RESEARCH PAPER

Use of Propranolol in the Treatment of Infantile Hemangioma

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ABSTRACT

Background: Infantile hemangioma (IH) is the most common benign vascular tumor in infancy. Propranolol, a non-selective beta-blocker, has become the standard first-line treatment since its serendipitous discovery in 2008. However, real-world data from the Middle East, particularly Iraq, remain scarce.

Objective: To evaluate the effectiveness and safety of propranolol in treating infantile hemangioma, with particular focus on lesion size reduction, color regression, rate of involution, and the need for surgical intervention.

Methods: A retrospective cohort study was conducted at Raparin Teaching Hospital, Erbil, Iraq, from March 2023 to March 2026. Thirty-five infants diagnosed with infantile hemangioma and treated with oral propranolol (2 mg/kg/day) were included. Outcomes assessed included lesion size reduction, color regression, rate of involution, adverse effects, and the need for surgical intervention.

Results: The cohort comprised 35 patients (mean age at treatment initiation: 4.3 ± 2.1 months; 62.9% female). The most common hemangioma type was superficial (54.3%), and the head/neck region was the most frequently affected site (48.6%). Following propranolol therapy, 71.4% of patients achieved >75% lesion size reduction, and 88.6% demonstrated complete or near-complete color regression. Excellent involution was recorded in 74.3% of cases. The overall response rate was 97.1% (34/35 patients), with 60.0% achieving complete response and 37.1% achieving partial response. Adverse effects were recorded in 22.9% of patients, all mild and self-limiting. Crucially, none of the 35 patients required surgical intervention (0%, 95% CI: 0.0–10.0%), confirming the high efficacy of medical therapy.

Conclusion: Propranolol is highly effective and safe in the treatment of infantile hemangioma, achieving significant lesion regression and complete elimination of the need for surgical intervention in this cohort. These findings support its continued use as first-line medical therapy.

Keywords: Infantile hemangioma, propranolol, beta-blocker, vascular tumor, lesion involution, pediatric surgery, Erbil, Iraq.

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INTRODUCTION

Infantile hemangioma is the most common benign vascular tumor of infancy, occurring in approximately 4–10% of infants worldwide (Bruckner and Frieden, 2006). It is characterized by abnormal proliferation of endothelial cells and typically appears within the first few weeks of life (Bandera et al., 2021). Premature infants are more likely to have a hemangioma, and they occur more frequently in Caucasian infants than Asian infants, and are rare in African-Americans (Kolokythas, 2016).

Infantile hemangiomas usually follow a predictable natural course, consisting of a rapid proliferative phase during early infancy, followed by a slow involution phase that may extend over several years (Itinteang et al., 2014). Although many lesions regress spontaneously without intervention, a significant proportion may lead to functional impairment, cosmetic disfigurement, ulceration, bleeding, or life-threatening complications depending on their size, location, and rate of growth (Hasbani and Hamie, 2022).

There are three types of infantile hemangiomas, categorized by appearance and behavior: Superficial hemangioma (“strawberry mark”), most common type, Deep hemangioma, and Combination (Kilcline and Frieden, 2008).

In 2008, propranolol, a non-selective beta-adrenergic blocker, was serendipitously discovered to induce rapid regression of infantile hemangiomas. Since then, propranolol has become the first-line treatment for complicated infantile hemangioma due to its high efficacy and relatively favorable safety profile(Tan et al., 2021). The proposed mechanisms of action of propranolol include vasoconstriction, inhibition of angiogenesis, induction of endothelial cell apoptosis,

and downregulation of pro-angiogenic factors such as vascular endothelial growth factor (VEGF) (Cuesta et al., 2022).

Occasionally, some testes are performed to make sure that the child can safely take the medication. These may include an electrocardiogram (EKG), or occasionally other laboratory tests, depending upon the child's history and physical examination, and the family history (Yu et al., 2022). If there are several hemangiomas on the child's skin, an ultrasound of the abdomen may be ordered to check for hemangiomas in the liver or spleen, the child is also tested for allergic reaction to propranolol (Krowchuk et al., 2019).

