

Endonasal Endoscopic Dacryocystorhinostomy with the Use of Radiofrequency (RF) Surgical Technique

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Abstract

Endonasal endoscopic dacryocystorhinostomy (DCR) with radiofrequency (RF) surgical technique is a procedure selected for nasolacrimal duct obstruction and chronic dacryostenosis in the setting of patent canaliculi and a functional lacrimal pump. Two major approaches are utilized: external, via a transcutaneous incision and endonasal endoscopically guided. The surgery has the high success rate via both approaches. We review the history, evolution, current techniques, complications and future directions of DCR radiofrequency RF operative technique. The modified endonasal RF-coagulation technique was performed in patients aged 18 - 85 (women-80, men-35) from 2017 to 2023. All patients suffered from chronic dacryocystitis. They had been administered the course of traditional conservative treatment and were provided with the ophthalmologist's and otorhinolaryngology's consultations prior to the surgery. In order to verify the diagnosis, the patients were conducted the CT-scan examination of nasal cavity and paranasal sinuses as well as the endoscopy of nasal cavity. Endonasal dacryocystorhinostomy with RF coagulator proved to be effective in 80% of patients; Over 3 - 4 years following the surgery, the recurrence was manifested in 8 patients after 6 months and in 12 patients, after a year. The above mentioned surgical treatment is administered by minimally invasive surgical method. At the same time, the long-term, for about 1 year, implantation of silicone drainage in the nasolacrimal ducts significantly reduces the risk of recurrence. At the present stage, the endoscopic Endo-DCR surgery is being improved, and the diverse treatment methods, including radiofrequency (RF) in endonasal endoscopic microsurgical techniques, are being studied and introduced into practice.

Keywords

Dacryocystorhinostomy, Endoscopic Dacryocystorhinostomy, Dacryocystitis,

1. Introduction-Relevance

Dacryocystitis represents the fairly prevalent disease among the patients of both sexes in adolescent and adult population. Despite the development of a number of surgical techniques and the involvement of high-tech equipment in this process, the active increase in the mentioned pathology in modern reality as well as the incomplete effectiveness of its conservative and surgical treatment instigates the advancement and improvement of the new methods of surgical intervention.

Dacryocystitis is inflammation of the lacrimal sac which typically occurs secondarily to obstruction within the nasolacrimal duct and the resultant backup and stagnation of tears within the lacrimal sac [1] [2].

Anatomy: Tears are produced by the lacrimal glands; paired almond shaped exocrine glands which sit in the upper lateral portion of each orbit in the lacrimal fossa, an area found within the frontal bone. The tears lubricate the eye and are then collected into the superior and inferior puncta and then drain into the inferior and superior canaliculi. From the canaliculi, the tears pass through the valve of Rosenmuller into the lacrimal sac, where they then flow down the nasolacrimal duct, through the Valve of Hasner, and finally drain into the nasal cavity [1].

2. Etiology

The etiology of dacryocystitis is typically due to a nasolacrimal duct obstruction (NLDO). This can further be categorized into duration (acute versus chronic) and onset (congenital and acquired causes) [1].

Acute and chronic refer to the duration of current symptoms, with acute usually being a time frame less than three months [1] [2].

- Acute dacryocystitis usually requires systemic antibiotic therapy prior to intervention for the NLDO. In the United States, likely culprits are *Staphylococcus aureus*, *B hemolytic Streptococcus*, and *Haemophilus influenzae* in children. In adults, the more likely causative microorganisms include *Staphylococcus epidermidis*, *Staphylococcus aureus*, *Streptococcus pneumoniae*, and *Pseudomonas aeruginosa*.
- Chronic dacryocystitis typically presents with less inflammatory signs and requires surgical therapy for the underlying cause.

The active growth of dacryocystitis among the population is conditioned by plenty of factors, among which I would like to highlight allergic diseases recognized as the problem of the XXI century, and particularly, the allergic rhino-conjunctivitis, which over time leads to the obstruction of tear ducts. The above conclusion is based on the research and consultations conducted by us. In addition, the causes of dacryocystitis include new neoplasms of the nasal cavity

and accessory nasal sinuses, chronic conjunctivitis, the prolonged use of anti-glaucoma medications and many others.

