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In Vivo Microvascular Patterns of Human Vocal Folds With Polyps Assessed by Rigid and Contact Laryngeal Endoscopy

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ABSTRACT

Background: Microvascularization of the superior membranous surface of the human vocal fold tends to be parallel to its long axis. That vascular pattern changes in the presence of disease. Objective: To describe the microvascular alterations observed in human vocal folds affected by vocal fold polyp using rigid and contact laryngeal endoscopy. **Methods:** A retrospective descriptive study was conducted in 11 patients of both sexes with histopathologically confirmed vocal fold polyps who underwent laryngeal microsurgery associated with rigid and contact laryngeal endoscopy. D'Ávila's classification (2002) was used to characterize microvascular alterations in three anatomic regions of the vocal fold: superior membranous surface, superior cartilaginous surface, and subglottic surface. Results: All 12 microvascular patterns described by D'Ávila were identified. Seventy-four altered microvessels were observed, predominantly ectatic parallel vessels and branching network vessels. Branching network microvessels were identified on the surface of the polyp. Conclusion: Vocal fold microvascularization is altered in the presence of polyp. The presence of a branching network microvascular pattern on the surface of a single or multiple vocal fold lesion strongly suggests vocal fold polyp.

Keywords: Rigid laryngoscopy; Contact laryngoscopy; Vocal fold polyp; Laryngeal microvascularization

INTRODUCTION

Microvascularization of the superior membranous surface of the human vocal fold tends to follow the longitudinal axis of the vocal fold, a pattern that reduces resistance to the mucosal wave during phonation [1,17,32]. This vascular arrangement may be modified in the presence of laryngeal disease [9,14].

In 1874, Fraenkel described a case of vocal fold hemorrhage and associated it with dysphonia [17]. Since then, several studies have examined the vascularization of the human vocal folds, although relatively few have focused on the microvascular changes that accompany benign vocal fold lesions [11,15,16].

Pontes, Behlau, and Gonçalves described abnormalities of the subepithelial vascular network as vasculodysgenesis [34]. Later, D'Ávila proposed a descriptive classification of microvascular alterations based on changes in vessel caliber, direction, and anastomoses [14].

The introduction of rigid and contact laryngeal endoscopy by Andréa and collaborators enabled in vivo and in situ anatomic and histologic evaluation of the superficial layer of the larynx during suspension microlaryngoscopy [2-6].

Vocal fold polyps are more frequent in male individuals and are commonly associated with vocal abuse. They usually arise in the anterior half of the membranous vocal fold and show considerable variability in shape, color, size, and vascularization [13,28,29,36].

OBJECTIVE

The primary objective of this study was to describe the types of microvascular alterations observed in human vocal folds affected by polyp using rigid and contact laryngeal endoscopy (Figures 1 and 2).

