



BRIEF REPORT

# Elevated eosinophil levels observed in infantile hemangioma patients from Kaifeng, China [version 1; peer review: 2 approved]

Xianglei Li<sup>1</sup>, Chunyan Ma<sup>1</sup>, Jiaoyang Xu<sup>1</sup>, Biao Gao<sup>1</sup>, Michael Steele <sup>2</sup>, Adi Idris <sup>3</sup>

<sup>1</sup>Department of clinical laboratory, Kaifeng Central Hospital, Kaifeng, Henan province, China

<sup>2</sup>Faculty of Health Sciences, Australian Catholic University, Brisbane, Queensland, Australia

<sup>3</sup>Menzies Health Institute Queensland and School of Medical Science, Griffith University, Gold Coast, Queensland, Australia

**v1** First published: 16 Dec 2019, 8:2111 (<https://doi.org/10.12688/f1000research.21608.1>)  
 Latest published: 16 Dec 2019, 8:2111 (<https://doi.org/10.12688/f1000research.21608.1>)

**Abstract**

Infantile hemangioma (IH) is one of the most common soft-tissue neoplasms of infancy. Although clinical diagnosis for IH is well-established, the haematological parameters associated with IH are not well explored. In this short study, we observed significantly higher eosinophil (EO) numbers in IH patient blood compared to healthy controls. This contributed to the observed higher EO % in the peripheral blood of IH patients and was irrespective of age. This new haematological finding could carry a potential diagnostic/prognostic relevance for IH.

**Keywords**

Infantile hemangioma, eosinophil, haematology, China

**Open Peer Review**

**Reviewer Status**

	Invited Reviewers	
	1	2
<b>version 1</b> 16 Dec 2019	 report	 report

- Mark I.R. Petalcorin** , Universiti Brunei Darussalam, Gadong, Brunei
- Swaminathan Sethu** , Narayana Nethralaya Foundation, Bangalore, India

Any reports and responses or comments on the article can be found at the end of the article.

**Corresponding author:** Adi Idris ([a.idris@griffith.edu.au](mailto:a.idris@griffith.edu.au))

**Author roles:** **Li X:** Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration; **Ma C:** Conceptualization, Funding Acquisition, Methodology, Project Administration, Resources, Supervision, Validation; **Xu J:** Data Curation, Investigation, Methodology, Validation; **Gao B:** Data Curation, Formal Analysis, Investigation; **Steele M:** Formal Analysis, Software, Validation; **Idris A:** Formal Analysis, Supervision, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing

**Competing interests:** No competing interests were disclosed.

**Grant information:** The author(s) declared that no grants were involved in supporting this work.

**Copyright:** © 2019 Li X *et al.* This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

**How to cite this article:** Li X, Ma C, Xu J *et al.* **Elevated eosinophil levels observed in infantile hemangioma patients from Kaifeng, China [version 1; peer review: 2 approved]** F1000Research 2019, 8:2111 (<https://doi.org/10.12688/f1000research.21608.1>)

**First published:** 16 Dec 2019, 8:2111 (<https://doi.org/10.12688/f1000research.21608.1>)

## Introduction

Infantile hemangioma (IH) is a common benign tumour in children that presents as precursor vascular lesions, which either present at birth or develop during the early neonatal period and undergo rapid proliferation<sup>1</sup>. IH is the most common vascular tumour of infancy, occurring in up to 10% of infants<sup>2</sup> and is characterized by high expression of genes involved in vasculogenesis, angiogenesis and tumorigenesis<sup>3</sup>. In the Chinese population, low birth weight, prematurity and maternal progesterone have been associated with IH development<sup>4</sup>. Although clinical diagnosis for IH is well-established, other than the proposed embryonic stem cell origins of IH<sup>5</sup>, little is known about the peripheral blood cell repertoire in IH patients, let alone in Chinese patients. This concise study seeks to determine any potential haematological signature(s) that may be present in the peripheral blood of IH diagnosed Chinese patients. In this retrospective study, we report significantly elevated eosinophil numbers in Chinese IH patients.