Dacryocystorhinostomy represents the basic technique for the treatment of dacryocystitis. Two methods are distinguished: external transcutaneous and endonasal or transnasal.

The study method employed by us is endonasal or transnasal technique through utilizing RF coagulator.

3. Preoperative Evaluation

Every patient underwent the full ophthalmological evaluation consisting of probing of canaliculi and lacrimal irrigation, so as to confirm distal obstruction, lacrimal canaliculi patency, and exclude other causes of epiphora, which would otherwise contraindicate endoscopic surgery. The decision to perform a septoplasty was based on the endoscopic evaluation of the nasal cavity [2].

Indications

We utilize the external approach in the vast majority of our primary DCR cases. We generally reserve the endoscopic approach for secondary cases, for patients who are overly concerned about the possibility of a scar or in cases of tumor involving the lacrimal sac as well as nasal passages and sinuses (Table 1).

Table 1. Indications and contraindications for dacryocystorhinostomy.

Indications	Contraindications
Clinically significant epiphora in the presence of nasolacrimal duct obstruction	Patient is on anti-coagulation medications and is unable to stop perioperatively
Chronic conjunctivitis in presence of nasolacrimal duct obstruction	Active dacryocystitis
Dacryocystitis	Tumor of lacrimal sac
Dacryoliths in lacrimal sac causing periodic episodes of nasolacrimal duct obstruction	

4. Material and Methods

The modified endonasal RF-coagulation technique was performed in patients aged 18 - 85 (women-80, men-35) from 2017 to 2023. All patients suffered from chronic dacryocystitis. They had been administered the course of traditional conservative treatment and were provided with the ophthalmologist's and otorhinolaryngology's consultations prior to the surgery. In order to verify the diagnosis, the patients were conducted the CT-scan examination of nasal cavity and paranasal sinuses as well as the endoscopy of nasal cavity.

The surgery is performed under the general endotracheal anesthesia. Following the anemization and anesthesia of nasal cavity mucosa {3 - 4-ml of Sol. Lidocaine 2% + Sol. Adrenaline 1:200,000}, the lateral wall of nasal cavity as well as middle and lower nasal passages are examined using a 30-degree endoscope.

Lancet #15 is utilized to make two parallel vertical incisions. The first incision is made 3 mm posterior to the maxillary line, continues vertically from the upper attachment of middle turbinate and proceeds to the lower part of the middle nasal turbinate. The second incision begins at the top of the first incision, moves forward by 3 - 4 mm and continues downwards vertically and parallel to the first incision. The mucosal layer is stripped off the lateral nasal wall and is extended to the inferior nasal concha that is followed by the osteotomy performed with Kerrison forceps and, thus, the anteromedial part of nasolacrimal sac is freed from the overlying bone tissue. Then the ophthalmologist inserts a probe through the lower lacrimal duct into the nasolacrimal sac and under the control of the endoscope the otorhinolaryngologist makes a U-shaped incision on the medial part of lacrimal sac, then the tissues of medial part of lacrimal sac are pulled back towards the inferior conchae of nasal cavity where they are fixed with the mucousal layer having been stripped off the nasal cavity and form the junction between the lacrimal sac and nasal cavity. The ophthalmologist inserts a silicone drainage into the nasal cavity through upper and lower lacrimal ducts and nasal junction, which is fixed in nasal cavity to its lateral wall.

5. Research Goal

Our research paper aims to review the major stages of developing Dacryocystorhinostomy and the modern surgical methods. In addition, our research is focused on minimizing the development of postoperative scars and fibrotic tissue as well as reducing the incidence of recurrence of dacryocystitis. For this purpose, the utilization of RF coagulator was prioritized because the laser treatment results in increased fibroblast activity that conditions the high.

6. History

One of the earliest methods for surgical treatment of dacryocystitis was provided 2000 years ago, in the 1st century AD by Celsius, who utilized the nasolacrimal duct puncture for treatment. Celsius described the treatment of dacryocystitis employing the nasolacrimal ducts puncture procedure. In the 12th century, in his book "Correct Manual of Ophthalmology" the Andalusian oculist Muhammad ibn Aslam al-Ghafiqi described the principles of surgical treatment for the lacrimal system [1]. He reported that he had used a small spear-shaped instrument which he inserted through the tear bone toward the nose. He inserted a swab, which was "dry or soaked in bovine fat," into the incision, where the swab was left for some time and changed daily, eventually leading to the formation of a fistula that was the purpose of this surgical procedure, *i.e.* tears flowed directly from the lacrimal point into the nasal cavity. This principle of fistula formation remains virtually the same to this day.

