




# Initial experience with a multidisciplinary approach for the management of complex vascular anomalies

Jorge Alejandro Oliveros Rivero<sup>\*1,2</sup>, Daniel Benigno Acosta Farina<sup>1,2</sup> , Angella Romina López Cedeño<sup>1,2</sup>

1. Postgraduate in Pediatric Surgery, Postgraduate Faculty, Universidad Católica Santiago de Guayaquil - Ecuador.
2. Department of Pediatric Surgery, Children's Hospital "Dr. Roberto Gilbert Elizalde," Guayaquil Welfare Board, Ecuador.

## Abstract

**Introduction:** Vascular anomalies (VAs) are constituted by a broad spectrum of alterations, including tumors and vascular malformations, and pediatric patients with vascular anomalies usually benefit from the contributions made by a multidisciplinary team approach. This study aimed to describe the initial experience of a multidisciplinary approach group for managing complex vascular anomalies in pediatric patients.

**Methodology:** This observational study of pediatric patients (< 18 years) presented and analyzed a group of vascular anomalies in Ecuador from November 2019 to May 2022. Diagnoses were compiled according to the International Society for the Study of Vascular Anomalies, the location of the lesion, the treatment offered, complications, and evolution; patients with uncomplicated infantile hemangioma and congenital hemangioma were excluded.

**Results:** Forty-five patients with vascular anomalies were included, of whom 53% were female and 47% were male. The mean age at presentation was 5.93 years, 78% had vascular malformations, and 22% had vascular tumors. Venous vascular malformations were the most frequent at 22%, and lymphatic malformations were the most frequent at 16%. The most frequent location was the head/face affected by venous-type vascular malformations, with 29%. At least one symptom was present in 89% of the patients; the most commonly used treatment was sclerotherapy in 36.36%.

**Conclusion:** This is the first report made in Ecuador of a multidisciplinary team that treats complex VA in children according to the reviewed bibliography, affirming that VA is a great challenge due to the broad spectrum of pathologies. The multidisciplinary team guarantees complete management in complex VA cases, achieving an adequate diagnosis to offer the best therapeutic options for the pediatric patient.

## Keywords:

**MESH:** Child; Vascular Malformations; Blood Vessels; Vascular Diseases; interdisciplinary research.

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\* Corresponding author.

## Introduction

Vascular anomalies (VAs) comprise a broad spectrum of blood and lymphatic vessel abnormalities, including tumors and vascular malformations [1].

In 1996, the International Society for the Study of Vascular Anomalies (ISSVA) was formed. It divided VAs into two large groups, vascular tumors (VT) and vascular malformations (VM), and described the etiology and clinical manifestations based on histopathological and imaging studies. A summary of the latest update of the ISSVA classification published in 2018 is shown in Tables 1 and 2.

VTs are characterized by proliferation and hyperplasia of endothelial cells. Instead, VMs are secondary to inborn errors in vascular morphogenesis leading to malformed, ectatic, and dilated vessels [3].

Although 26 years have passed since the formation of the ISSVA, many terms are still being misused to describe the pathologies that belong to VTs and VMs, leading to an inaccurate diagnosis and inadequate treatment. [4].

Given the great diversity of presentations with which VAs can manifest and the extensive anatomical distribution that they can affect, it is understandable that a single medical specialty cannot encompass all the knowledge and experience sufficient for diagnosing and treating VAs [5]. In our hospital, we are not exempt from this reality, which is why we agree that a multidisciplinary team best treats patients with VA with experience in these pathologies, for which the vascular anomalies group was formed in November 2019.

This study's objective was to describe a multidisciplinary group's initial experience in managing complex vascular anomalies in pediatric patients in a tertiary care hospital.

## Population and methods

### Design of the investigation

This trial is an ambispective, cross-sectional observational study.

### Scenery

The study was carried out in the pediatric surgery service of the Dr. Roberto Gilbert Elizalde Children's Hospital of the Guayaquil Benevolent Board in Guayaquil-

Ecuador. The study period was from November 1, 2019, to May 31, 2022.