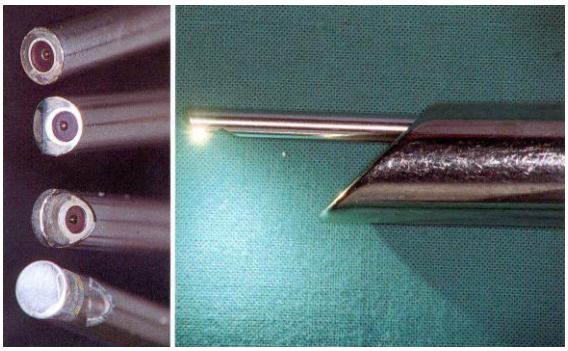

Figure 1: Rigid Endoscopy Micro Surgery. Karl-Storz brand, 25 cm long, 4mm

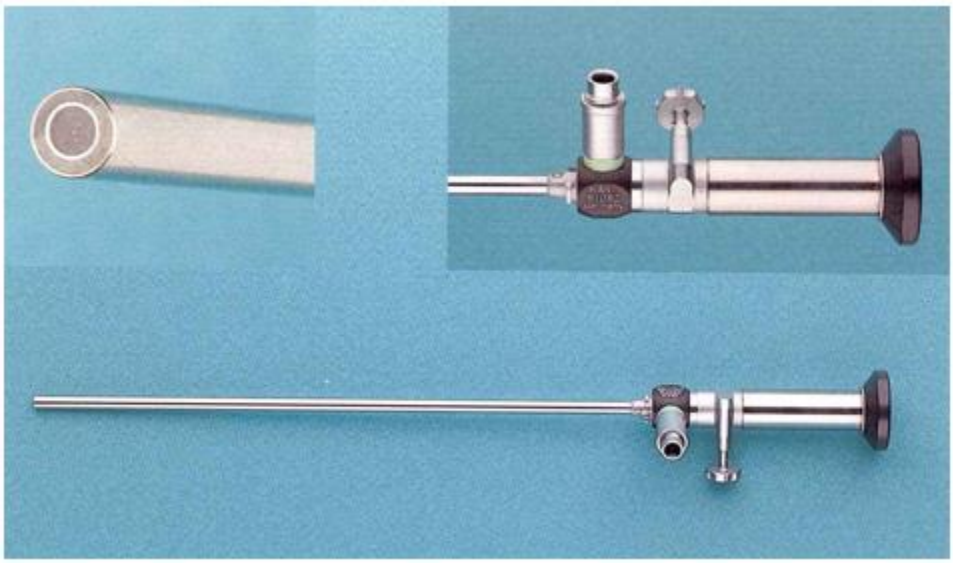

Figure 2: Contact endoscope, Karl-Storz brand, 25 cm long, 5 mm in diameter, with 0º angulation and 60x and 150x magnification (Hopkins model).

Specific objectives were: (1) to describe associated pathologic alterations in the vocal fold affected by polyp; (2) to describe microvascular alterations in the contralateral vocal fold; and (3) to describe pathologic alterations in the contralateral vocal fold.

MATERIALS AND METHODS

This retrospective descriptive study was conducted during a period of 2 consecutive years. Patients were evaluated underwent rigid endoscopy and surgery at São Lucas Hospital and Pronto Clínica Hospital, all located in Aracaju, Sergipe, Brazil.

Initially, 16 patients of both sexes with videostroboscopic findings suggestive of vocal fold polyp who underwent laryngeal microsurgery were assessed. Five patients were excluded because histopathologic examination did not confirm the diagnosis of polyp, resulting in a final sample of 11 patients.

Inclusion criterion: patients with histopathologic confirmation of vocal fold polyp.

Data were extracted from medical records and surgical forms. Patients were evaluated transoperatively by two otorhinolaryngologists before and after polyp removal, always using the same sequence of 0°, 30°, 70°, and 120° rigid endoscopes followed by the contact endoscope.

For video documentation analysis, the vocal folds were divided into three Anatomic Areas d'Avila: area I, superior membranous surface; area II, superior cartilaginous surface; and area III, subglottic surface (Figures 3 to 7).

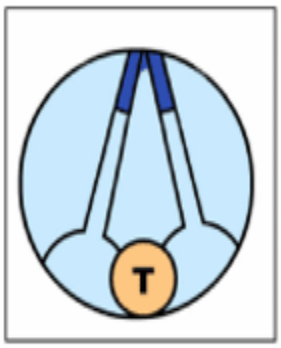

Figure 3: Area I

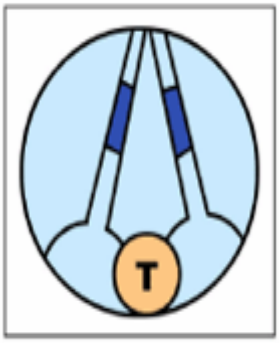

Figure 4: Area II

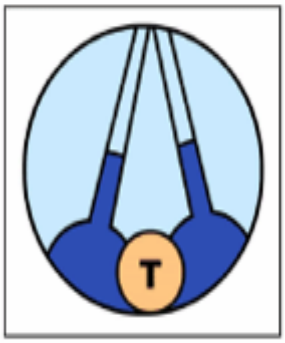

Figure 5: Area III

Anatomical Areas d'Avila (d'Avila, 2023)

Microvascular alterations were classified according to D'Ávila's 2002 system, which includes four main groups-parallel, transverse, punctiform, and branching vessels—with their respective subtypes [14].

The study was approved by the Research Ethics Committee of the University Hospital of the Federal University of Sergipe. CAAE – 0924.0.0000.107-06.