In the 18th century, Woolhouse in England proposed the method similar to external DCR which favoured the excision of the lacrimal sac, the perforation of lacrimal bone, and the insertion of a gold, leather or silver drainage in the duct

[1].

The modern method of external dacryocystorhinostomy was first proposed in 1904 by Adeo Totti, a Florentine professor of otolaryngology in the early 20th century. The principle of Totti's method was to extract the lacrimal sac applying the external procedure that envisaged the removal of the medial wall of lacrimal sac along with the adjacent mucosa of lacrimal and nasal bones which aimed to replace the wall of lacrimal sac with the lateral wall of the nose and thereby to open the nasolacrimal duct directly into the nasal cavity. The successful performance of the surgery was impeded by the difficulty with adequate resection of nasal bone and mucosa, the presence of secondary granulations and the adhesive processes. In some cases, Totti modified the procedure by removing part of the middle conchae and making the wider bone windows [1].

In 1914, Kunt moved the nasal mucosal suture into the periosteum so as to decrease the granulation tissue.

In 1921 Dupuis-Dutamps and Bourget modified Totti's operation by making vertical incisions of the nasal mucosa and lacrimal sac. The vertical passages were utilized to connect the anterior and posterior wisps of the nasal mucosa and the lacrimal sac. In 1933, they further refined their technique by the excision of resulting fistula and repeated revision. The success rate of granulation and the reduction of scar tissue increased up to 95%.

In the 80s of the last century the endonasal endoscopic surgeries were introduced into practice for the purpose of diagnostics and surgical treatment for the diseases of nasal cavity. The intranasal use of rigid endoscopes and specialized microsurgical instruments facilitated the performance of endoscopic endonasal dacryocystorhinostomy.

The mentioned has significantly increased the interest evinced in performing dacryocystorhinostomy by the various techniques of transnasal access.

Endo-DCR (endoscopic transnasal dacryocystorhinostomy) was first described in 1989 by McDonogh and Meiring (1989). Recently, the procedure has gained popularity over traditional external dacryocystorhinostomy. The DCR and Endo DCR are targeted at creating a fistula to bypass the blocked nasolacrimal duct that allows tears to drain directly into the nasal cavity [3] [4]. The diversity of instrumental as well as anatomic variations offers the opportunity for individualized planning of the endoscopic approach in patients.

Endonasal DCR was originally administered using the traditional surgical instruments and therefore was referred to as "mechanical" endonasal DCR.

"Energized" endoscopic DCR techniques have evolved since the advent of instruments of new design which eliminated the need for electro-coagulators and actually reverted to mechanical endonasal DCR. At the same time, the exposure of lacrimal sac has been completely achieved. Utilizing the external DCR, the surgeon can better maneuver and endoscopically individualize the bone and soft tissue openings [5] [6].

Endonasal endoscopic dacryocystorhinostomy (Endo DCR) is performed without the external section and with the adequate visualization of contours of

structures to be operated, also, with the minimal invasion into the mucosa and anatomical structures applying the almost “bloodless” method.

Endo-DCR has some advantages over external dacryocystorhinostomy. The most notable advantage is that the endoscopic approach is cosmetically more appealing due to the absence of visible scarring and bruising. The rehabilitation process of patients is faster and more painless [7] [8] [9].

The patients who are detected nasolacrimal duct obstruction, the inflammatory disease of nasal cavity and paranasal sinuses as well as the further recurrence after external dacryocystorhinostomy represent fine candidates for endo-DCR. Adults with anatomic variations of atypical forms of congenital dacryostenosis may also benefit from endoscopic DCR. The acute dacryocystitis with abscess formation represents the contraindication for external DCR, and in this case some authors favor Endo DCR [1] [3]. Multiple studies have demonstrated that Endo DCR has a lower risk of intraoperative bleeding. Initially, external dacryocystorhinostomy was deemed to have a higher success rate of 85% - 100%. The advancements in technology have made endoscopic dacryocystorhinostomy the procedure of choice for otolaryngologists as well as plenty of ophthalmologists. Some recent studies have revealed that the success rate of endoscopic dacryocystorhinostomy equals to or is better than external DCR. Endo DCR is as safe and effective as external DCR [4] [8].