## Methods

Kaifeng Central Hospital (Kaifeng, China) is designated as a health care centre by the Kaifeng city government. Retrospective analysis of Kaifeng Central Hospital patient records was performed for this study and the study protocol was approved by the Kaifeng Central Hospital Ethics Committee, which waived the need for informed consent from patients/guardians for the use of their records. Underlying data are all de-identified demographic variables and blood parameters for each individual patient<sup>6</sup>. Patients' parents/guardians had been made aware that this data could be used for research purposes.

Study subjects included paediatric patients (n = 1631) of all sexes (Male (M) = 460 / Female (F) = 1171) between the ages of 0 to 12 months (3.77 ± 2.98 months, mean ± SD) who were diagnosed with IH from January 2011 to December 2016. Control subjects (n=1602) were healthy children who had blood taken during routine medical check-up visits to the hospital during that same period. As previously seen<sup>7</sup>, we observed significantly more female IH patients than males (Chi squared test, p<0.001). The inclusion criteria included only infants up to 12 months of age and infants with all variables measured (WBC, RBC, MPV, HGB, PCT, EO%, EO#). The exclusion criteria were subjects with other existing conditions and diseases including eczema, systemic infection, allergy, haematological diseases, immunological diseases and adrenocortical insufficiency and who were not undergoing treatment for IH.

Peripheral blood samples (n = 3233) were assayed for full blood panel count on the Sysmex XN-800i (Sysmex Europe GmbH, Norderstedt, Germany) as per manufacturer's protocol. Blood variables measured included white blood cell (WBC) counts, red blood cell (RBC) counts, mean platelet volume (MPV), haemoglobin (HGB) levels, procalcitonin (PCT) levels and eosinophils (EO) percentage/counts.

Due to strong non-normality of some variables the non-parametric Mann-Whitney Test was used in the analysis of continuous variables. Chi-Square test of independence was used for categorical data. All statistical analysis was done on IBM SPSS

Statistics 22.0 (SPSS Institute, Chicago, IL, USA). Before analysis, all variables were reviewed for accuracy of data entry and missing values. Due to the large sample size involved, statistical analysis is focused primarily on frequencies and percentages.

## Results

We analysed blood parameters between IH patients and healthy controls (Table 1). Notably, we observed a high elevation of EO numbers in IH patients compared to healthy subjects. Compared to the healthy control (0.19±0.24 ×10<sup>9</sup>/ μL), there is an almost significantly (Chi-Square test of independence, p<0.001) two-fold higher EO count in IH patients (0.4±0.37 ×10<sup>9</sup>/ μL). This contributed to the observed higher EO % in the peripheral blood of IH patients.

This observation was irrespective of age as significantly higher EO numbers (Mann-Whitney test, p<0.001) were observed only between IH patient and healthy control cohort for each age-matched group, not between each age group (Table 2). Other measured blood parameters were comparable between IH patients and healthy controls (Table 1).

## Discussion

Elevated EOs are classically associated with the presence of inflammation in patients with conditions such as asthma, allergy and parasitic infections. Our exclusion criteria in this study discounted any possibility of this on our observations. Previous haematological analyses of blood collected from 34 IH patients

**Table 1. Haematological profile in healthy and infantile hemangioma subjects.**

	IH (n=1631)	Control (n=1602)	P-value
Age (in months)			
Mean (SD)	3.77 (2.98)	3.44 (2.67)	0.016 <sup>1</sup>
Median (IQR)	3 (5)	2 (4)	
0–3 months N (%)	958 (50.0)	958 (50.0)	
4–6 months N (%)	364 (50.4)	358 (49.6)	
6–12 months N (%)	309 (51.9)	286 (48.1)	
Gender			
Male N (%)	460 (38.5)	736 (61.5)	<0.001 <sup>2</sup>
Female N (%)	1171 (57.5)	866 (42.5)	
WBC (10 <sup>9</sup> /μL)	10.10 (3.21)	10.39 (4.38)	
RBC (10 <sup>9</sup> /μL)	4.33 (0.69)	4.79 (0.51)	
MPV (fL)	9.74 (0.81)	9.47 (0.81)	
HGB (g/L)	113.59 (16.90)	122.74 (14.78)	
PCT (%)	0.05 (0.03)	0.04 (0.02)	
EO %	3.96 (2.46)	1.91 (2.11)	<0.001 <sup>1</sup>
EO # (10 <sup>9</sup> / μL)	0.40 (0.37)	0.19 (0.24)	<0.001 <sup>1</sup>

