Available online at www.sciencedirect.com
ScienceDirect
journal homepage: http://www.elsevier.com/locate/medici

Original Research Article

Infantile hemangioma: Predicting proliferation by infrared thermography

Arūnas Strumila [a], Vytis Kazlauskas [a,*], Gintas Pošiūnas [a], Gilvydas Verkauskas [a], Virgilijus Beiša [b]

[a] Children's Surgery Centre, Faculty of Medicine, Vilnius University, Vilnius, Lithuania
[b] Centre of Abdominal Surgery, Faculty of Medicine, Vilnius University, Vilnius, Lithuania

ARTICLE INFO

Article history:
Received 26 January 2016
Received in revised form
19 March 2017
Accepted 6 April 2017
Available online xxx

Keywords:
Infantile hemangioma
Infrared thermography
Prediction of proliferation
Surface temperature

ABSTRACT

Background and objective: Infantile hemangiomas (IHs) are benign lesions found in infants. Predicting the cosmetic outcome of these lesions is very difficult. Therefore, in this prospective study, we assessed whether using an infrared thermometer (IRT) to measure the surface temperature of IHs would help to predict their proliferative potential.

Materials and methods: Between January 2012 and March 2014, we prospectively investigated 103 children up to 6 months of age with a diagnosis of IH. None of them required immediate treatment. Two projection plain photographs of the IHs were obtained and the temperature of the IH surface was measured with the IRT at each visit. The IHs in these patients were divided into three groups: stable, slightly growing and growing IHs. We analyzed temperature differences between the groups, relative operating characteristic (ROC) curves, and possible application of this method to clinical practice.

Results: The median initial temperatures in the groups were 36.7 °C for the stable group, 37 °C for the slightly growing group, and 37.4 °C for the growing group ($P < 0.01$). The area under the ROC curve for the temperature values to predict growth was 0.929. Temperatures at or above 37.4 °C showed a specificity of 95%, a sensitivity of 75%, a positive predictive value 81%, and a negative predictive value of 95%.

Conclusions: IRT is a time and cost effective tool, and is easy to learn. The surface temperature of IH reflects its remaining growth potential and could be used in the outpatient setting for the evaluation and follow-up of IH.

1. Introduction

Infantile hemangioma (IH) is a benign vascular tumor in infants that is occasionally present at birth, but most often occurs during the first weeks of life. Sometimes IHs are preceded by tiny red papules, telangiectasia, pale macules or pseudoecchymosis, which are present at birth and have a tendency to develop into IH during the first months of life [1,2]. The estimated incidence of IHs varies from 4 to 12% of infants,

* *Corresponding author at*: Children's Surgery Centre, Faculty of Medicine, Vilnius University, Santariškių 7, 08406 Vilnius, Lithuania.
E-mail address: vytkazl@gmail.com (V. Kazlauskas).

http://dx.doi.org/10.1016/j.medici.2017.04.002

Please cite this article in press as: Strumila A, et al. Infantile hemangioma: Predicting proliferation by infrared thermography. Medicina (2017), http://dx.doi.org/10.1016/j.medici.2017.04.002

depending on the studied population. IH is the most common tumor of infancy [3,4]. Unlike other tumor, IH demonstrates a unique natural history. Proliferation and involution have been defined as the main phases of the IH life cycle [5]. Most IHs proliferate until 3–10 months of age and typically start to regress soon after the child's first birthday. The regression process continues for several subsequent years [6,7]. IH is a benign lesion demonstrating no significant invasion or metastasis, but its course may be compromised by ulcerating, bleeding, scarring, disfigurement, airway, oral or visual obstruction, and even cardiovascular complications [8–10]. While most IHs leave little to no residua, some may leave scars, subcutaneous fibro-fatty masses, yellowish discoloration, or telangiectasia [11]. Approximately 10% of the tumor grow rapidly to a significant size and result in the previously listed complications [1]. We have questioned whether it is possible to determine the increased proliferative activity of IH during routine physical examination. Detection of increased proliferative activity is important for physicians to increase their vigilance and consider treatment. Unfortunately, physical examination alone is not objective enough to predict proliferation. Proliferating IH has increased vascularity based on histological examination [5]. As a result, increased microcirculation could be reflected by increased IH surface temperature. We tested the hypothesis that the temperature of the IH surface is indicative of increased proliferative activity.

