Intraoperative intraorbital bleeding: considerations from a collaborative and retrospective Italian study with a management algorithm proposal*

Iacopo Dallan[1], Miriana Picariello[1], Giacomo Fiacchini[1], Rikki Canevari[2], Mario Rigante[3], Ernesto Pasquini[4], Enzo Emanuelli[5], Enrico Alexandre[1], Lodovica Cristofani-Mencacci[1], Paolo Castelnuovo[6]

[1] ENT Unit, Azienda Ospedaliero-Universitaria Pisana, Pisa, Italy

[2] Department of Otorhinolaryngology, Head and Neck Surgery, University of Genoa, Genoa, Italy

[3] ENT Department, University of Perugia, Perugia, Italy

[4] ENT Department, Ospedale Bellaria, Bologna, Italy

[5] ENT Unit, Padova, Italy

[6] ENT Department, Fondazione Marchi, Varese, Italy

Rhinology 60: 6, 421 - 426, 2022

https://doi.org/10.4193/Rhin22.068

***Received for publication:**

February 12, 2022

Accepted: July 21, 2022

Abstract

Background: Intraoperative intraorbital bleeding is a rare but potentially catastrophic event that can lead even to blindness, if not treated promptly. The goal of surgery is to quickly reduce intraorbital pressure thus restoring normal visual function. Aim of our work is to propose a practical algorithm helping the surgeon in the setting of this critical event.

Methodology: An Italian multi-institutional retrospective study was conducted. All the cases of intraoperative intra-orbital bleeding requiring at least some form of surgical management were analyzed. Cases simply managed conservatively were excluded from this analysis.

Results: Sixteen cases were collected. Of these, 12 were initially treated with a medial wall orbital decompression, while 4 were treated via a lateral canthotomy and inferior cantholysis (LCC). Ten patients recovered completely. Four patients presented post-op sequelae (diplopia, enophthalmous and/or eyelid malpositioning). Two major negative outcomes (blindness) were observed.

Conclusions: Timely surgical intervention is critical. According to the setting in which the bleeding occurs, different options are available. LCC is probably the most rapid maneuver that can be done to reduce intraorbital pressure. Anyway, if the patient is still in the OR and a complete ethmoidectomy yet done we advise, as first step, to perform a medial orbital wall decompression.

Key words: endoscopic sinus surgery, orbital compartment syndrome, orbital pressure, orbital haemorrhage, retrobulbar hematoma

Introduction

Intraoperative intraorbital bleeding is a rare but potentially catastrophic event. Its estimated incidence is largely unknown although a historical series regarding endoscopic sinus surgery (ESS) reported retrobulbar hematoma (RH) between 0.05 to 0.12% [(1)]. Intra-orbital bleeding causes an orbital compartment syndrome (OCS) related to rapidly increasing intra-orbital pressure that can lead to permanent blindness if not treated promptly. The rapid nature of the hematoma often precludes a formal ophthalmologic evaluation and has led to treatment algorithms in the literature that advocate early surgical intervention [(2-6)]. The primary goal of surgery is to increase the intra-orbital space to accommodate the expansion of the RH. This theoretically leads to a decreased pressure on the orbital contents, vessels, and optic nerve. Unfortunately, although several papers have addressed this topic, the actual number of reported treated patients is limited. Thus, given the rarity of such events, to try to add useful insights to the current body of data on this topic, we have conducted a retrospective study collecting the experience of several Italian groups on this argument with the

Table 1. Data of the patients.

Pt.	Sex	Side	Associated diseases or concomitant therapy	Clinical presentation	Suspected bleeding source	Type of orbital decompression	Clinical outcome
1	M	R	CRS, DM	P, H, MRM paresis	NV	LCC & MWD	EM & Diplopia
2	M	R	CRS	P	NV	MWD	RAI
3	F	L	NP	P, H	NV	LCC & MWD	RAI
4	M	L	MEC, depression	P	AEA	MWD, LCC, LCD	E
5	M	R	CRS	P, H, VD	NV	MWD	Blindness
6	M	R	Osteoma	P, H	AEA	MWD, IOE	RAI
7	M	L	CSF leak	P, H	AEA	MWD	RAI
8	M	L	NP (rev)	P, H, VD	AEA	MWD	RAI
9	F	L	Frontal sinus IP (rev)	P	AEA	MWD	RAI
10	M	R	CRS	H, VD	AEA	MWD	Blindness, E
11	M	L	CRSnp	P, H	AEA	MWD	RAI
12	F	R	CRSnp (rev), IBP	P, H	NV	MWD	RAI
13	M	L	Blow out fracture reduction	P, H, VD	AEA	MWD	Diplopia & EM
14	F	L	CRSnp, IBP	P, H, VD	AEA	LCC & MWD	RAI
15	M	R	Basedow	H, VD	AEA	MWD (extended)	Diplopia, E
16	M	R	CRSnp	P, H, VD	AEA	MWD	RAI