Propranolol oral solution is usually taken twice daily by the dose 2 mg\kg\day, mixed with milk (Baron, 2023). The length of treatment will depend upon the child's individual situation, but most infants are treated until about 12-18 months of age to ensure a maximum response to the medication, and to try to decrease the chance of rebound (repeated growth of the hemangioma after stopping the medicine). The dose is usually gradually lowered over time to see how the hemangioma responds (Tan et al., 2021).

PATIENTS AND METHODS

Study Design and Setting

This is a retrospective cohort study conducted at the Pediatric Surgery Department of Raparin Teaching Hospital, Erbil City, Kurdistan Region of Iraq. The study was carried out over a three-year period from 6 March 2023 to 6 March 2026. Raparin Teaching Hospital is the principal tertiary pediatric referral center serving the Kurdistan Region and its surrounding governorates.

Study Population and Eligibility Criteria

A total of 35 infant patients were enrolled all presenting to the outpatient pediatric surgery clinic during the study period with a clinical diagnosis of infantile hemangioma who met the following criteria were considered for inclusion. Inclusion criteria: Clinical diagnosis of infantile hemangioma confirmed by a pediatric surgeon, age ≤ 12 months at initiation of propranolol therapy, presence of one or more of the following indications for treatment: rapid growth, functional impairment (e.g., periorbital, airway, or oral hemangiomas), risk of ulceration or hemorrhage, and significant cosmetic concern. Exclusion criteria: Contraindications to propranolol, including bronchial asthma or reactive airway disease, congestive heart failure, or cardiac conduction abnormalities, prior treatment with propranolol or any other beta-blocker for hemangioma, known hypersensitivity to propranolol, parents or guardians unwilling or unable to comply with scheduled follow-up visits.

Treatment Protocol

All patients received oral propranolol at a dose of 2 mg/kg/day administered in two divided doses. Treatment was initiated following baseline assessment including measurement of heart rate, blood pressure, and random blood glucose. An electrocardiogram was obtained in selected patients with suspected cardiac anomalies or significant arrhythmia history. Treatment was maintained until the age of 12–18 months or until maximal therapeutic response was achieved, with gradual dose tapering at the end of the treatment course. Follow-up visits were scheduled at two weeks, one month, and then every two to three months thereafter throughout the treatment duration. At each visit, lesion size, color, and texture were reassessed, and adverse effects were documented.

Outcome Measures

The primary outcome measures were: Reduction in maximum lesion size, categorized as none, <25%, 25–50%, 51–75%, or >75%, color regression, categorized as none, mild, moderate, or near complete, and rate of involution, classified as poor, moderate, good, or excellent.

Secondary outcomes included: Time to initial response, defined as the interval from treatment initiation to first observable change in color or size, overall treatment response (complete, partial, or no response), occurrence and characterization of adverse effects, recurrence after cessation of propranolol and final outcome classified as complete involution, partial involution, or persistent lesion. The critical secondary outcome of interest was the rate of surgical intervention.

Data Collection

Data were collected retrospectively from the patient medical records using a standardized data collection tool (questionnaire) specifically designed for this study. Variables collected included patient demographics (sex, date of birth, age at diagnosis, age at treatment initiation), hemangioma characteristics at baseline (type, location, number of lesions, maximum lesion size, pre-treatment color, and complications), treatment details (dose, frequency, duration), effectiveness parameters, safety data, and final outcome.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics version 26.0. Descriptive statistics were used to summarize demographic and clinical data. Continuous variables were presented as mean ± SD or median, while categorical variables

were expressed as frequencies and percentages. The paired samples t-test was used for normally distributed continuous data, confirmed by the Shapiro–Wilk test ($p > 0.05$), and the Wilcoxon signed-rank test was applied for ordinal data. Associations between categorical variables were analyzed using Chi-square or Fisher's exact tests. A p-value < 0.05 was considered statistically significant, and all tests were two-tailed. The 95% confidence interval for surgical intervention rate was calculated using the Wilson score method.