Control – Healthy subjects, IH-Infantile hemangioma patients, WBC- white blood cells, RBC- Red blood cells, MPV – Mean platelet volume, HGB- Hemoglobin, PCT-Procalcitonin, EO-Eosinophils

<sup>1</sup> Mann-Whitney Test

<sup>2</sup> Chi-Square Test of Independence

**Table 2. Comparison of the levels and percentage population of eosinophils among different age groups between healthy and infantile hemangioma subjects.**

	IH mean (SD)	Control mean (SD)	P-value
Aged 0–3 months EO %	3.90 (2.47)	1.88 (2.18)	<0.001 <sup>†</sup>
EO #	0.42 (0.36)	0.19 (0.25)	<0.001 <sup>†</sup>
Aged 4–6 months EO %	4.28 (2.64)	1.84 (1.84)	<0.001 <sup>†</sup>
EO #	0.42 (0.45)	0.19 (0.22)	<0.001 <sup>†</sup>
Aged 7–12 months EO %	3.77 (2.15)	2.10 (2.17)	<0.001 <sup>†</sup>
EO #	0.34 (0.23)	0.20 (0.22)	<0.001 <sup>†</sup>

<sup>†</sup> Mann-Whitney Test

in an Italian study revealed slightly elevated EO %<sup>8</sup>, but IH blood parameters were not compared to that in healthy subjects. Mean EO reference numbers in the general Chinese population are between  $0.1 - 0.2 \times 10^9$ , in concordance with healthy EO levels we observe.

One major limitation in this study is the inability to compartmentalize IH patients into different clinical phases (i.e. proliferating phase, early regressing (involuting) phase, and advanced regressing (involved) phase) as this information was not made available to us during retrospective data collection. Future work will focus on determining whether EO numbers increase progressively throughout the different IH clinical phases.

Propranolol, a beta-blocking agent, has been used as the first-line therapy for the management of IH since 2008<sup>10</sup>. However, propranolol use for managing IH in China only came about after findings from a prospective 2011 trial<sup>11</sup>. Given that propranolol has been shown to prevent the release of EO-activating cytokines<sup>12</sup>, propranolol would work favourably in IH patients to reduce the abnormally high EO numbers seen in our patients. In this present study, we show for the first time a significant elevation in EO numbers in IH paediatric patients and this could potentially carry a diagnostic/prognostic relevance in Chinese children. IH is commonly diagnosed clinically based on natural history of the lesion. Currently, the most important marker to accurately diagnose IH is glucose transporter 1 (GLUT1)<sup>13</sup>, though this marker is present despite the proliferative activity of the IH lesion<sup>14</sup>. The use immune cytokines as a potential biomarker for IH progression was recently proposed<sup>8,15</sup> and some of those cytokines (e.g. interleukin -8) could directly impact EO proliferation. Standard haematological (e.g. abnormal EO numbers) and unique cytokine signatures could potentially serve as a diagnostic/prognostic marker for IH progression.

### Data availability

Open Science Framework: Elevated eosinophil levels observed in infantile hemangioma patients from Kaifeng, China, <https://doi.org/10.17605/OSF.IO/P8XR36>.

This project contains the following underlying data:

- raw data\_Li *et al.* xls (Raw haematological data)

Data are available under the terms of the [Creative Commons Zero “No rights reserved” data waiver](#) (CC0 1.0 Public domain dedication).