In order to further increase the likelihood of success rate of endoscopic dacryocystorhinostomy, surgeons have used the laser energy to perform the operation. Laser procedures are faster and provide the excellent hemostasis throughout the surgery.

However, the laser procedure was found to induce the fibroblastic activity resulting in the excessive scarring and stenosis of the rhinostoma compared to non-laser dissection. The studies conducted by Main and some others evidenced that initially the laser DCR group had a higher success rate (81.7%) than surgical DCR (75.8%) within the first 3 months. But after 12 months of follow-up, the patients with surgical endoscopic DCR had a higher symptomatic success rate of 74.3% compared to 68.3% in the laser group. There also exist conflicting data on the type of laser and the length of its utilization. In this case, laser endoscopic DCR appears to have a lower success rate than non-laser endoscopic DCR or external DCR [5] [8] [9].

At the present stage, the endoscopic Endo-DCR surgery is being improved, and the diverse treatment methods, including radiofrequency (RF) in endonasal endoscopic microsurgical techniques, are being studied and introduced into practice [8] [9] [10].

7. Hypothesis of the Study

Hypothetically, in most cases the endonasal endoscopic dacryocystorhinostomy with the application of RF coagulator does not develop postoperative fibrotic granulation tissue.

Study Design:

- The study is observational in nature.
- Time-series design: preoperative and postoperative observation.
- The study design is consistent with the provisions of Declaration of Helsinki.

Study Subjects:

- The cohorts of patients are from the base of “Vivamedi” clinic.
- The age of the study subjects ranges from 5 to 85 years.
- The number of study subjects is 95 patients.

8. Findings and Conclusions

Endonasal dacryocystorhinostomy with RF coagulator proved to be effective in 80% of patients. Over 3 - 4 years following the surgery, the recurrence was manifested in 8 patients after 6 months and in 12 patients after a year. The above mentioned surgical treatment is administered by minimally invasive surgical method. At the same time, the long-term, for about 1 year, implantation of silicone drainage in the nasolacrimal ducts significantly reduces the risk of recurrence.

The purpose of the statistical study is to observe the results of treatment using endonasal endoscopic dacryocystorhinostomy coagulator according to 4 characteristics: tearing, purulent discharge, pain, and abscess. The results of the study are data before surgery and 2; 4; 8 and 12 months after surgery. Tearing was observed in 95 patients before surgery. Quantitative indicators by month are presented in the following form (See **Figure 1**):

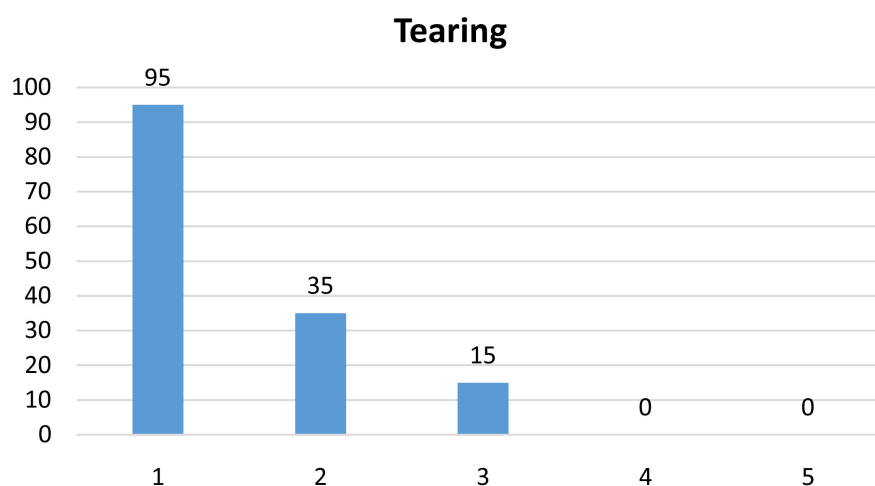


Figure 1. Tearing before and after surgery. 1—before surgery, after 2—2 months, after 3—4 months, after 4—8 months, after 5—12 months.

