A Novel Hypothesis of Visual Loss Secondary to Cosmetic Facial Filler Injection

Xin Li, MD,* Le Du, MD,† and Jian-jian Lu, MD‡

Abstract: With the current tendency of increasing minimally invasive cosmetic surgeries, some rare but disastrous complications of facial filler injections come into sight, such as visual loss. The study aims to investigate the possible route that the injected droplet accesses the ophthalmic artery to explain and prevent such devastating complications. We searched the National Library of Medicine's PubMed database for cases of visual loss secondary to cosmetic facial filler injection, and reviewed relevant case reports/surveys, as well as accompanying references. Data obtained were analyzed, with special interest in injected sites and filler material, and clinical features of visual loss. Based on the anatomy of facial vessels, we inferred the possible route of injected droplet migrating from injection sites to ophthalmic artery. Most physicians propose a retrograde embolic mechanism, but the culprit artery when injecting different sites is not determined. We consider accidentally breaking into supraorbital artery or supratrochlear artery may cause occlusion of ophthalmic artery when injecting into glabella or forehead region. Speaking of the nasolabial fold and nasal dorsum region, any injections in the anastomosis of the dorsal nasal artery, angular artery, and lateral nasal artery can lead to retrograde embolism. Similarly, in the temporal region, we believe there is abnormal anastomosis between frontal branch of superficial temporal artery from external carotid artery and supraorbital artery from ophthalmic artery. In our hypothesis, we can explain the accompanying brain infarction after iatrogenic visual loss. If the injecting pressure is forceful enough, it may push the embolic materials into middle cerebral artery. Although iatrogenic ophthalmic artery occlusion is a rare complication after the facial filler injection surgery, it is usually devastating. Both the patient and the surgeon should be aware of the risk of irreversible blindness. Ideally, the injection sites should avoid the small vessels nearby, the injecting force and velocity should be as gentle and slow as possible.

Key Words: cosmetic facial filler injection, visual loss

(*Ann Plast Surg* 2015;75: 258–260)

Facial filler injection for soft-tissue augmentation and rejuvenation has increased noteworthy in the last decade. The procedure is well accepted and widely performed because of the convenience, pleasing outcomes, and favorable safety.^{1,2} However, there are some rare but devastating adverse effects, such as iatrogenic blindness and stroke. As early as 1963, sudden vision loss after injection of corticosteroids suspensions in the bare spots on scalp was described.³ Then, blindness after injections of various substances for alopecia areata and cosmetic

surgery was reported.^{4–6} Visual loss and stroke after cosmetic injections have drawn many surgeons' attention ever since.

In 2012, Lazzeri et al⁷ conducted a systematic review on iatrogenic blindness after facial cosmetic injections, he reviewed the clinical data of 32 patients, and suggested some precautions to avoid such complications. Similarly, Park and his colleagues^{8,9} enrolled 44 patients in a Korean national survey and investigated their clinical manifestations and visual prognosis of retinal artery occlusion resulting from the surgery.

Despite all the research done in the past few years, the underlying pathogenesis is not well understood. We presumed a novel hypothesis to explain how the injected droplet access to the ophthalmic artery and suggested some precautions that may prevent, such devastating complications.

REVIEW

We searched the National Library of Medicine's PubMed database and reviewed the available literature regarding the occurrence of blindness after facial injections and accompanying references. Data obtained were analyzed, including clinical symptoms and signs, injection sites and injected filler material, the associated examinations. A total of 75 patients were included,^{7–13} which is the largest case series reported to date (Table 1). Thirty-seven patients, who suffered blindness received autologous fat injections, which were described to have a worse visual prognosis and higher cerebral infarction incidence.^{8,9} Other substances included hyaluronic acid (20%), collagen (7%), and corticosteroids (5%) for the early years and other cases.

We further believed that various injection sites conducted different routes access the ophthalmic artery. Eight of the 75 patients (11%) were injected into multiple regions, we analyzed the most possible culprit injection site based on the anatomy and symptoms onset. Glabella, nasal dorsum, and nasolabial fold were the most frequent injected sites, with 34 (45%), 19 (25%), and 14 (19%) cases, respectively.