### References

- Léauté-Labrèze C, Harper JL, Hoeger PH: **Infantile haemangioma**. *Lancet*. 2017; **390**(10089): 85–94.  
[PubMed Abstract](#) | [Publisher Full Text](#)
- Kilcline C, Frieden IJ: **Infantile hemangiomas: how common are they? A systematic review of the medical literature**. *Pediatr Dermatol*. 2008; **25**(2): 168–73.  
[PubMed Abstract](#) | [Publisher Full Text](#)
- Harbi S, Wang R, Gregory M, *et al.*: **Infantile Hemangioma Originates From A Dysregulated But Not Fully Transformed Multipotent Stem Cell**. *Sci Rep*. 2016; **6**(1): 35811.  
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Chen XD, Ma G, Chen H, *et al.*: **Maternal and perinatal risk factors for infantile hemangioma: a case-control study**. *Pediatr Dermatol*. 2013; **30**(4): 457–61.  
[PubMed Abstract](#) | [Publisher Full Text](#)
- Boscolo E, Bischoff J: **Vasculogenesis in infantile hemangioma**. *Angiogenesis*. 2009; **12**(2): 197–207.  
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Li X, Ma C, Xu J, *et al.*: **Elevated eosinophil levels observed in infantile hemangioma patients from Kaifeng, China**. *OSF*. 2019.  
<http://www.doi.org/10.17605/OSF.IO/P8XR36>
- Munden A, Butschek R, Tom WL, *et al.*: **Prospective study of infantile haemangiomas: incidence, clinical characteristics and association with placental anomalies**. *Br J Dermatol*. 2014; **170**(4): 907–13.  
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- D’Arcangelo D, Nicodemi EM, Rossi S, *et al.*: **Identification of serum regression signs in infantile hemangioma**. *PLoS One*. 2014; **9**(3): e88545.  
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Wu X, Zhao M, Pan B, *et al.*: **Complete blood count reference intervals for healthy Han Chinese adults**. *PLoS One*. 2015; **10**(3): e0119669.  
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Léauté-Labrèze C, Dumas de la Roque E, Hubiche T, *et al.*: **Propranolol for severe hemangiomas of infancy**. *N Engl J Med*. 2008; **358**(24): 2649–51.  
[PubMed Abstract](#) | [Publisher Full Text](#)
- Jin YB, Lin XX, Ye XX, *et al.*: **[A prospective study of propranolol as first-line treatment for problematic infantile hemangioma in China]**. *Zhonghua Zheng Xing Wai Ke Za Zhi*. 2011; **27**(3): 170–3.  
[PubMed Abstract](#)
- Hallsworth MP, Twort CH, Lee TH, *et al.*: **beta(2)-adrenoceptor agonists inhibit release of eosinophil-activating cytokines from human airway smooth muscle cells**. *Br J Pharmacol*. 2001; **132**(3): 729–41.  
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- North PE, Waner M, Mizeracki A, *et al.*: **GLUT1: a newly discovered immunohistochemical marker for juvenile hemangiomas**. *Hum Pathol*. 2000; **31**(1): 11–22.  
[PubMed Abstract](#) | [Publisher Full Text](#)
- North PE, Waner M, James CA, *et al.*: **Congenital nonprogressive hemangioma: a distinct clinicopathologic entity unlike infantile hemangioma**. *Arch Dermatol*. 2001; **137**(12): 1607–20.  
[PubMed Abstract](#) | [Publisher Full Text](#)
- Yamashita T, Jinnin M, Makino K, *et al.*: **Serum cytokine profiles are altered in patients with progressive infantile hemangioma**. *Biosci Trends*. 2018; **12**(4): 438–41.  
[PubMed Abstract](#) | [Publisher Full Text](#)

# Open Peer Review

Current Peer Review Status:  

---

## Version 1

Reviewer Report 27 January 2020

<https://doi.org/10.5256/f1000research.23816.r57885>

© 2020 Sethu S. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.