P-proptosis; H-haematoma; MRM-medial rectus muscle; VD-visual deterioration; MEC-meningoencephalocele; DM-diabetes mellitus; CRS-chronic rhinosinusitis; CRSnp-chronic rhinosinusitis with nasal polyps; LCC-lateral canthotomy and cantholysis; CCD-canthal cutdown; NP-nasal polyposis; MWD-medial wall decompression; NV-nameless vessel; IP-inverted papilloma; IOE-intraorbital exploration; RAI-restitutio ad integrum; E-enophthalmos; EM-eyelid malpositioning; IBP-incresed blood pressure.

aim to propose our pragmatic management algorithm.

Materials and methods

An Italian multi-institutional retrospective and collaborative study was conducted during 2021 involving high volume and referral centers with high experience in endoscopic endonasal surgery. All the cases of intraoperative intra-orbital bleeding requiring at least some form of surgical management were collected and analyzed. Cases simply managed conservatively were excluded from this analysis. Centers were contacted via email and a database was sent and completed by the referring authors. Pre-existing diseases, reason for surgery, clinical presentation, management (focusing on surgical aspects) and clinical outcomes were evaluated.

Results

A total of 16 cases were collected from 6 centers. In all cases intraoperative bleeding occurred during transnasal endoscopic surgery performed for different clinical conditions. Demographic and generic data are shown in Table 1.

Regarding surgical management, 12 patients were treated initially via medial wall decompression. Ten of these were performed shortly after development of proptosis. In one case, after an initial improvement of symptoms, the eye developed a rapidly evolving proptosis, and an external exploration of the intra-orbital bleeding source was attempted via Lynch incision and the intra-orbital hematoma was thus evacuated.

In 4 cases, given the extreme urgency for treatment, a lateral canthotomy and cantholysis (LCC) was performed. From a clinical standpoint, although without a clear "red line", we considered extreme urgent the cases with a very rapid evolution in which proptosis is quickly developing and the eye become very hard (like stone). In 2 cases the procedure was performed bedside, in the ward, while in the other 2 cases this procedure was performed when the patient was still in the operating room. In these last 2 cases we started with a medial wall decompression (full ethmoidectomy was yet completed and medial orbital decompression was very rapidly performed) but clinical outcome after this procedure was deemed inadequate. In 3 of these 4 cases, LLC was then associated with an endoscopic medial wall decompression. In one case, after an initial clinical improvement, the patient shortly developed a rapidly evolving proptosis which required a lateral cut down procedure. In this case the orbital septa were opened and then the eye remained soft. The patient was then awakened from general anesthesia with no functional impairment.

In all cases IOP measurements were not able to be obtained, and clinical decision making was used to determine need for surgical