Ethical Considerations

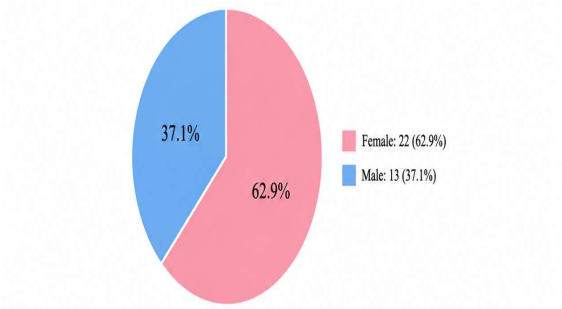
tEthical approval for the study was obtained from he Kurdistan Higher Council of Medical Specialists Medical Research Ethics Committee. Patient data were anonymized prior to analysis, and patient study IDs were used throughout to protect confidentiality. Informed consent for propranolol treatment was obtained from the patients' parents or legal guardians as part of standard clinical care.

RESULTS

Sex Distribution of the Study

A total of 35 patients with infantile hemangioma treated with oral propranolol were included in the study. Females constituted the majority of cases, accounting for 62.9% (22 patients), while males represented 37.1% (13 patients), yielding a female-to-male ratio of 1.7:1 (Figure 1).

Figure 1. Sex distribution of the study (n=35)



Age and Baseline Lesion Size Characteristics

The mean age at diagnosis was 2.6 ± 1.4 months, while the mean age at initiation of propranolol therapy was 4.3 ± 2.1 months. The mean maximum lesion size at baseline was 3.8 ± 1.6 cm as represent on (Table 1).

Table 1. Age and baseline Lesion Size Characteristics (n=35)

Variable	Mean ± SD
Age at diagnosis (months)	2.6 ± 1.4
Age at treatment initiation (months)	4.3 ± 2.1
Maximum lesion size at baseline (cm)	3.8 ± 1.6

Baseline Characteristics of Infantile Hemangioma

Superficial hemangiomas were the most common type, observed in 54.3% of patients, followed by mixed lesions (28.6%) and deep lesions (17.1%). Most patients presented with a single lesion (80.0%), whereas multiple lesions were identified in 20.0% of cases.

The head and neck region were the most frequently affected anatomical site (48.6%), followed by the trunk (22.9%), upper limb (11.4%), lower limb (8.6%), perineal/genital region (5.7%), and other sites (2.9%).

Regarding lesion appearance before treatment, bright red lesions were the most common (57.1%), followed by dark red (25.7%), bluish (14.3%), and skin-colored lesions (2.9%).

Complications prior to treatment were absent in 62.9% of patients. Among patients with complications, ulceration was the most frequent finding (14.3%), followed by functional impairment (11.4%), bleeding (8.6%), and infection (2.9%) as shown in (Table 2).

Table 2. Baseline Characteristics of Infantile Hemangioma (n= 35)

Characteristic	n (%)	Characteristic	n (%)
Hemangioma type		**Pre-treatment color**	
Superficial	19 (54.3 %)	Bright red	20 (57.1 %)
Mixed	10 (28.6 %)	Dark red	9 (25.7 %)
Deep	6 (17.1 %)	Bluish	5 (14.3 %)
Number of lesions		Skin colored	1 (2.9%)
Single Lesion	28 (80.0 %)	**Complication before treatment**	

Multiple Lesion	7 (20.0 %)	No complicatio n	22 (62.9 %)
Location		Ulceration	5 (14.3 %)
Head/Neck	17 (48.6 %)	Functional impairment	4 (11.4 %)
Trunk	8 (22.9 %)	Bleeding	3 (8.6%)
Upper limb	4 (11.4 %)	Infection	1 (2.9%)
Lower limb	3 (8.6%)		
Perineal/Gen ital	2 (5.7%)		
Other site	1 (2.9%)		

Treatment Details

All 35 patients received oral propranolol at a standard dose of 2 mg/kg/day administered in two divided doses. The mean duration of therapy was 9.4 ± 3.2 months, ranging from 4 to 18 months. Treatment was completed successfully as planned in 32 patients (91.4%). Early discontinuation occurred in 3 patients (8.6%); two cases were related to mild adverse effects, while one case was due to parental non-compliance.