**Swaminathan Sethu** 

GROW Research Laboratory, Narayana Nethralaya Foundation, Bangalore, Karnataka, India

The following are minor suggestions that may improve the clarity and interpretation of the data

1. The title can be “Elevated peripheral blood eosinophil levels in infantile hemangioma patients” or “Elevated peripheral blood eosinophil levels in Chinese patients with infantile hemangioma”.
2. The authors have pointed out that IH is significantly higher in females compared to males. It would be useful to analyse and represent the results in table 1 and 2 based on gender. In other words, in addition to the current statistical analysis, it would be interesting to know whether the eosinophil (EO) levels were significantly different between controls and IH in males and females subjects separately. The authors can also expand the Table 1 parameters based on gender as well.
3. Further, it will be useful to know the normal range for EO in pediatric population. The authors have mentioned the range for Chinese adult population. The authors can calculate the proportion (%) of subjects with IH above the normal range (if available) or the proportion (%) of subjects with IH above the median level in the control group. The authors can also attempt AUC analysis, if possible to improve the clinical relevance of EO levels in the diagnosis of IH.
4. It would be useful to know whether the authors had access to the proportions of other leukocyte subsets other than EO. This would be relevant and the authors can consider addressing this in the discussion.
5. It is unclear how the % of Procalcitonin (PCT) was computed and whether it is possible to include the concentration range for the same. Further, it was not stated as to why PCT was included in the inclusion criteria and how it is relevant to IH or EO levels in the context of IH.
6. Could power calculation be done to show the robustness of the finding with relevance to the sample size?

**Is the work clearly and accurately presented and does it cite the current literature?**

Yes

**Is the study design appropriate and is the work technically sound?**

Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**

Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**

Yes

**Are all the source data underlying the results available to ensure full reproducibility?**

Yes

**Are the conclusions drawn adequately supported by the results?**

Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Immunology; Immunophenotyping; Immune cell subset variations in health and disease

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.**

Reviewer Report 02 January 2020

<https://doi.org/10.5256/f1000research.23816.r57886>

© 2020 Petalcorin M. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.



**Mark I.R. Petalcorin** 

PAPRSB Institute of Health Sciences, Universiti Brunei Darussalam, Gadong, Brunei

In this concise article, Li and co-authors reported that the infantile hemangioma (IH) patients showed significantly higher eosinophil levels more than the healthy control subjects suggesting a potential diagnostic relevance. Although promising, the article requires more in-depth analysis especially in addressing the causation factors that result in the increase of eosinophil levels.

I have some concerns on the data analysis. Firstly, the mean values of percent eosinophils observed in IH patients of 3.96 and in healthy subjects of 1.91, as shown in Table 1, are both still within the normal clinical range of 0-6% EO (Medscape). Thus, the elevated eosinophil levels in IH patients might be interpreted as physiologically irrelevant by clinicians as the values are still within the normal range.

Secondly, whilst the difference of %EO values between IH and healthy subjects is statistically significant, the raw data show that only 15% of the total IH patients and about 5% of the healthy subjects have high %EO values above the normal range of 6%. It would be useful if the authors will include this in their

analysis considering the clinical implications. In addition, the authors should also specify what is the normal range of %EO used in China as this can vary in different clinical laboratories.

Lastly, I think that there are other factors contributing to the observed increase of eosinophil levels that might be present but not measured in this study such as drug treatment given to IH patients, which could be the underlying cause of the increase but not taken into account. This is the limitation of a retrospective study such as this, in which the authors have no control on how the data were designed and collected, and whether the patients received drug treatment or not. The claim of a potential diagnostic usefulness for this study is an overestimation as the causation is not well-established but only through the association. But this is a good pilot study to test the hypothesis that can be further explored.

As a minor comment, it would be useful to include the units used for all the parameters mentioned in the raw haematological data.

**Is the work clearly and accurately presented and does it cite the current literature?**

Partly

**Is the study design appropriate and is the work technically sound?**

Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**

Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**

Yes

**Are all the source data underlying the results available to ensure full reproducibility?**

Yes

**Are the conclusions drawn adequately supported by the results?**

Partly

***Competing Interests:*** No competing interests were disclosed.

***Reviewer Expertise:*** clinical chemistry

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.**

---

The benefits of publishing with F1000Research:

- Your article is published within days, with no editorial bias
- You can publish traditional articles, null/negative results, case reports, data notes and more
- The peer review process is transparent and collaborative
- Your article is indexed in PubMed after passing peer review
- Dedicated customer support at every stage

For pre-submission enquiries, contact [research@f1000.com](mailto:research@f1000.com)

**F1000Research**