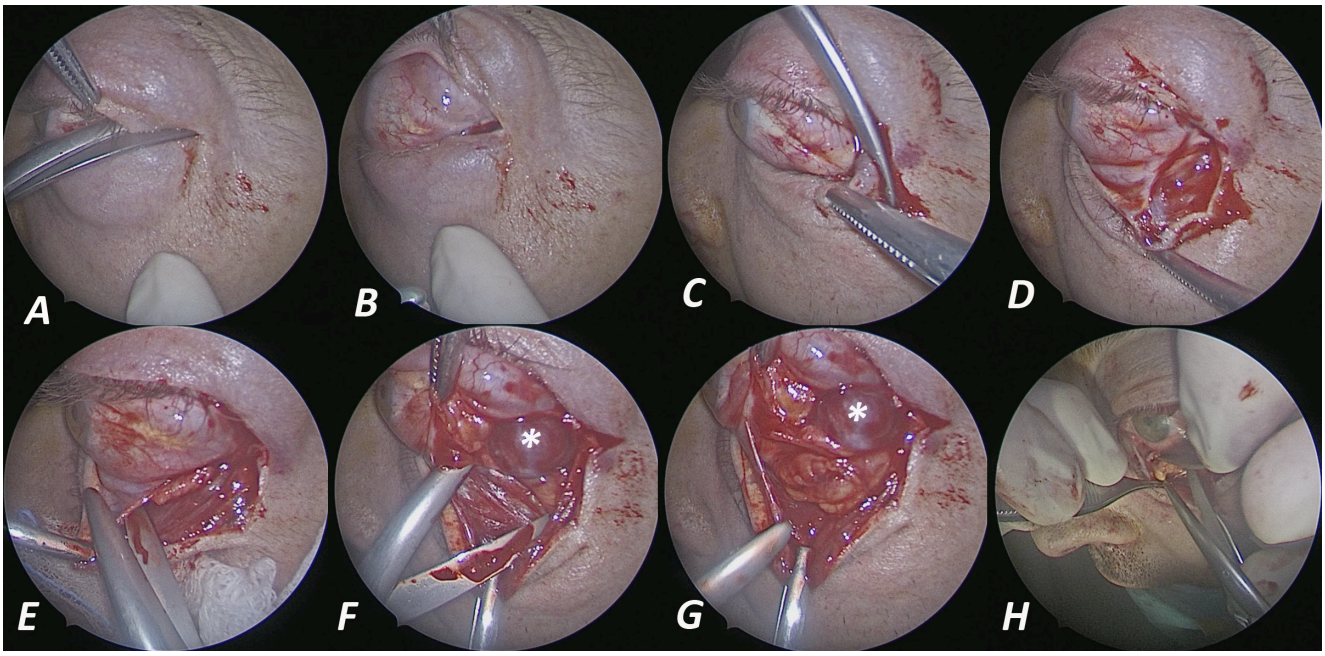

Figure 1. Canthal cutdown procedure performed in pt. 4. Step by step.

A: lateral canthotomy; B: Incision; C: inferior cantholysis; D: inferior cantholysis completed (inferior limb of the eyelid anteriorly reflected); E: inferior fornix incision (transconjunctival); F: orbital septae disruption; G: inferior orbital fat exposed and prolapsed; H: completion of the inferior orbitotomy approach. In Figure. F and G note the presence of an extremely turgid vein (inferior lateral vortex vein) (white asterisk), witnessing an evident increasing of the intra-orbital pressure, not yet responding to LLC.

intervention.

Regarding functional outcomes: we observed a mild eyelid mispositioning (secondary to LLC) in 2 patients. This defect was corrected with a second eyelid surgery in one of these patients. Postoperative enophthalmos of various degrees was observed in 3 cases, none of which required a corrective surgery. Permanent blindness occurred in 2 patients. Permanent blindness, occurred in these 2 patients, was thought to be secondary to delays related to transfer from an outside institution. Persistent diplopia in primary gaze was observed in 3 patients. In one patient it was due to direct muscle damage occurring at the time of injury, in a second patient was considered related to pre-existing disease (basedow) and in the last patient to the post-traumatic blow out fracture.

Discussion

Intraoperative intraorbital bleeding is a rare but potentially catastrophic condition that can lead to OCS and consequently to permanent blindness. Management algorithms, based on retrospective data, have been suggested [5,6]. OCS is a clinical diagnosis, characterized by acute proptosis, tight eye, eyelid ecchymosis and progressive visual impairment. Although the severity of the proptosis may be alarming, it does not appear to be a good prognostic indicator as it doesn't seem to have a direct correlation with the severity of tonometric pressure. In this respect tonometric pressure has been considered by some authors as the best guide for determining the severity of the condition [7]. Tonometry, ultrasound, and CT scans can be used to clinically demonstrate OCS although every effort should be made to avoid a delay in treatment when a RH is suspected [8]. In other words, radiological or ophthalmological evaluations are time-consuming procedures which could be avoided to spare the most important variable in this setting: time. However, if an ophthalmologic evaluation is readily available, it should be performed.

Outside the topic of post-traumatic RH less information is available, and it is mostly based on historical series [1,5,6,9-12]. In this paper, we have decided to focus our attention only on cases that required some form of surgical management. This is because conservatively managed patients represent a different clinical scenario which is not comparable to the one of those needing surgical treatment, according to the authors' point of view. This is evident when analyzing the case series of the latter papers, which show a limited number of cases (around 80), most of which were managed conservatively. In these series, a total of less than 10 post ESS intra-orbital bleedings requiring surgical management have been reported.