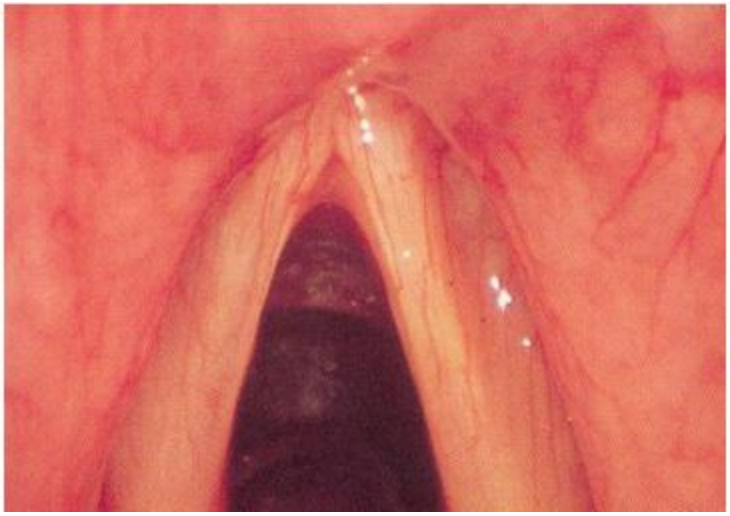

Figure 6: Area I and II (d'Avila). Superior membranous surface of the PVs, identified through the 0º REMS. (D'Ávila)

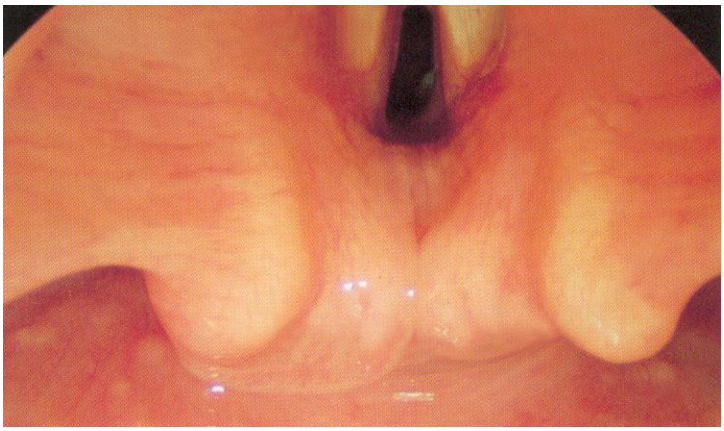

Figure 7: Area III (d'Avila).Posterior cartilaginous surface of the PVs, identified through the 0º REMS. (Cunha)

RESULTS

Eleven patients with vocal fold polyp were identified: 10 male patients (91.9%) and 1 female patient (9.1%). Age ranged from 32 to 47 years, with a mean age of 42.18 years. Three patients were 31–40 years old and eight were 41–50 years old.

Ten patients had unilateral polyp (90.9%) and one had bilateral polyp (9.1%). All patients reported vocal abuse, and five (45.5%) reported smoking.

In the 12 vocal folds affected by polyp, 74 altered microvessels were identified. The most frequent patterns were parallel ectatic (27.0%), branching network (13.6%), and mild tortuous parallel (12.1%). Branching network microvessels were observed on the surface of the polyp.

Most microvascular alterations were concentrated in area I (superior membranous surface), followed by area II (superior cartilaginous surface) and area III (subglottic surface).

Regarding polyp type, five lesions were fibrous (41.7%), four were hemorrhagic (33.3%), and three were gelatinous (25.0%).

Half of the vocal folds affected by polyp presented associated pathologic alterations. Among contralateral vocal folds, one was considered normal and nine showed pathologic changes.

In contralateral vocal folds, 23 altered microvessels were identified, with predominance of the parallel ectatic pattern (34.9%).

Below we present the various types of microvascular changes in the vocal folds affected by polyps, individually identified. All figures presented were extracted from the case studies of the research (Figures 8 to 20).

