specificities detected in maternal plasma than in placental eluate (Table 2). In the corresponding cord blood samples, we measured the nine allergen-specificities detected in the placental eluate, all were <0.1 kU_A/l. When comparing the specific IgE values from placental eluates and corresponding maternal plasma samples, a significant correlation was apparent (Fig. 3). Correlation of both total and allergen-specific IgE levels between maternal plasma and placental eluate, and the lack of allergen-specific IgE in cord blood suggest maternal origin of the placental IgE.

Natural IgE antibodies are not detected in placental eluate, but are present in maternal plasma

As only a part of the total IgE eluted was allergen-specific, we addressed the question if the remainder could be natural IgE antibodies. We determined the levels of anti-PC antibodies as a measure of natural antibodies. Anti-PC antibodies of all subclasses could be detected in all maternal blood samples, with high levels of IgM and IgG and low levels of anti-PC IgE (Table 3). Anti-PC IgE antibodies could not be detected in placental eluate while anti-PC IgA and IgM antibodies could be detected in 11/12 and in seven of 12 placental eluate samples, respectively. Immunoglobulin G was the most abundant anti-PC subclass within placental eluate detected in 12/12 samples. Anti-PC IgE and IgA antibodies could not be detected in cord blood plasma. In contrast, both anti-PC IgM and IgG antibodies could be detected in 10/10 cord blood samples, of which the IgG levels were the highest.

Cord blood plasma is not contaminated with maternal blood plasma

In cord blood plasma, total IgA levels were all below the 10 µg/ml limit (median 5.0 µg/ml; range 1.9–8.5 µg/ml),