Two pathophysiology models (venous vs arterial bleeding) have been proposed [5] to explain differences in clinical scenarios, but anyway the type of bleeding can't be used as a prognosticator. Furthermore, no experimental sound data analyzing these items, as well as the temporal windows, are available in literatu-

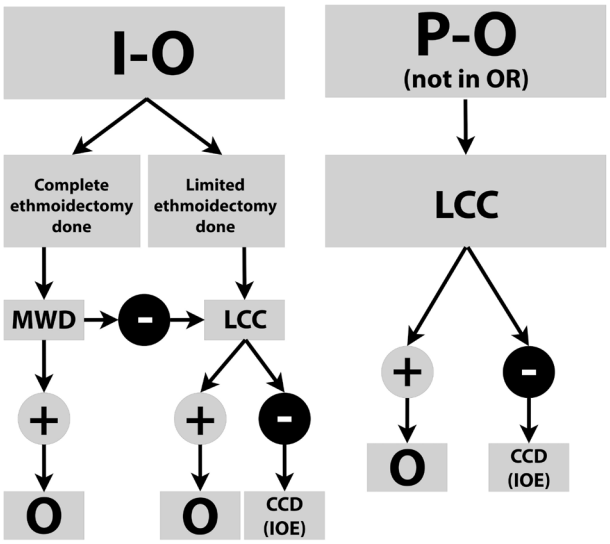

Figure 2. Proposed management algorithm.
I-O: intraoperative; P-O: post-operative; LCC: lateral canthotomy and cantholysis; CCD: canthal cut down; MWD: medial wall decompression; O: observation; IOE-intraorbital exploration.

re. In our series, the anterior ethmoidal artery was suspected as the bleeding vessel in 11 cases. As a matter of fact, AEA can be at risk during endoscopic endonasal surgery when performing an ethmoidectomy, especially in well pneumatized sinuses. This artery can be injured much more frequently than posterior ethmoidal or even intraorbital artery. Usually arterial bleeding causes an immediate, large volume, high-pressure hematoma, which significantly increases intra-orbital pressure (IOP). As little as 5ml of blood accumulation within the orbital spaces can increase IOP to dangerous levels [11]. Obviously, in this scenario, the main goal of surgery is to reduce IOP. Lateral canthotomy with or without cantholysis is probably the most rapid maneuver that can be done to reduce IOP [13]. While a slow bleeding can increase IOP to sight-threatening level in 60-90 minutes, a rapid arterial bleeding can threaten vision in 15 to 30 minutes [11]. If the bleeding flow is massive, this time interval can be even shorter. Thus, time is paramount when dealing with OCS. Obviously, treatment options tend to be more surgically oriented for arterial hematomas than for venous ones. It must be underlined that, anatomically speaking, most of the venous vessels close to the medial orbital wall (and so possibly at risk during endonasal surgery) are not so big, so one can assume that a major and rapidly evolving bleeding is difficult to be realized in venous damage. Notwithstanding, as previously stated, when treating these situations, a lateral canthotomy possibly with cantholysis should be performed [14]. If LCC is not effective, and immediate symptom/sign relief is not seen, a medial wall decompression or an open exploration of the orbit in search of the bleeding source and hematoma removal should be performed [10]. Control of the intra-orbital bleeding vessel has been advocated as a critical point, but practically speaking this maneuver seems to be not so necessary. In other words, it is not so clear whether a more aggressive management of the source of bleeding is needed or not [12]. In our cohort, this procedure has been performed only once (6% of cases), and by a very skilled and confident orbital surgeon. In all remaining cases, no intra-orbital exploration has been attempted. Clinically speaking, LCC could be insufficient to reduce orbital pressures in the presence of a dynamic OCS (active bleeding) [14]. The reason for that appears to be related to the presence of several septa within the orbit itself forming compartments. These would reduce the possibility for the orbital content to expand adequately after LCC. In such cases, a lateral canthal cutdown technique (anterior orbitotomy) may be required to reach physiological IOP. Evidence shows that with this procedure, IOP remains close to baseline, even in cases of active bleeding [14]. One of our cases seems to confirm the findings described by Strand et al. We experienced a case of acute arterial bleeding initially managed via medial decompression. In this case, after an initial clinical improvement, the eye restarted to be proptotic and extremely tight. This situation required a canthal cutdown procedure plus partial lipectomy to successfully control the situation. From a technical point of view, we advise to progress in a step-by-step fashion, performing first a lateral canthal incision reaching the lateral orbital rim. Thus done, an inferior cantholysis has to be performed and the lateral limb of the inferior eyelid freed. Once this task is completed an inferior fornix approach is performed and the orbital septa disrupted (Figure 1). So, based on our experience, we propose a management algorithm to address surgically, in a step-by-step fashion, critical intra-orbital bleedings (Figure 2). We basically consider 2 types of situations: intra- or postoperative bleedings. In the first situation, we believe that a medial wall orbital decompression should be attempted as a first choice if a complete ethmoidectomy has already been performed, while in cases of limited ethmoidal surgery the first procedure should be LCC. If OCS happens in the ward, LCC should be the first procedure, because of the rapidity with which it can be performed (Figure 3). If a poor response after LCC is obtained or a second clinical worsening is observed rapidly after LCC, a canthal cut down procedure has to be performed, as previously described. Orbital exploration should be attempted only if the surgeon is totally confident with orbital anatomy and surgery.