After 2 months only 36.8% of patients had tearing problems after 4 months 15.8% after 8 and 12 months, patients did not complain of tears.

60 patients had purulent discharge before the operation. Quantitative indicators by month look like this (See **Figure 2**):

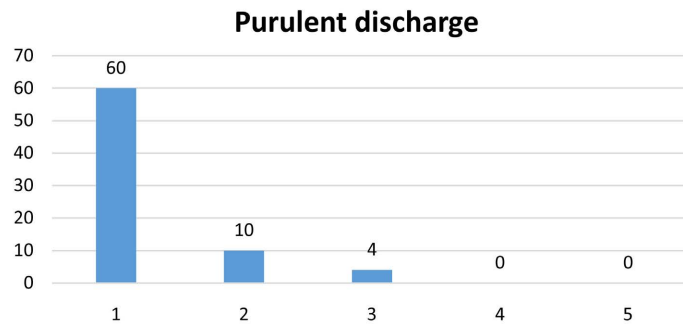


Figure 2. Purulent discharge before and after surgery. 1—before surgery, after 2—2 months, after 3—4 months, after 4—8 months, after 5—12 months.

As the study showed after 2 months purulent discharge was observed only in 16.7% of patients and after 4 months in 6.7%. After 8 and 12 months the patients had no purulent discharge.

Eye pain was also monitored where 25 patients were included in the study. None of the patients complained of pain after the operation (See **Figure 3**).

Percentage by month

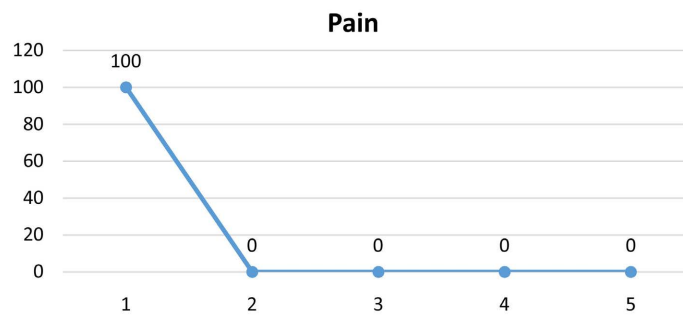


Figure 3. Pain before and after surgery. 1—before surgery, after 2—2 months, after 3—4 months, after 4—8 months, after 5—12 months.

Another feature of the study was abscess. Before the operation only 10 patients had this disease. 2 months after the operation only 30% had an abscess after 4; 8 and 12 months, the patients did not have the disease (See **Figure 4**).

Quantitative indicators by month

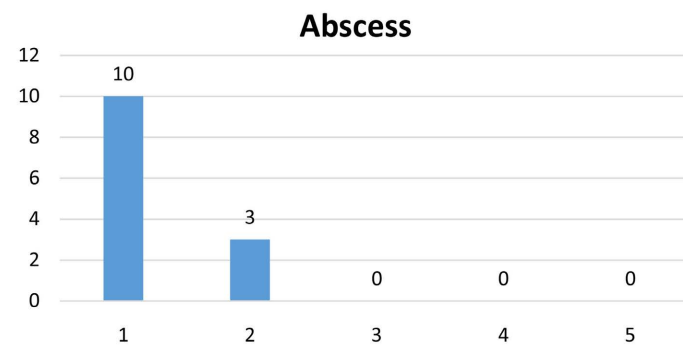


Figure 4. Abscess before and after surgery. 1—before surgery, after 2—2 months, after 3—4 months, after 4—8 months, after 5—12 months.

It was also interesting for the research to compare the dynamics of diseases in two age groups: patients aged 5 to 45 years and patients aged 46 to 85 years (See **Figures 5-8**).