**Table 1.** Classification of vascular anomalies according to the ISSVA

<b>Benign tumor</b>
infantile hemangioma
congenital hemangioma
rapidly involutory
partially involutory
nonrevoluntary
Lobulated capillary hemangioma (pyogenic granuloma)
Tufted Angioma*
<b>Locally aggressive or borderline tumor</b>
Kaposiform hemangioendothelioma*
Kaposi's sarcoma
Intralymphatic papillary hemangioendothelioma (Dabska tumor)
<b>Malignant tumor</b>
angiosarcoma
Epithelioid hemangioendothelioma
<b>simple malformations</b>
capillaries
lymphatic
venous
arteriovenous
Arteriovenous fistula
<b>combined malformations</b>
Two or more vascular malformations
<b>malformations of great vessels</b>
<b>Malformations associated with other anomalies</b>
Klippel-Trenaunay syndrome
Parkes-Weber syndrome
Servelle-Martorell syndrome
Sturge-Weber syndrome
Capillary malformation in extremity associated with nonprogressive congenital hypertrophy
Maffucci syndrome
Capillary malformation-macrocephaly
Capillary malformation-microcephaly
CLOVES syndrome
Proteus syndrome
Bannayan-Rile Ruvalcaba syndrome
CLAPO syndrome

Full version available at [issva.org/classification](https://issva.org/classification); \*Some consider these two entities part of the same spectrum rather than two different entities.

### Inclusion criteria

Hospitalized pediatric patients with an established diagnosis of complex VA entered the study. A complex VA committee was formed to analyze each case. Incomplete records were excluded from the analysis, as were patients with a diagnosis of focal and superficial IH, as well as congenital hemangiomas, which were treated directly by specialists in the area of dermatology.

Studio size

The universe was patients admitted to the institution. The sampling was nonprobabilistic for convenience, and all possible cases were included in the study period.

Variables

The variables were diagnosis, age, VA location, and type of treatment.

Data sources/measurement

The data were collected in a specific electronic form for this purpose. The hospital's electronic system of clinical records was used to investigate cases. Institutional specialists from pediatrics, dermatology, pediatric surgery, plastic surgery, imaging, interventional imaging, hemodynamics, cardiovascular surgery, maxillofacial surgery, gastroenterology, ophthalmology, hematology, cardiology, pathology, traumatology, otorhinolaryngology, and urology participated in the VA group. Neurosurgery, pediatric surgery residents, and pediatric residents meet every 15 days for the presentation and analysis of all patients with complex VA referred from the different services that make up the hospital to make the correct diagnosis and offer the best treatment according to the case. All patients had to present adequate information collected in the interrogation, in addition to blood count, PT, PTT, D money, fibrinogen, and Doppler ultrasound, simple and contrast-enhanced MRI, and in some cases, simple and contrast-enhanced computed tomography. Data were recorded by a research physician who attended VA group meetings. This revision commits included a review of the clinical history, history of the injury, previous treatment, physical examination, laboratory tests, imaging studies, biopsy if any, and a diagnosis that was established using the nomenclature recommended by the ISSVA classification of 2018 and the follow-up after the presentation of each case.

Statistical method

The data analysis is univariate and descriptive with frequencies and percentages. The statistical package SPSS v.22 (version 2013, Armonk, NY: IBM Corp.) was used for the analysis.

Results

Forty-five cases were analyzed (Table 2). Initially, 49 patients were presented in the VA group, of which four were discarded since they were not pathologies with the definition of VA, excluding an immature cervical teratoma, necrotizing granulomatous panniculitis in the thorax, left infra-diaphragmatic pulmonary sequestration, and a hamartoma of the right shoulder.

General characteristics of the study group

Of a total of 45 patients with VA, of whom 24 (53%) were female and 21 (47%) male, according to the ISSVA classification, 35 (78%) had vascular malformations, and 10 (22%) had vascular tumors. Table 2 shows a summary of the different types of VA diagnosed. The age range at presentation in the VA group was 0.002 to 17 years, with a mean of 5.93 years.

Table 2. Distribution of patients with VA according to the ISSVA classification.

Diagnosis	Fre- quency (n=45)	Perce- ntage
MV: venous	10	22%
MV: macrocystic lymphatic	7	16%
MVM: arterial and venous	5	11%
vascular tumor	3	7%
MVM: arterial, venous, and lymphatic	3	7%
MVM: venous and lymphatic	2	4%
CVS: hereditary hemorrhagic telangiectasia	2	4%
TV: Kaposiform hemangioendothelioma	2	4%
MVV: BEAN syndrome	2	4%
TV: Hepatic hemangioma	2	4%
MVM: arterial, venous, and capillary	2	4%
TV: Deep infantile hemangioma	1	2%
MV: microcystic lymphatic	1	2%
TV: Tufted Angioma	1	2%
MVL: Primary congenital lymphedema	1	2%
TV: subglottic hemangioma	1	2%

MV: vascular malformation; MVM: mixed vascular malformation; VT: vascular tumor; CVS: capillary vascular malformation; MVV: venous vascular malformation; MVL: Lymphatic vascular malformation.

Table 3 summarizes the most frequent topographic location of the VA, showing that VMs in the head/face were the most frequent with 10 (29%) patients, and in the case of VT, the most frequent was in the chest with 3 (27%) patients.