Effectiveness Outcomes

A marked clinical improvement was observed following propranolol therapy (Table 3). Regarding lesion size reduction, more than 75% reduction was achieved in 25 patients (71.4%), while 7 patients (20.0%) demonstrated a 51–75% reduction. Only one patient (2.9%) showed less than 25% reduction in lesion size, and no patient demonstrated complete treatment failure.

Substantial improvement in lesion color was also observed. Near-complete color regression occurred in 21 patients (60.0%), moderate regression in 10 patients (28.6%), and mild regression in 3 patients (8.6%). Only one patient (2.9%) showed no color regression. Overall, complete or near-complete color improvement was achieved in 88.6% of patients, representing a highly significant therapeutic response ($p < 0.001$).

The rate of involution was classified as excellent in 26 patients (74.3%), good in 7 patients (20.0%), and moderate in 2 patients (5.7%). No patient had a poor involution response.

A highly significant reduction in mean maximum lesion size was demonstrated after treatment. The mean lesion size decreased from 3.8 ± 1.6 cm before treatment to 0.9 ± 0.8 cm after treatment, with a mean reduction of 2.9 cm (95% CI: 2.4–3.4 cm; $t = 12.8$; $p < 0.001$).

Initial clinical response was observed within the first two weeks in 18 patients (51.4%), between two and four weeks in 13 patients (37.1%), and after more than four weeks in 4 patients (11.4%). The overall response rate was 97.1%, with complete response achieved in 21 patients (60.0%) and partial response in 13 patients (37.1%). Only one patient (2.9%) showed no response to treatment. No patients required surgical intervention during the study period.

Table 3. Effectiveness Outcomes Following Propranolol Therapy (n = 35)

Outcome Measure	n (%)/Mean ± SD	p-value
Lesion Size reduction		<0.001
>75% reduction	25 (71.4%)	
51–75% reduction	7 (20.0%)	
25–50% reduction	2 (5.7%)	
<25% reduction	1 (2.9%)	
Color regression		<0.001
Near complete	21 (60.0%)	
Moderate	10 (28.6%)	
Mild	3 (8.6%)	
None	1 (2.9%)	
Rate of involution		<0.001
Excellent	26 (74.3%)	
Good	7 (20.0%)	

Moderate	2 (5.7%)	
Poor	0 (0.0%)	
Overall response		<0.001
Complete	21 (60.0%)	
Partial	13 (37.1%)	
No response	1 (2.9%)	
Mean lesion size: Before treatment	3.8 ± 1.6 cm	
Mean lesion size: After treatment	0.9 ± 0.8 cm	<0.001*
Surgical intervention required	0 (0.0%)	N/A

Safety Outcomes

Adverse effects were recorded in 8 patients (22.9%). All adverse effects were mild in severity, and none required hospitalization. The most common adverse effect was sleep disturbance, reported in 4 patients (11.4%), followed by gastrointestinal symptoms (nausea, feeding intolerance) in 3 patients (8.6%), and symptomatic bradycardia in 1 patient (2.9%). No episodes of clinically significant hypotension, hypoglycemia, or bronchospasm were recorded. Safety data are summarized in Table 4.

Dose reduction was required in 2 patients (5.7%) due to bradycardia and GI symptoms, respectively. Treatment discontinuation was necessary in 1 patient (2.9%) due to persistent feeding intolerance. All adverse effects resolved following dose reduction or treatment cessation. The clinician's overall safety assessment was rated as 'safe' in 31 patients (88.6%) and 'acceptable' in 4 patients (11.4%).