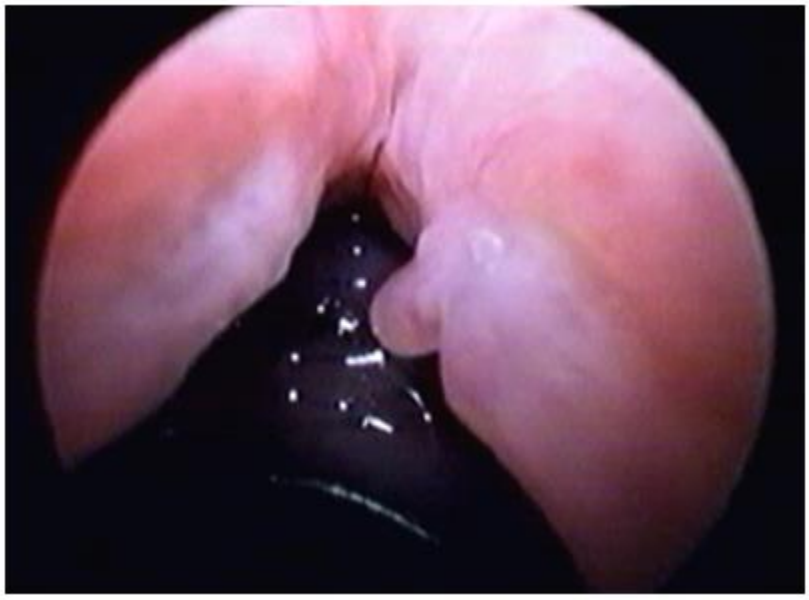

Figure 8: Subglottic surface of the PVs, identified through the 120º REMS. A-1: Parallel amputated: presents sudden interruption.

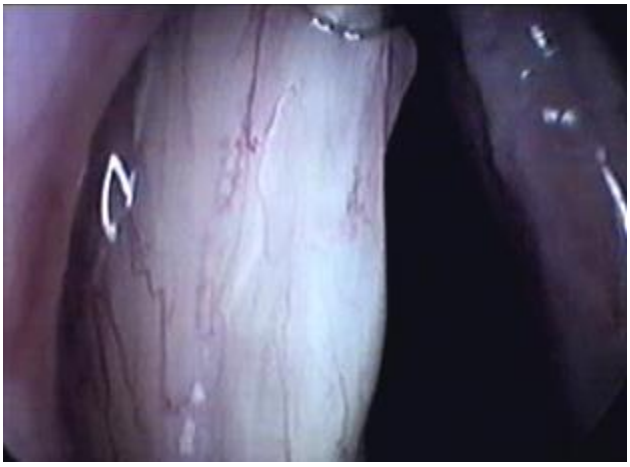

Figure 9: Amputated parallel microvessel, identified using the 0º REM and located in Area I.

A-2: Ectatic Parallel: presents widening of the caliber

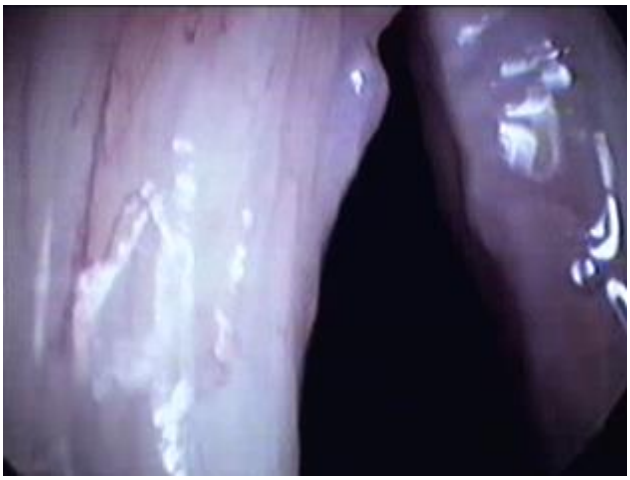

Figure 10: Ectatic parallel microvessel, identified through the 0º REMS and located in area I.

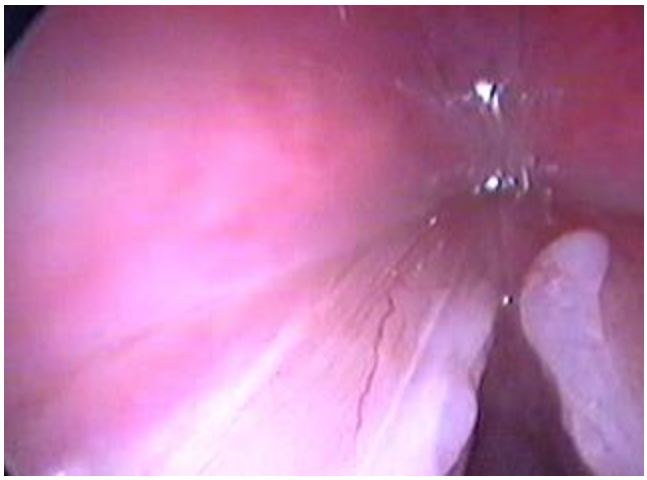

Figure 11: Mild tortuous parallel microvessel, identified using the 70º REMS and located in Area I.