**Table 3.** Distribution of patients with VA according to topographic location.

Location	MV N=35	%	TV N=10	%
Head face	10	29	1	10
Neck	3	9	2	20
Chest	1	3	3	30
Abdomen	1	3	-	-
Genitals	1	3	-	-
Superior members	6	17	--	-
Lower limbs	6	17	1	10
subglottic	-	-	1	10
Liver	-	-	2	20
Multiple locations (>2)	7	20	0	0

MV: vascular malformation; VT: vascular tumor.

A total of 40 (89%) patients attended due to presenting at least one symptom, among which we can describe the presence of a tumor that could be accompanied by pain, body asymmetry, functional limitation, aesthetic problems, and other symptoms that were reported. They were stridor, melena, acrocyanosis, asthenia accompanied by pallor.

Of the patients diagnosed in the group of vascular anomalies, 4 (8.8%) patients presented complications due to VA, 2 (4.4%) manifested Kasabach-Merritt syndrome, which was VT, and 1 (2.2%) died as a consequence of VA. Disseminated intravascular coagulation with a diagnosis of mixed venous and extensive lymphatic type VM. Another patient (2.2%) presented respiratory distress and was diagnosed with lymphatic type VM at the cervical level.

The 45 patients included in this study were diagnosed according to the ISSVA classification, of which 23 (51%) had not yet received the indicated treatment, and 22 (49%) patients had been treated. The summary can be seen in Table 4, the type of treatment received.

**Table 4.** Distribution of the type of treatment received by VA patients.

Type of treatment	Frequency n=45	%
Pending treatment	23	51%
Sclerotherapy	8	18%
Surgery	3	7%
embolization	2	4%
Embolization + propranolol	2	4%
Sirolimus	2	4%
Embolization + surgery	1	2%
Embolization + Sirolimus + vincristine	1	2%
Sclerotherapy + Sirolimus	1	2%
High on request	1	2%
Propranolol	1	2%

The treated patients remained in follow-up with good evolution; however, 2 (9.09%) patients presented complications: one patient presented left facial paralysis after resection of a vascular tumor in the malar region, which improved with physical therapy, and one patient presented dehiscence of the wound after partial resection of a mixed vascular malformation (arterial - venous) of the right malar region, which improved with conservative treatment.

## Discussion

The main challenge of VA is diagnosis. As has been reported in several studies, more than half (53%) of the patients referred to specialized VA centers were misdiagnosed, which results in inappropriate treatment, including improper use of drugs, radiation, surgery, sclerotherapy, and embolizations [6, 7]. Therefore, the support of a multidisciplinary team is essential to provide patients with a diagnosis from the first consultation, guaranteeing optimal treatment.

For a long time, VAs were named with erroneous terms; however, work has been incessant to achieve a universal nomenclature that has been frequently updated, the last being published in 2018 by the ISSVA [2, 5]. This classification has been applied to all our patients, which allows us to diagnose VA more efficiently and to be able to offer adequate treatment in each case. However, we cannot forget that these pathologies form part of a spectrum, and many have not yet been located in no specific classification.

In this study, only patients with complex VAs that required multidisciplinary management were included, and infantile or simple congenital hemangiomas were not included since they are treated on an outpatient basis by dermatology similar to those reported in other published studies [8]; therefore, the 45 patients diagnosed with VA in our group do not represent the total number of VAs treated in our hospital.

The sex most frequently presented VA in this study was female with 53%; a similar result was observed in the study published by Lidsky et al. [9], where women predominated with 56.3%.

In the study published by Sires et al. [8], the authors reported that the highest proportion of patients with VA presented MV, representing 88% and

7.5% VT, similar to the present study, in which we observed that 78% of the cases presented MV.

Venous VMs were the most frequent VA in our study; 10 (22%) cases were diagnosed; this is similar to what is reported in the world literature, where the highest proportion is given by venous-type MVs, which can range between 36.7% and 70% [7, 10].

The topographic locations most affected by VMs were the head (29%) and neck (9%), similar to what was published by Cuervo et al. [5], where 46.1% of VMs affected the head and neck. In the study conducted by Ng et al. [11], 43% of all VAs affected the head and neck.

Symptomatic VAs were the most frequent in our study, occurring in 89% of cases. In the study published by Sires et al. [8], symptomatic VAs were also the most frequent, with more than 95% of the cases. It is essential to mention that VAs can be complicated as part of the natural evolution of the disease, as evidenced in this study where 4 (8.8%) patients presented complications, 2 (4.4%) with VT presented Kasabach-Merritt syndrome, one improved with the use of vincristine and sirolimus and the other with systemic steroid combined with sirolimus and sclerotherapy, one (2.2%) patient with extensive mixed venous and lymphatic type VM died as a result of disseminated intravascular coagulation and another patient (2.2%) presented respiratory distress which had a diagnosis of cervical lymphatic type MV which improved with the use of intravenous steroid combined with sclerotherapy and sirolimus.