2. Materials and methods

All patients with IHs between January 2012 and March 2014 were followed up in the Department of Paediatric Surgery. In all cases, IHs were confirmed clinically. Inclusion criteria for the survey were as follows: the patient presented with IHs located along the body axis (head, neck, chest, abdomen, and buttocks), was up to six months of age, had not received previous treatment, and had not been ill for at least 36 h. Informed consent was obtained from all individual participants included in the study.

There were 103 patients who met the inclusion criteria: 63 (61%) were female and 40 (39%) were male. A total of 66 patients had two appointments (the duration of the follow-up was 1 month) and 37 patients had more than two appointments, ranging from three to five appointments (the duration of the follow-ups ranged 2–4 months) accounting for 156 growth evaluations and 260 visits in total. The evaluation of the IHs consisted of a physical examination (palpation), followed by 2 projection plain photographs and measurement of surface temperatures of the IHs after 20 min in the exam room to allow for equilibration. We used the *Microlife* NC 120 infrared thermometer (IRT) to measure temperatures in centigrade. The environmental temperature was constant at 20 °C–22 °C. The temperature of each IH was measured repeatedly until three consecutive measurements demonstrated a constant value. Growth evaluations were performed by comparing the current picture of IH to the one taken a month previous and categorized as stable, slightly growing or growing.

To avoid bias, all photographs were reviewed by the same two independent evaluators, a pediatric surgeon and pediatric surgery resident, for all cases. Our database was arranged by linking the initial temperature of the lesion to the category of its course, detected on a subsequent series of photos. The slightly growing group consisted of only cases in which the two independent evaluators were not in agreement or the growth was segmental (change of shape at one segment).

The Institutional Review Board and the Independent Ethics Committee of Vilnius University approved all aspects of this study.

The normality of data was verified by the Shapiro–Wilk test and a nonparametric comparison with the Mann–Whitney test was performed. Since almost all the data demonstrated nonnormal distribution, they were expressed as medians with 25th and 75th quartiles. The receiver operating characteristic (ROC) analysis was applied to determine sensitivity and specificity of the test. The same statistical operations were performed in the analysis of age distribution in the respective groups to determine the significance of age in predicting proliferative activity of IH. The results were considered significant at $P < 0.05$. All calculations (except the P value) were approximated to one decimal. SPSS 16.0 was used for calculations.

3. Results

Of the 156 IHs evaluated, 100 (64%) were assigned to the stable group; 30 (19%), to the slightly growing group; and 26 (17%), to the growing group. Medians with 25th and 75th quartiles of the temperatures measured in the groups are demonstrated in Table 1. There was a statistically significant difference in the variables in all three groups of proliferative activity. A cut-off value of 37.4 °C was extracted from the ROC curve, which is demonstrated in Fig. 1. Temperature at or above 37.4 °C

Table 1 – The comparison of temperatures and age between the groups by growing profile.

Variable	Growing profile		
	Stable IHs (n = 100)	Slightly growing His (n = 30)	Growing His (n = 26)
Temperature (°C)	36.7 (36.4; 36.9)*,†	37 (36.7; 37.3)*	37.4 (37.2; 37.6)
Age, months	3 (2; 4)‡	3 (2; 4)½	2 (1; 3)

Values are median (25th; 75th quartiles).
*P < 0.01 versus growing. †P < 0.01 versus slightly growing. ‡P < 0.01 versus growing. ½P = 0.02 versus growing (Mann–Whitney test to compare the groups).

Please cite this article in press as: Strumila A, et al. Infantile hemangioma: Predicting proliferation by infrared thermography. Medicina (2017), http://dx.doi.org/10.1016/j.medici.2017.04.002