Finally, we want to emphasize the necessity to be as rapid as possible. In this respect it is really critical that patient post-op monitoring be really close and that the whole post-op environment (nurses and caregivers in general) well trained in observing any possible critical situation. Furthermore, given that ophthalmological evaluation is rarely rapidly available, any decision should be taken on a clinical basis with the aim of sparing time. As a matter of fact, the 2 major negative outcomes

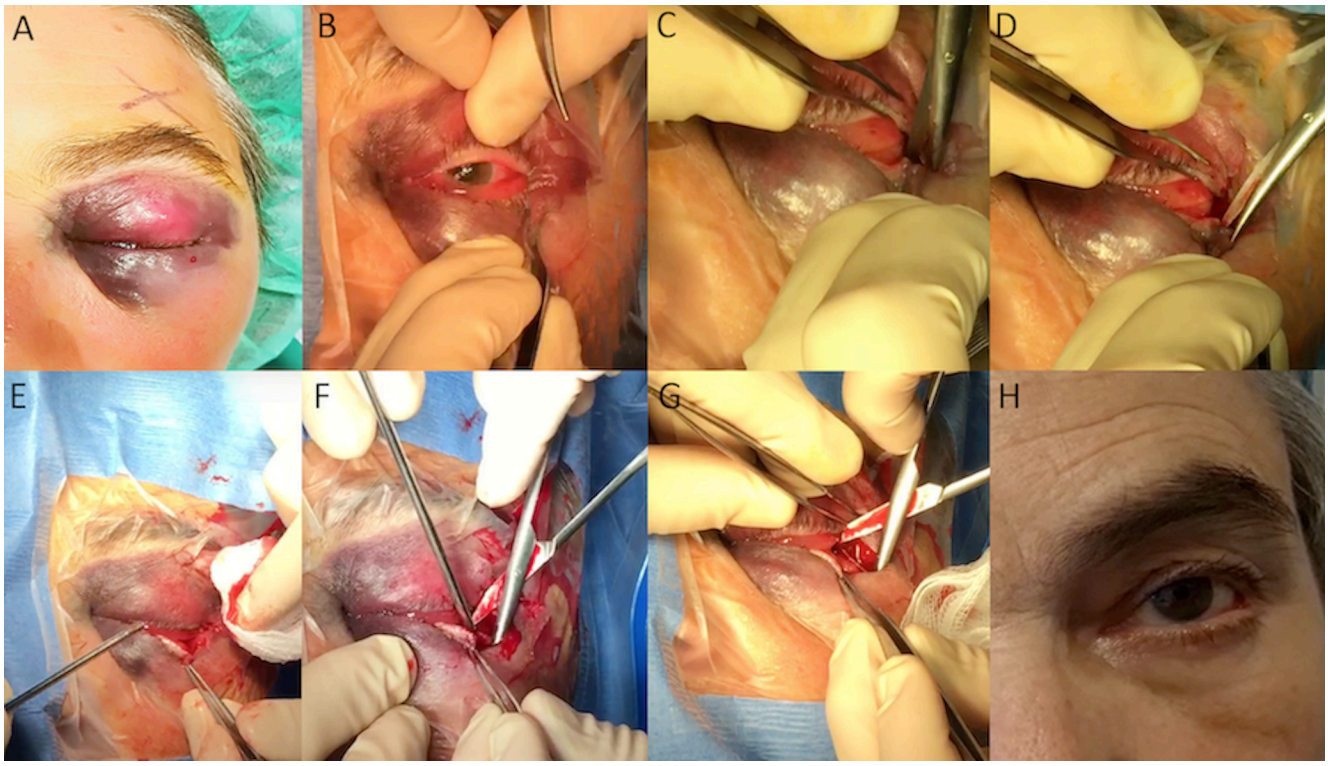

Figure 3. Lateral canthotomy and cantholysis performed in pt. 3. Step by step.