Of the 22 (49%) patients treated in this study, it was observed that the most used therapeutic method was sclerotherapy, which was performed in 8 (36.36%) patients, similar to that reported by Lidsky and collaborators [9], who in the 29.5% of the cases applied sclerotherapy. This is because most VAs are venous-type MVs followed by lymphatic-type ones, which respond very well to sclerotherapy with bleomycin, as reported by Salinas et al. [12]. In a study published in our center in 2018, in cases of venous-type VM that require applying sclerotherapy with the Tessari method to form foam, we recommend using bleomycin with polidocanol as recommended by Yang et al. [13] in their study, since this combination with polidocanol allows its detergent base to form more stable foam, which is not achieved by trying to use bleomycin alone.

Although 100% of the patients presented in the VA group already have a diagnosis and the best therapeutic plan has been selected according to each case, 51% of the patients have not attended to receive the proposed treatment, and this is due to the COVID pandemic, being in homes far from our center, in addition to the inability to obtain sirolimus and sclerosants for these patients for different reasons.

Complications of therapy depend on the nature of the injury and the type of intervention performed. In this study, 2 (9.09%) complications were detected after treatment, which does not differ from other similar studies in which they report a complication of 6.8% to 7.4% [9].

In this study, there are several limitations. First, despite being an ambispective review, it is not randomized, which does not allow us to make comparisons between treatments such as sclerosants. Some patients have received previous therapies before being referred to our group, and we did not include these treatments in our study due to the difficulties in collecting and evaluating data on these treatments, for which only the management implemented in our hospital was included. Finally, as an institution, we do not have the administrative availability to acquire sirolimus, bleomycin or polidocanol, which in most cases delays the start of treatment.

We recommend carrying out studies with a more significant number of patients and including instruments to assess patients' quality of life before and after treatment.

## Conclusions

The experience presented in this study is the first report made in Ecuador of a multidisciplinary team that treats complex VAs in children; according to the reviewed bibliography, VAs continue to be a great challenge for physicians due to the broad spectrum of pathologies that comprise them that require the attention of more than one specialist. The multidisciplinary team guarantees complete management in complex VA cases, achieving an adequate diagnosis to offer the best therapeutic options for the pediatric patient.

## Abbreviations

VA: vascular abnormalities.  
MV: vascular malformation.  
MVM: mixed vascular malformation.  
VT: vascular tumor.  
CVS: capillary vascular malformation;  
MVV: venous vascular malformation;  
MVL: Lymphatic vascular malformation.

## Supplementary information

None declared by the authors.

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## Author contributions

Jorge Alejandro Oliveros-Rivero: Data curation, research, acquisition of funds, Supervision, Methodology.  
Daniel Acosta Farina: Conceptualization, Data Conservation, Fund Acquisition, Research.  
Angella Romina López Cedeño: Conceptualization, Data Retention, Fundraising, Research, Resources, Software, Writing - original draft.

All authors read and approved the final version of the manuscript.

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## Availability of data and materials

The data sets generated and analyzed during the current study are not publicly available due to participant confidentiality but are available through the corresponding author upon reasonable academic request.

## Statements

### Ethics committee approval and consent to participate

The Ethics Committee approved the research protocol of the Teaching Committee of the Dr. Roberto Gilbert Elizalde Children's Hospital.

### Publication consent

It is not required in articles in which physical examination images, radiographs, tomography, or magnetic resonance studies are not published.

### Conflicts of interest

The authors declare no conflicts of interest.

## Author Information

**Jorge Alejandro Oliveros Rivero:** Surgeon from the Francisco de Miranda National Experimental University (Venezuela, 2015).

**Daniel Benigno Acosta-Farina:** Doctor of Medicine and Surgery from Santiago de Guayaquil Catholic University (Guayaquil, 2004). Specialist in Pediatric Surgery from the Autonomous University of Barcelona (Barcelona, 2007). Specialist in Health Services Management from the Escuela Superior Politécnica del Litoral (Guayaquil, 2007).

**Angella Romina López Cedeño:** Physician from the Catholic University of Santiago de Guayaquil, (Guayaquil, 2008). Specialist in pediatrics from the Catholic University of Santiago de Guayaquil (Guayaquil, 2015). Higher local development and health diploma from the Private Technical University of Loja (Loja, 2017). Specialist in Medicine (Pediatric Dermatology) from the Autonomous University of Mexico (Mexico, 2018).



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