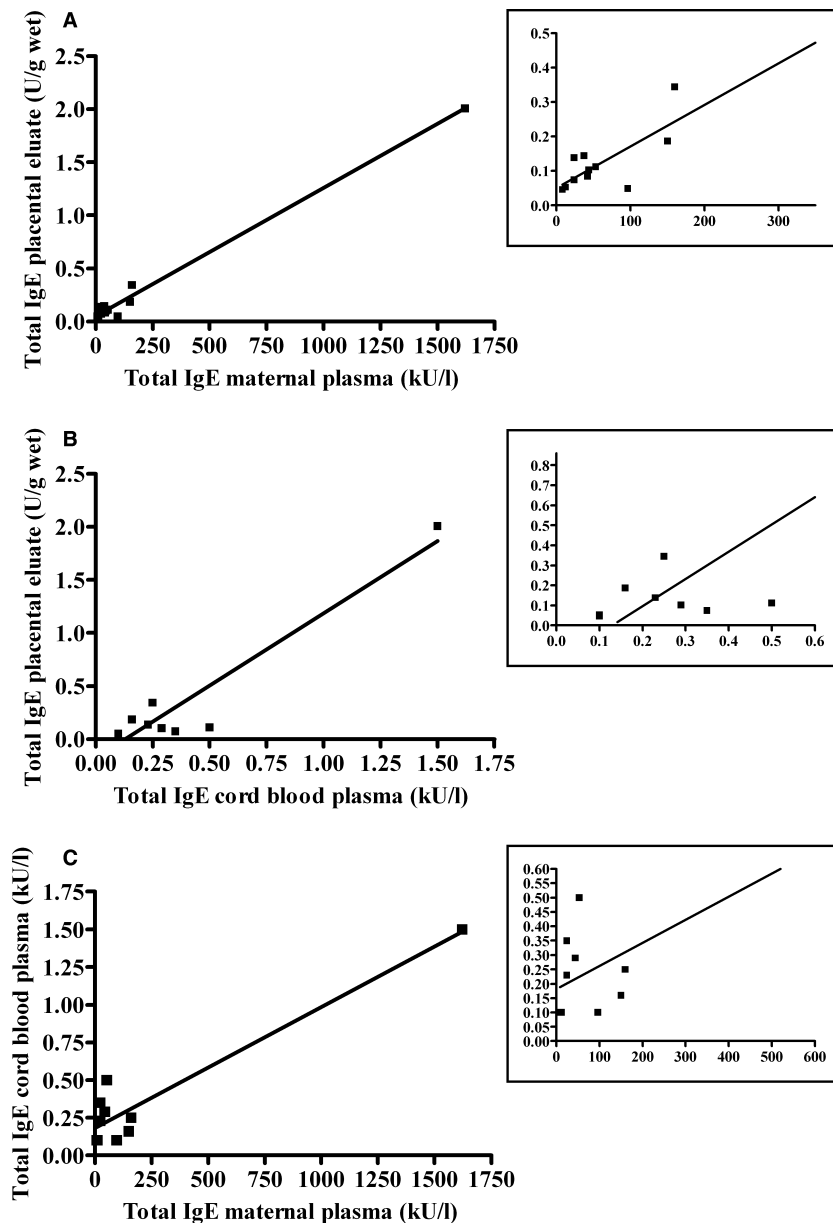


Figure 2. Comparison of total IgE levels in placental eluate ($n = 12$) maternal plasma ($n = 12$) and cord blood plasma ($n = 10$), measured using the ImmunoCAP System (Phadia AB). Total IgE levels in placental eluate are depicted in U/g wet weight placenta, and for maternal and cord blood plasma in kU/l. The lower range areas are enlarged at the right-hand side. Comparison between: (A) placental eluate and maternal plasma, (B) placental eluate and cord blood plasma and (C) cord blood plasma and maternal plasma. Spearman's rank correlation test was used to assess the relation among the different samples. A significant correlation was found between IgE levels in maternal plasma and placental eluate ($P = 0.014$, $r_s = 0.69$). Significant correlations were not found between IgE levels in placental eluate and cord blood plasma and between cord blood plasma and maternal plasma ($P = 0.054$, $r_s = 0.63$ and $P = 0.179$, $r_s = 0.47$, respectively).

indicating that the cord blood plasma samples were not contaminated with maternal blood plasma (15). In maternal plasma, total IgA levels were between 0.5 and 2.0 mg/ml (median 1.0 mg/ml) and in placental eluate between not detectable and 3.5 $\mu\text{g/g}$ wet placenta (median 1.9 $\mu\text{g/g}$ wet placenta).

Discussion

Here, we demonstrate for the first time that IgE can be eluted from the placenta by means of pH treatment. Furthermore, we show that the eluted placental IgE can be allergen-specific and is most likely of maternal origin.

Table 2. Allergen-specific IgE levels in maternal plasma/placental eluate†

Mother no.	Timothy grass	rPhl p 1	rPhl p 5b	Birch	rBet v 1	Dog dander	House dust mite
7	6.7/0.013	2.2/*	4.0/*	*/*	*/*	*/*	*/*
9	16.9/0.005	7.0/*	7.6/*	*/*	*/*	*/*	*/*
10	1.0/*	0.5/*	*/*	23.0/0.024	17.0/0.019	*/*	*/*
11	62.0/0.116	33.0/0.081	22.9/0.036	*/*	*/*	0.4/*	*/*
12	1.4/*	0.8/*	*/*	*/*	*/*	3.7/0.007	14.9/0.016

Allergen-specific IgE levels were measured using the ImmunoCAP System (Phadia AB).

*Values <0.35 kU_A/l.

†Values are in kU_A/l for the maternal plasma and in U_A/g for the placental eluate.

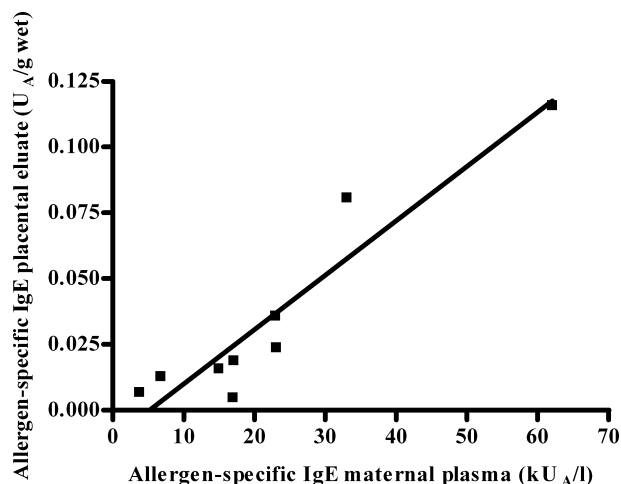


Figure 3. Comparison of allergen-specific IgE between maternal blood plasma and placental eluate. Allergen-specific IgE levels ($n = 9$) were measured using the ImmunoCAP System (Phadia AB), in 5 placental eluates with a Phadiatop ≥ 0.35 kU_A/l and their corresponding maternal plasma samples. Allergen-specific IgE levels in placental eluate are given in U_A/g wet weight placenta, and for maternal blood plasma in kU_A/l. Spearman's rank correlation test was used to assess the relation between the different samples, and a significant correlation was found ($P = 0.003$, $r_s = 0.88$).