Moreover, 18 patients (24%) were diagnosed with cerebral infarction, confirmed by magnetic resonance imaging or angiography, only 11 of them (15%) have neurologic symptoms, such as contralateral hemiplegia or weakness, dysarthria, or aphasia.

ANATOMY AND HYPOTHESIS

Anatomy

The orbital vascular anatomy is highly complex, with tremendous interindividual variations. The main source of blood supply to the orbit is the ophthalmic artery, the first branch of the internal carotid artery.¹⁴ The branches of the ophthalmic artery are divided into 2 groups. The orbital group consists of the lacrimal artery, supraorbital artery, the supratrochlear artery, the anterior and posterior ethmoid artery, and nasal artery. The ocular group distributes blood to the muscles and bulb of the eye and consists of the long ciliary artery, short ciliary artery, anterior ciliary artery, central retinal artery, and muscular artery.¹⁴

The retina is normally supplied by the central retinal artery and the short posterior ciliary arteries. In some cases, approximately 20% of the population, there is a branch of the ciliary circulation called the

Received January 10, 2015, and accepted for publication, after revision May 7, 2015. From the *No 17 Department, †No 16 Department, and ‡No 5 Department, Plastic Surgery Hospital, Chinese Academy of Medical Sciences, Beijing, China.

Conflicts of interest and sources of funding: Source of funding is from Peking Union Medical College Youth Scientific Research Funds (33320140096).

Reprints: Jian-jian Lu, MD, No 5 Department, No. 33 Ba-Da-Chu, Shi-Jing-Shan district, Beijing 100144, China. E-mail: 13910038881@163.com.

Copyright © 2015 Wolters Kluwer Health, Inc. All rights reserved. This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially.

ISSN: 0148-7043/15/7503-0258

DOI: 10.1097/SAP.0000000000000572

TABLE 1. Demographic and Clinical Features of 75 Patients With Iatrogenic Visual Loss After Cosmetic Facial Filler Injections

Variable	Value
Average age, y	37
Sex, n (%)	
Male	8 (10.7)
Female	67 (89.3)
Cosmetic injection substance, n (%)	
Autologous fat	37 (49)
Hyaluronic acid	15 (20)
Collagen	5 (7)
Corticosteroids	4 (5)
Others	13 (17)
Injection sites, n (%)	
Multiple sites	8 (11)
Forehead	6 (8)
Glabella	34 (45)
Scalp	3 (4)
Temporal	2 (3)
Nasolabial fold	14 (19)
Nasal dorsum	19 (25)
Others	2 (3)

cilioretinal artery which supplies the retina between the macula and the optic nerve. If this artery is present, the central vision will be preserved even in case of central retinal artery occlusion.¹⁵

Sometimes, the ophthalmic artery does not arise normally from the internal carotid artery, but from the middle meningeal artery, which originates from external carotid artery.¹⁴ Furthermore, there are various anastomoses between the ophthalmic artery and various branches of

the external carotid artery. For example, the frontal branch of superficial temporal artery may anastomose with supratrochlear artery or supraorbital artery.

Hypothesis

Many researchers have proposed that retrograde arterial embolic mechanisms are responsible for the occlusion of central retinal artery.⁷⁻⁹ We speculated the possible route of the embolism migrating from different injection sites to ophthalmic artery (Fig. 1), causing iatrogenic retinal artery occlusion.

Injections Into the Glabella and Forehead

When surgeons injected facial fillers into the glabella or forehead region, the injecting needle may accidentally break the wall of the distal artery, such as supraorbital artery or supratrochlear artery. In this case, the injection force could overcome the systolic arterial pressure, it will push the injected tiny droplet to travel proximally along ophthalmic artery, even pass the origin of the central retinal artery. When the injection is done, the force is relieved, the arterial systolic pressure then propels the injected droplet distally into the ophthalmic artery, and its branches. If the injecting force is big enough, the droplet may reach more proximally, so that it may block the middle cerebral artery when the force recedes. This could explain the accompanying cerebral infarction.