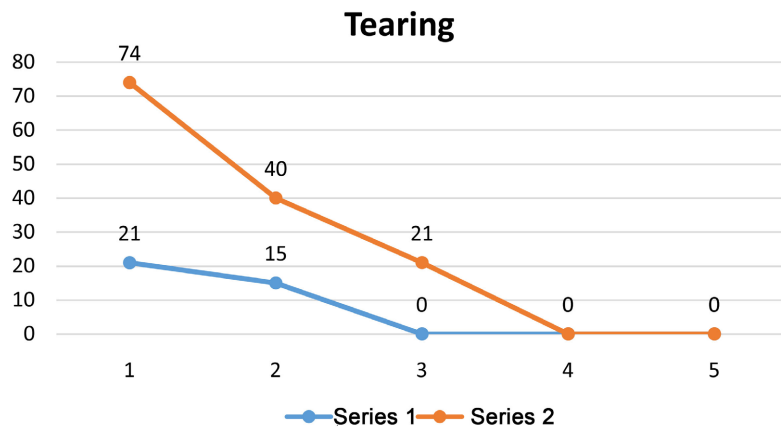


Figure 5. Tearing patients aged 5 to 45 years are marked blue, patients aged 46 to 85 years are marked orange.

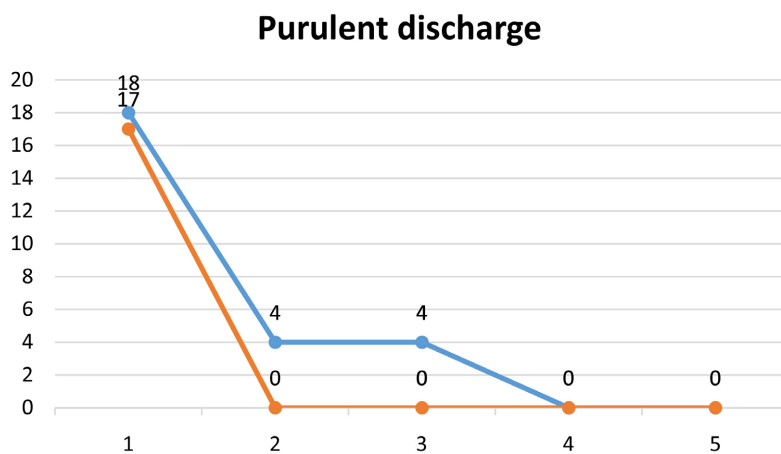


Figure 6. Purulent discharge. patients aged 5 to 45 years are marked blue, patients aged 46 to 85 years are marked orange.



Figure 7. Pain in male patients.

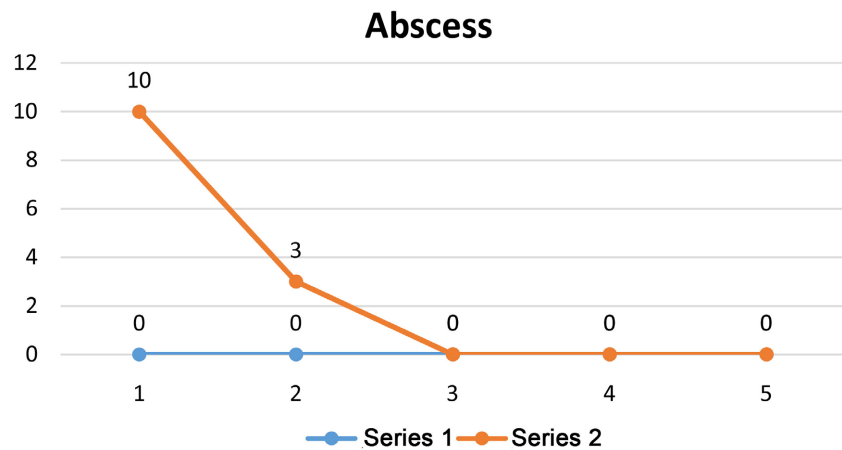


Figure 8. Abscess in female patients.

The course of diseases in groups of patients sorted by gender was interesting for research. In particular 19 male (group I) and 76 female patients (group II) who suffered from tearing before surgery were included in the study. After the operation in Group I after 2 months, 42.1% of patients had tearing, after 4 months 21.05%, after 8 and 12 months, patients did not have this complaint. As for Group II, 28.9% of patients had tearing after 2 months of surgery, after 4 months 15.8%, after 8 and 12 months, patients did not have this complaint. As for purulent discharge, out of 8 male patients and 40 female patients included in the study, none of the patients had this complaint after the operation. We had a similar situation during abscess in 2 male and 10 female patients. As for pain in 19 male patients there was no pain after surgery and in 45 female patients 11.1% of patients had pain after 2 months and after 4, 8 and 12 months, this complaint was not reported by patients in this group.

Conflicts of Interest

The authors declare no conflicts of interest.

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