Table 4. Adverse Effects Profile During Propranolol Therapy (n = 35)

Adverse Effect	n	%
Any adverse effect	8	22.9%
Sleep disturbance	4	11.4%
GI symptoms (nausea, feeding intolerance)	3	8.6%
Bradycardia (symptomatic)	1	2.9%
Hypotension	0	0.0%
Hypoglycemia	0	0.0%
Bronchospasm	0	0.0%
Severity: Mild (all cases)	8	22.9%
Dose reduction required	2	5.7%
Treatment discontinued	1	2.9%
Surgical intervention required	0	0.0%

Follow-up and Final Outcome

At the end of the follow-up period, complete involution was the final outcome in 21 patients (60.0%), partial involution in 13 patients (37.1%), and persistent lesion in 1 patient (2.9%). Recurrence after cessation of propranolol was observed in 3 patients (8.6%), all of whom had superficial hemangiomas with partial initial response and subsequently responded to a second course of propranolol. No patient required surgical intervention at any point during the study period (0/35; 95% CI: 0.0–10.0%). The clinician's overall effectiveness assessment was rated as 'excellent' in 26 patients (74.3%) and 'good' in 8 patients (22.9%), with 'fair' in 1 patient (2.9%), and 'poor' in 0 patients.

DISCUSSION

This retrospective cohort study provides strong evidence supporting the high efficacy and favorable safety profile of oral propranolol at 2 mg/kg/day in the management of infantile hemangioma in a Middle Eastern pediatric population. The most clinically significant finding was that no patient required surgical intervention (0%; 95% CI: 0.0–10.0%), reinforcing the current global shift toward medical rather than surgical management of infantile hemangioma.

The overall response rate of 97.1% observed in this study is consistent with previously published literature. The landmark randomized controlled trial by Léauté (Léauté-Labrèze et al., 2015), demonstrated significant efficacy of propranolol, and subsequent observational studies have reported response rates ranging between 85% and 98%. In the present study, 60.0% of patients achieved complete involution and 74.3% were

rated as having excellent clinical outcomes, which aligns well with these earlier findings and supports the reproducibility of propranolol effectiveness across different populations.

A marked reduction in lesion size was also observed following treatment, further confirming the well-established anti-angiogenic and pro-involution effects of propranolol, which are mediated through vasoconstriction, downregulation of VEGF, and induction of endothelial apoptosis. Early clinical improvement, often within the first two weeks of therapy in more than half of the patients, reflects the characteristic rapid vasoconstrictive response described in prior studies and is frequently the earliest indicator of treatment success.

Although superficial hemangiomas showed higher complete response rates compared to deep and mixed types, the association between lesion type and treatment response did not reach statistical significance ($p = 0.329$). This may be related to the relatively small sample size and the overall high response rate across all subgroups. Nevertheless, the observed trend is consistent with previous reports suggesting that superficial lesions tend to respond more rapidly and completely, while deeper lesions may show slower but still clinically meaningful regression.

The safety profile in this cohort was favorable, with adverse effects occurring in 22.9% of patients. These were mild and transient, mainly consisting of sleep disturbance and gastrointestinal symptoms. Importantly, no serious adverse events such as hypoglycemia, bronchospasm, or hemodynamic instability were observed. This aligns with the previous literatures (Hasbani and Hamie, 2022; Hermans et al., 2013), and supports the safety of propranolol when appropriate screening and monitoring protocols are followed prior to and during treatment.

Recurrence after discontinuation of therapy was observed in 8.6% of patients, which is within the range reported in previous studies (approximately 10–25%). All recurrent cases responded well to a second course of propranolol, further supporting its therapeutic reliability and reusability in clinical practice (Gong et al., 2025).

From a clinical and health-system perspective, the absence of any surgical intervention is particularly important. Surgery was reserved for complicated or residual lesions; however, propranolol has significantly reduced the need for operative management. This finding highlights its impact not only on patient outcomes but also on reducing surgical risks, hospital burden, and healthcare costs.

The predominance of head and neck lesions in this cohort is consistent with epidemiological patterns reported in the literature and may explain the relatively early presentation and initiation of therapy. Early treatment is known to improve outcomes, which may have contributed to the high overall response rate observed in this study.

Several limitations should be considered. The retrospective design may introduce selection and information bias, and the relatively small sample size limits the ability to detect subtle subgroup differences. In addition, the absence of a control group restricts causal interpretation. Standardized imaging and volumetric measurements were not consistently available, and therefore clinical assessment was used in some cases, which may introduce variability. Overall, the findings of this study support propranolol as an effective, safe, and first-line treatment for infantile hemangioma, with excellent clinical outcomes and minimal complications when used appropriately.