Injections Into the Nasolabial Fold and Nasal Dorsum

There is anastomosis of the nasal area, consisting of dorsal nasal artery from the ophthalmic artery, angular artery, and lateral nasal artery from the facial artery. Injection into the nasolabial fold or nasal dorsum may accidentally break into the anastomosis, resulting in retrograde embolism.

Injections Into the Temporal and Scalp Area

As to the temporal region, some abnormal anastomosis between frontal branch of superficial temporal artery and supraorbital artery

FIGURE 1. Schematic of the blood supply of the face and eye in relation to the sites of cosmetic facial filler injections.

TABLE 2. Suggestions to Diminish the Risk of Retinal Artery Occlusion

1. Pay attention to the anatomy of the vessels around the orbit.
2. Blunt cannula is preferred.
3. Local anesthesia with epinephrine promotes artery to constrict, thus reduce the risk of facial filler delivery.
4. Aspiration before injection. It could demonstrate intravascular placement of the needle.
5. Inject the material when the needle is pulled back, move slightly to deliver the filler at different points along a line.
6. Limit injected filler volume to less than 0.1 mL with each pass.
7. Inject as slow and gentle as possible to decrease the injection pressure.
8. Inject into the superficial layer of superficial musculoaponeurotic system (SMAS), do not inject deeper layer.
9. Avoid shaping by pressing or pushing or pinching hard.

(or supratrochlear artery) may exist, and the droplet could be propelled to the ophthalmic artery through it. Even a tiny amount of the filler slipping into the ophthalmic artery can precipitate a central retinal artery occlusion, which result in permanent blindness. In some cases, the ophthalmic artery raises from the middle meningeal artery, which is a branch of external carotid artery.¹⁴ Under the circumstance, the microspheres may travel to the ophthalmic artery from the frontal branch of superficial temporal artery by external carotid artery system. Moreover, the zygomatic-orbital artery raised from superficial temporal artery has anastomosis with branch of ophthalmic artery, and may also be the retrograde arterial embolic route.

A few authors claimed central retinal artery occlusion was accompanied with thrombosis of the ophthalmic vein,¹⁶ which is rarely studied. There may be some arteriovenous anastomotic channels in certain region and could become the conduit for the reflux of the filler into the regional circulation.

DISCUSSION AND PREVENTION

Cosmetic facial injections sound like a relatively simple and straightforward approach. The 2013 American plastic surgery statistic report revealed that cosmetic minimally invasive procedures had increased 144% compared with 2000.² Moreover, in the past year, soft tissue fillers and hyaluronic acid injections had risen 13% and 18%, respectively.² Consequently, iatrogenic blindness after facial injections became a big issue perplexing both physicians and patients.

In this study, we summarized clinical characteristics of 75 patients experiencing iatrogenic occlusion of the ophthalmic artery and its branches after cosmetic facial filler injections. Glabella, nasal dorsum, and nasolabial fold were the most frequent injection sites, surgeons should pay more attention to the nearby small vessels. Autologous fat grafting is demanding in recent years; however, once it causes retinal artery occlusion, the visual prognosis is worse.⁸ Even tiny amount of fillers infiltrates into the vessels, permanent blindness could occur.

Based on our hypothesis, some suggestions to avoid the disastrous complications after cosmetic facial filler injection were introduced (Table 2). Anatomy is always the fundamental principle for surgery. More focus should be concentrated to the vessels around the orbit, and the surgeons should know the anatomical plane and depth for each injection.¹⁷ The most important controllable factor for surgeons is the

speed and pressure of injection. Fillers should be injected as slowly and gently as possible, so that there will be no sufficient amount of facial filler being propelled into the vessel.^{7,18} Most surgeons prefer blunt cannulas with small-bore needles and smaller syringes because they slow the speed of injection, and less likely to puncture the vessels.^{17,18} Others argue that larger syringe has a greater cross-sectional area, therefore theoretically allow lower injection pressure.⁷ However, the surgeon's control is severely impaired by using larger syringe for fine injection of facial filler. In our opinion, the injection force and speed, the limited injected filler volume per pass are more important variables to control. Another precaution is the use of epinephrine-containing local anesthesia to reduce the size of vessels.