Figure 12: Parallel corkscrew-type microvessel, identified through CEMS and located in area I.

Figure 13: Parallel loop microvessel, identified through CEMS and located in area I.

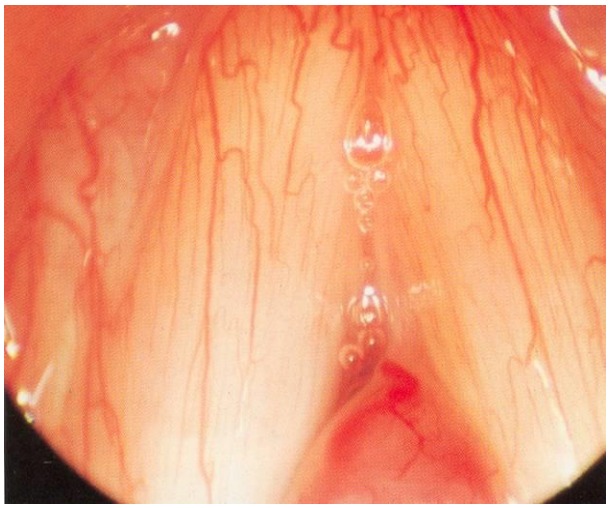

Figure 14: Parallel with anastomosis: presents lateral communication with other vessels

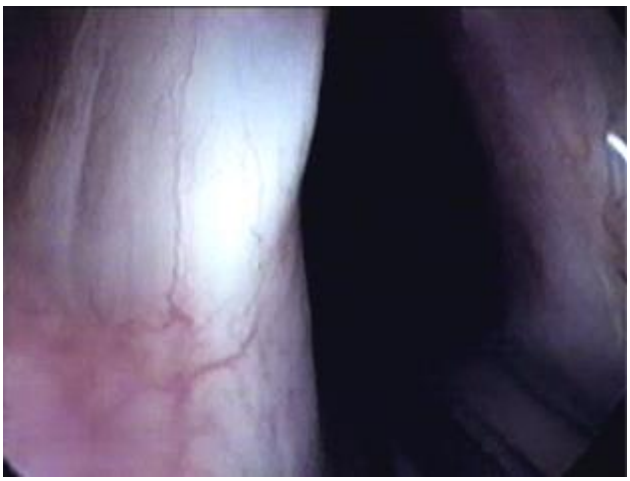

Figure 15: Single sinuous transverse microvessel, identified by the 0º REMS and located in area II.

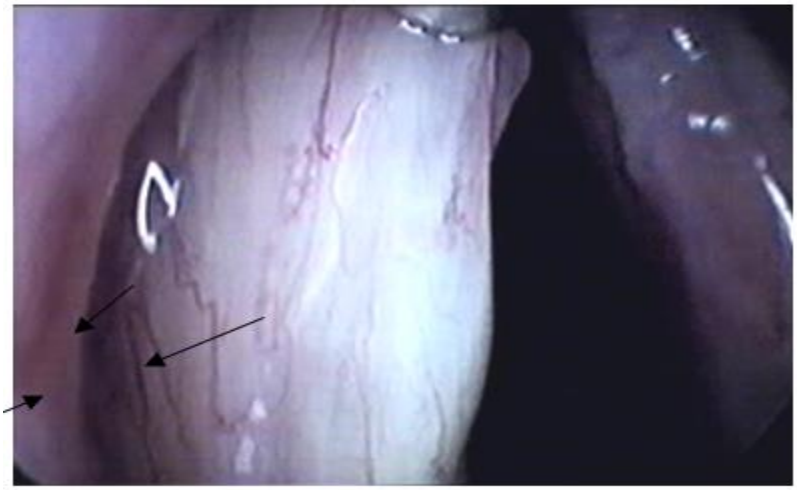

Figure 16: Multiple sinuous microvessel, identified through the 0º REMS and located in area II.