CONCLUSION

Oral propranolol at a dose of 2 mg/kg/day represents an effective and well-tolerated first-line therapy for infantile hemangioma. In this study of 35 patients treated at Raparin Teaching Hospital in Erbil, the overall response rate reached 97.1%. More than 75% reduction in lesion size was observed in 71.4% of cases, while near-complete or complete color regression occurred in 88.6%. In addition, 74.3% of patients achieved an “excellent” involution outcome. Importantly, no patient required surgical intervention, highlighting the ability of propranolol to avoid operative management in most cases. Reported adverse effects were mild, transient, and consistent with findings in the literature. Overall, these results support propranolol as the standard treatment for infantile hemangioma in the Kurdistan Region of Iraq and emphasize that early initiation and adequate treatment duration are essential for optimal outcomes.

RECOMMENDATIONS

Future prospective, multicenter studies with larger sample sizes and standardized outcome measures are recommended to further validate these findings in the regional population.

REFERENCES

Bandera, A.I.R., Sebaratnam, D.F., Wargon, O., Wong, L.-C.F., 2021. Infantile hemangioma. Part 1: epidemiology,

pathogenesis, clinical presentation and assessment. J. Am. Acad. Dermatol. 85, 1379–1392.
Baron, S., 2023. Propranolol, in: Handbook of Systemic Drug Treatment in Dermatology. CRC Press, pp. 215–219.
Bruckner, A.L., Frieden, I.J., 2006. Infantile hemangiomas. J. Am. Acad. Dermatol. 55, 671–682.
Cuesta, A.M., Gallardo-Vara, E., Casado-Vela, J., Recio-Poveda, L., Botella, L.-M., Albiñana, V., 2022. The role of propranolol as a repurposed drug in rare vascular diseases. Int. J. Mol. Sci. 23, 4217.
Gong, C., Yue, X., Zhang, L., Zhao, X., Shu, Q., 2025. Prevalence and Risk Factors Associated with the Recurrence of Infantile Hemangiomas After Discontinuation of Propranolol: A Systematic Review and Meta-Analysis. J. Clin. Med. 14, 7846.
Hasbani, D.J., Hamie, L., 2022. Infantile hemangiomas.
Hermans, D., Bauland, C., Zweegers, J., Van Beynum, I., Van Der Vleuten, C., 2013. Propranolol in a case series of 174 patients with complicated infantile haemangioma: indications, safety and future directions. Br. J. Dermatol. 168, 837–843.
Itinteang, T., Withers, A.H., Davis, P.F., Tan, S.T., 2014. Biology of infantile hemangioma. Front. Surg. 1, 38.
Kilcline, C., Frieden, I.J., 2008. Infantile hemangiomas: how common are they? A systematic review of the medical literature. Pediatr. Dermatol. 25, 168–173.
Kolokythas, A., 2016. Vascular malformations and their treatment in the growing patient. Oral Maxillofac. Surg. Clin. 28, 91–104.
Krowchuk, D.P., Frieden, I.J., Mancini, A.J., Darrow, D.H., Blei, F., Greene, A.K., Annam, A., Baker, C.N., Frommelt, P.C., Hodak, A., 2019. Clinical practice guideline for the management of infantile hemangiomas. Pediatrics 143, e20183475.
Léauté-Labrèze, C., Hoeger, P., Mazereeuw-Hautier, J., Guibaud, L., Baselga, E., Posiunas, G., Phillips, R.J., Caceres, H., Lopez Gutierrez, J.C., Ballona, R., 2015. A randomized, controlled trial of oral propranolol in infantile hemangioma. N. Engl. J. Med. 372, 735–746.
Tan, X., Guo, S., Wang, C., 2021. Propranolol in the treatment of infantile hemangiomas. Clin. Cosmet. Investig. Dermatol. 1155–1163.
Yu, L., Wei, L., Xu, Z., Zhang, B., Han, X., Sun, Y., Liu, Y., Wang, C., Qiu, L., Xiu, B., 2022. Safety assessment of propranolol for infantile hemangioma: a study in an Asian population. Expert Rev. Clin. Pharmacol. 15, 237–242.