CONCLUSIONS

In conclusion, iatrogenic blindness and cerebral infarction can occur after cosmetic facial filler injections. Surgeons and patients should be aware of the devastating complications, and the surgery should be performed carefully. The injection sites should avoid the small vessels nearby, and the injecting force and velocity should be as gentle and slow as possible. The surgery is constantly improved in the light of new scientific knowledge.

REFERENCES

1. US Food and Drug Administration. Dermal fillers. <http://www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/CosmeticDevices/WrinkleFillers/default.htm>. Accessed Oct 23, 2014.
2. American Society of Plastic Surgeon. 2013 Plastic surgery procedural statistics. <http://www.plasticsurgery.org/Documents/news-resources/statistics/2013-statistics/plastic-surgery-statistics-full-report-2013.pdf>. Accessed Oct 23, 2014.
3. Von B. Multiple embolisms in the fundus of an eye after an injection in the scalp. *Acta Ophthalmol (Copenh)*. 1963;41:85–91.
4. Selmanowitz VJ, Orentreich N. Cutaneous corticosteroid injection and amaurosis. Analysis for cause and prevention. *Arch Dermatol*. 1974;110:729–34.
5. Shin H, Lemke BN, Stevens TS, et al. Posterior ciliary-artery occlusion after subcutaneous silicone-oil injection. *Ann Ophthalmol*. 1988;20:342–4.
6. Teimourian B. Blindness following fat injections. *Plast Reconstr Surg*. 1988; 82:361.
7. Lazzeri D, Agostini T, Figus M, et al. Blindness following cosmetic injections of the face. *Plast Reconstr Surg*. 2012;129:995–1012.
8. Park SW, Woo SJ, Park KH, et al. Iatrogenic retinal artery occlusion caused by cosmetic facial filler injections. *Am J Ophthalmol*. 2012;154:653–662.e1.
9. Park KH, Kim YK, Woo SJ, et al. Iatrogenic occlusion of the ophthalmic artery after cosmetic facial filler injections: a national survey by the Korean Retina Society. *JAMA Ophthalmol*. 2014;132:714–23.
10. Lazzeri S, Figus M, Nardi M, et al. Iatrogenic retinal artery occlusion caused by cosmetic facial filler injections. *Am J Ophthalmol*. 2013;155:407–8.
11. Woo SJ, Park SW. Reply: To PMID 22835509. *Am J Ophthalmol*. 2013;155: 408–409.
12. Kim SN, Byun DS, Park JH, et al. Panophthalmoplegia and vision loss after cosmetic nasal dorsum injection. *J Clin Neurosci*. 2014;21:678–80.
13. Lu L, Xu X, Wang Z, et al. Retinal and choroidal vascular occlusion after fat injection into the temple area. *Circulation*. 2013;128:1797–8.
14. Hayreh SS. Orbital vascular anatomy. *Eye*. 2006;20:1130–44.
15. Central retinal artery. http://en.wikipedia.org/wiki/Central_retinal_artery. Accessed Oct 23, 2014.
16. Lee JH, Lee KH, Moon HJ. A case of unilateral blindness after paraffin injection on the forehead. *J Korean Ophthalmol Soc*. 1969;10:49–51.
17. Carruthers JD, Fagien S, Rohrich RJ, et al. Blindness caused by cosmetic filler injection: a review of cause and therapy. *Plast Reconstr Surg*. 2014;134:1197–201.
18. Ozturk CN, Li YM, Tung R, et al. Complications following injection of soft-tissue fillers. *Aesthet Surg J*. 2013;33:862–77.