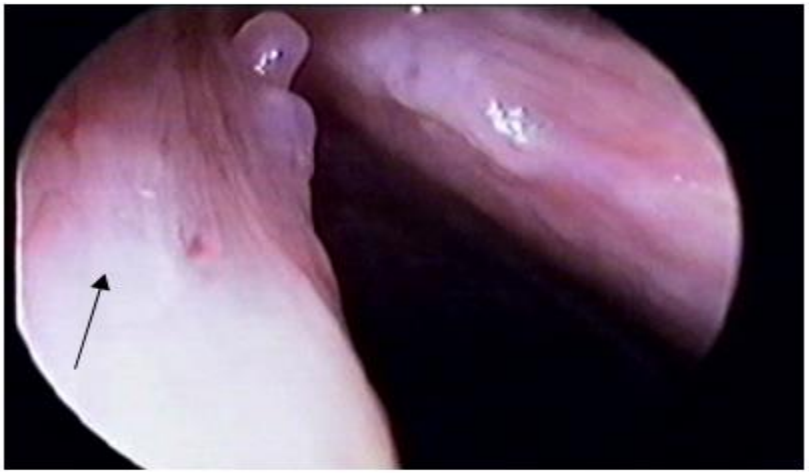

Figure 17: Single punctiform microvessel, identified using the 70º REMS and located in area I.

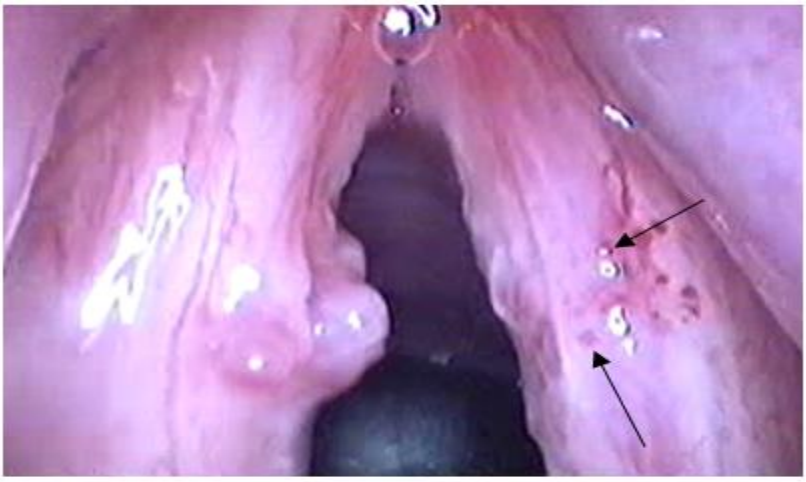

Figure 18: Multiple punctiform microvessel, identified through the 0º REMS and located in area I.

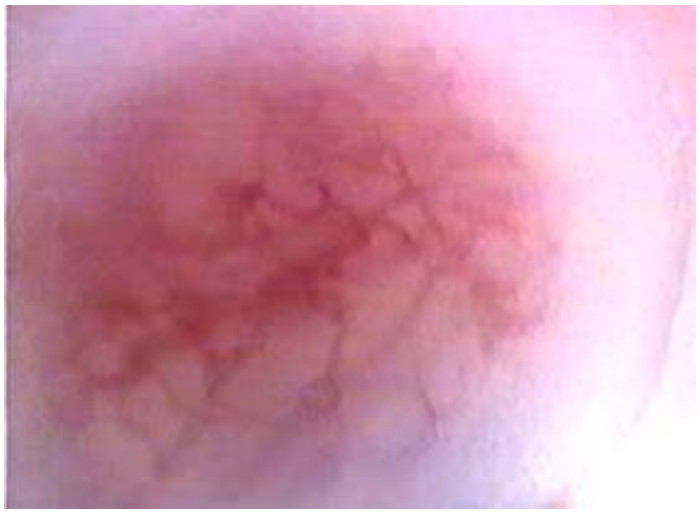

Figure 19: Branched network-type microvessel, identified through CEMS and located in area I (polyp surface).