A: pre-LLC appearance in the ward; B: exposure of lateral palpebral region; C: lateral incision till the orbital rim; D: inferior cantholysis; E: inferior cantholysis completed (inferior limb of the eyelid anteriorly reflected); F: inferior orbital septum lysis; G: fat exposed; H: post-op appearance.

in our series have been observed in case of delayed treatment. Although aware of the clear limitations of a pure clinical examination we do feel to state that the possibility of permanent damage strongly overwhelms the risks of performing any given procedure.

As a final consideration, it must be emphasized that most reports in the literature do not document the ocular pressure before and after therapeutic maneuvers, but rather cite improvement in vision as proof that the intervention is effective. This creates an obvious bias in the interpretation of any given data.

Conclusions

Given the nature and the rarity of this kind of event, it seems to be extremely difficult to plan and build up a prospective study on this topic while maintaining a balance between ethics and common sense.

Acknowledgements

None.

Authorship contribution

ID, MP and GF designed and performed the research; LC and GF performed data analysis and interpretation. ID, RC, MR, EP, EE, PC provided the data; ID, MP and EA wrote the manuscript; all authors have read and approved the manuscript.

Conflict of interest

The authors have no conflict of interest to declare.

Funding

There was no funding to declare.

References

1. May M , Levine HL, Mester SJ, Schaitkin B. Complications of endoscopic sinus surgery: analysis of 2108 patients: incidence and prevention. Laryngoscope1994 Sep;104(9):1080-3.
2. Corey JP, Bumsted R, Panje W, Namon A. Orbital complications in functional endoscopic sinus surgery. Otolaryngol Head Neck Surg 109:814–20, 1993.
3. Thompson RF, Gluckman JL, Kulwin D, Savoury L. Orbital hemorrhage during ethmoid surgery. Otolaryngol Head Neck Surg 102:45–50, 1990.
4. Goodall KL, Brahma A, Bates A, Leatherbarrow B. Lateral canthotomy and inferior cantholysis: an effective method of urgent orbital decompression for sight threatening acute retrobulbar haemorrhage. Injury 30:485–490, 1990.
5. Stankiewicz JA, Chow JM. Two faces of orbital hematoma in intranasal (endoscopic) sinus surgery. Otolaryngol Head Neck Surg 1999;120:841-7.
6. Sharma S, Wilcsek GA, Francis IC, et al. Management of acute surgical orbital haemorrhage: an otorhinolaryngologi-

cal and opthalmological perspective. J Laryngol Otol 114: 621–626, 2000.
7. Zoumalan CI, Bullock JD, Warwar RE, et al. Evaluation of intraocular and orbital pressure in the management of orbital hemorrhage; an experimental model. Arch Ophtholmol 2008; 126:1257–1260.
8. Winterton JV, Patel K, Mizen KD. Review of management options for a retrobulbar hemorrhage. J Oral Maxillofac Surg65:296, 2007.
9. Graham SM, Nerad JA. Orbital complications in Endoscopic Sinus Surgery using powered instrumentation. Laryngoscope 2003; 113: 874-8.
10. Han JK, Caughey RJ, Gross CW, Neumann S. Management of retrobulbar hematoma. Am J Rhinol 2008;22:522–524.
11. Stankiewicz JA, Lal D, Connor M, Welch K. Complications in Endoscopic Sinus Surgery for Chronic Rhinosinusitis: A 25-Year Experience. Laryngoscope, 121:2684–2701, 2011.
12. Colletti G, Valassina D, Rabbiosi D, et al. Traumatic and Iatrogenic Retrobulbar Hemorrhage: An 8-Patient Series. J Oral Maxillofac Surg. 2012 Aug;70(8):e464-8.
13. Saussez S, Choufani G, Brutus JP, et al: Lateral canthotomy: A simple and safe procedure for orbital haemorrhage secondary to endoscopic sinus surgery. Rhinology 36:37, 1998.
14. Strand AT, Czyz CN, Gibson A. Canthal cutdown for emergent treatment of orbital compartment syndrome. Orbit. 2017 Oct;36(5):285-292.

Miriana Picariello, MD
ENT and Audiology and Phoniatric Unit
Azienda Ospedaliero Universitaria Pisana
Via Paradisa 2
Pisa
Italy

Tel. +39 050997502
E-mail: miripicariello@gmail.com