Table 3. Anti-PC antibodies

Ig class	Maternal plasma* (EU/ml) ($n = 12$)	Placental eluate* (EU/g wet) ($n = 12$)	Cord blood plasma* (EU/ml) ($n = 10$)
IgE	12 (4–74)	ND	ND
IgA	1 891 (1272–3405)	0.3 (ND–0.7)	ND
IgM	32 715 (16 372–117 031)	0.1 (ND–1.3)	64 (25–157)
IgG	18 928 (2763–61 892)	13 (1–70)	15 622 (2341–58 944)

Anti-PC antibody levels were determined using a PC-BSA ELISA see Materials and methods.

EU, ELISA unit; ND, not detectable.

*Median (range).

The pH treatment of placental homogenates has been used before as a means of eluting IgG (12). In our placental eluates, we therefore also determined the amount of eluted total IgG by means of nephelometry. Total IgG could be detected in seven of 12 placental

eluates with a median of 16.4 mg/kg wet placenta (range: 0.3 – 45.7 mg/kg wet placenta), which is comparable with the study from Bonneau et al. (12). Control experiments indicated that pH treatment and placental enzymes decreased the levels of detected IgE. Loss in detection was, however, comparable for the different IgE antibodies.

An important concern in our study is the possibility of contamination with maternal blood. Total IgA levels in cord blood plasma are commonly used to estimate maternal blood contamination (15). In the cord blood plasma samples used here total IgA levels were all below 10 µg/ml and thus considered free from maternal blood. Furthermore, anti-PC IgA antibodies could be detected in maternal plasma and at low levels in placental eluate, although not in cord blood plasma. These data confirm earlier reports that IgA cannot pass through the placenta (16–18). Maternal blood contamination of placental eluate could also be ruled out as their levels of anti-PC IgM were very low, while it was highly abundant in maternal plasma and also present in cord blood plasma (Table 3).

We found a significant correlation between the levels of total IgE in maternal plasma and placental eluate (Fig. 2A). When removing the data from mother No. 12 from the analysis, to estimate the influence of this high value, an almost significant correlation was still evident ($P = 0.06$, $r_s = 0.59$), indicating a true correlation between the total IgE levels in the two compartments.

When comparing all the positive allergen-specific IgE values ($n = 9$), significant correlations were evident between these levels from placental eluate and maternal plasma (Fig. 3). Furthermore, we compared the Phadiatop values between the placental eluate and maternal plasma ($n = 12$) and detected a significant correlation between these values ($P < 0.001$, $r_s = 0.87$, data not shown). These correlations suggest maternal origin of the placental IgE. We could not detect allergen-specific IgE in cord blood. Furthermore, we did not detect allergen-specific IgE directed against milk or egg, in the placental eluate while allergies against these foods are among the first allergies children develop (19). These findings make it very unlikely that allergen-specific IgE in placenta would be of foetal origin.

To determine if the difference between total and allergen-specific IgE levels can partly be explained by the presence of natural IgE antibodies we measured the levels of anti-PC IgE antibodies. These could only be detected at low levels in the maternal plasma (Table 3), and thus could not explain the discrepancy between levels of total and allergen-specific IgE.

Contrary to the previous hypotheses, this study indicates that IgE antibodies can be transported over the placental barrier from the mother and into the villous stroma of the placenta. However, the IgE does not seem to accumulate in the placenta nor does it seem to be transported further to the cord blood. Immunoglobulin E suggested to be of maternal origin, has been detected in amniotic fluid where it can be swallowed by the foetus and taken up via the gut (20). The exposure of the foetus to maternal IgE via amniotic fluid might be one of the explanations to why the development of atopy in the child is more strongly correlated with maternal than paternal atopy (21). We can only speculate about the function of placental IgE. We suggest that it might be there because it is taken up and degraded by the Hofbauer cells. Monomeric IgG bound to Fc γ RI has been shown to be internalized and recycled to the cell surface while IgG complexes cause cross-linking of receptors leading to uptake and degradation (22). Immunoglobulin E, maybe

in a complex with IgG, might be taken-up and degraded in a similar way. Placental IgE could also have a homeostatic function in prolonging cell survival, as demonstrated for IgE bound to murine mast cells (23) and human lung mast cells (24). Another function for placental IgE could be protection of the foetus against parasites.

In conclusion, we present evidence that placental IgE is of maternal origin and can be allergen-specific. Future analysis of Hofbauer cells and their receptors binding IgE should reveal more about the function of placental IgE.

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