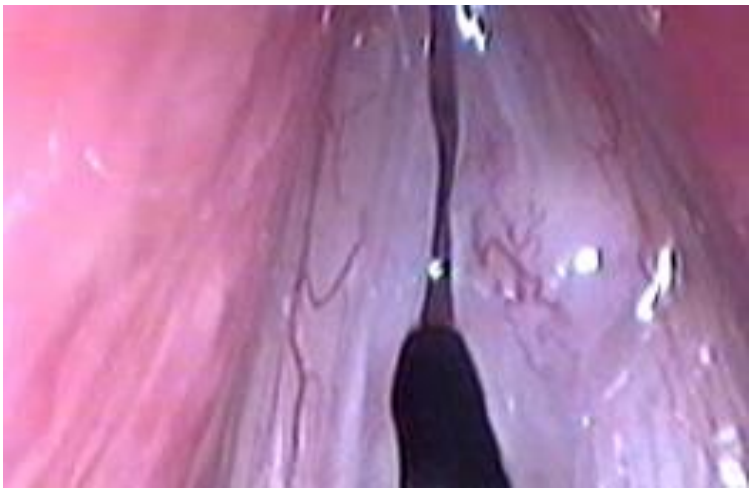

Figure 20: Arachnoid-type microvessel, identified using 0º REMS and located in area I (polyp surface).

DISCUSSION

Although comparison with a control group of normal vocal folds would have been desirable, this was not feasible because of the retrospective study design and ethical limitations related to performing examinations under general anesthesia in healthy individuals.

Within the literature reviewed by the authors, no previous study specifically addressed vascular alterations in vocal folds affected by polyp assessed simultaneously by rigid and contact endoscopy, except for D'Ávila's study on cyst and contralateral nodular reaction [14].

The predominance of male patients, unilateral lesions, and concentration of cases in the fourth and fifth decades of life are consistent with prior reports [13,28,36].

All patients reported vocal abuse, reinforcing the hypothesis that phonotrauma plays a major role in the development of vocal fold polyp [29].

Most microvascular alterations were observed on the superior membranous surface, the portion most exposed to phonotrauma. This suggests that repeated mechanical stress plays an important role in local vascular remodeling [14,24]. Among the 12 patterns of D'Ávila's classification, the parallel ectatic microvessel was the most frequent in both affected and contralateral vocal folds, suggesting that it may represent a nonspecific microvascular finding, possibly related to vocal trauma rather than to a single lesion type.In contrast, the branching network pattern was identified in 10 of the 12 vocal folds affected by polyp and was specifically located on the surface of the lesion. This finding suggests a strong diagnostic association with vocal fold polyp and may be useful during endoscopic differential diagnosis of benign laryngeal lesions.

CONCLUSION

All 12 types of microvascular alterations described in D'Ávila's classification were identified in vocal folds affected by polyp. The branching network microvascular pattern was observed in 10 of the 12 vocal folds affected by polyp (83.33%).

Associated pathologic alterations were observed in 6 of the 12 vocal folds affected by polyp (50.0%).

Nine types of microvascular alterations were detected in contralateral vocal folds.

Three types of pathologic alterations were detected in contralateral vocal folds.

Table 1: Age distribution of the study sample.

Age group (years)	n	%
31–40	3	27.2
41–50	8	72.8
Total	11	100

Table 2: Frequency of altered microvascular patterns in vocal folds affected by polyp.

Microvascular alteration	**n**	**%**
Parallel amputated	5	6.8
Mild tortuous parallel	9	12
Parallel tortuous / corkscrew-like	6	8.1
Parallel ectatic	20	27
Loop-like parallel	7	9.5
Parallel with anastomosis	5	6.8
Single sinuous transverse	5	6.8
Multiple sinuous transverse	1	1.3
Branching network	10	14
Arachnoid branching	1	1.3
Single punctiform	3	4
Multiple punctiform	2	2.7
Total	74	100

Table 3: Distribution of polyp types.

Polyp type	n	%
Fibrous	5	41.7
Hemorrhagic	4	33.3
Gelatinous	3	25
Total	12	100

Table 4: Vocal folds affected by polyp with and without associated pathological changes.

Category	n	%
With associated pathological changes	6	50
Without associated pathological changes	6	50
Total	12	100

Table 5: Contralateral vocal folds: normal versus pathological.

Category	n	%
Normal contralateral vocal folds	1	10
Contralateral vocal folds with pathological changes	9	90
Total	10	100

Table 6: Frequency of altered microvascular patterns in contralateral vocal folds.

Microvascular alteration	n	%
Parallel amputated	0	0
Mild tortuous parallel	3	13
Parallel tortuous / corkscrew-like	1	4.3
Parallel ectatic	8	35
Loop-like parallel	3	13
Parallel with anastomosis	0	0
Single sinuous transverse	1	4.3
Multiple sinuous transverse	1	4.3
Branching network	0	0
Arachnoid branching	1	4.3
Single punctiform	2	8.6
Multiple punctiform	3	13
Total	23	100

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