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The effect of Stab Incision Glaucoma Filtering Surgery on Intraocular Pressure in Primary Angle Closure Glaucoma

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Abstract

The current study aims to evaluate the stab incision trabeculectomy technique on the intraocular pressure in primary angle closure glaucoma patients. Patients indicated for glaucoma surgery were selected for this prospective interventional study. Twenty-four eyes of 24 patients were included in this study. IOP was measured by the Goldmann applanation tonometer preoperatively and in the follow-up on the first day, the seventh day, the first month, the third month and the sixth month. The preoperative mean intraocular pressure was 28 mmHg (SD 5.1). Mean Postoperative IOP on the first day, third day, first week, first month, third month, and the sixth month was (9.5 mmHg (SD 5.1), 10.9 mmHg (SD 3.1),13.2 mmHg (SD 3.7), 15.5 mmHg (SD 5.5),15 mmHg (SD 4) and 14.3 mmHg (SD 2.4) respectively). In postoperative titrations among the studied cases, 8 (33.3%) cases required needling, which was statistically significant. (P value 0.025 %). 11 (45.8 %) cases required massage, which was statistically significant. (P value 0.000 %). 4 (16.7 %) cases required surgery, which was statistically significant. (P value 0.004 %). 6 (25 %) cases required anti-glaucoma drops, which was statistically significant. (P value 0.021 %). Hyphema occurred in 1 case (4.2 %) of cases. Stab incision technique was a safe and quick alternative to conventional trabeculectomy. IOP control with fewer complications was observed during the first six months of follow-up; mean Intraocular pressure was ~14 mmHg.

Keywords: PACG, IOP, Stab incision trabeculectomy.

1. Introduction

Trabeculectomy surgery was long established as the gold standard in glaucoma filtering surgery but is fraught with numerous short and long-term complications **[1].** A significant disadvantage of trabeculectomy/tunnel

trabeculectomies is their need for a conjunctival peritomy and subconjunctival dissection. The latter heals with scarring and subconjunctival fibrosis, which increases the risk of a failed filter. Creating a flap takes time and requires careful dissection, with many possible complications. These include tearing, laceration, buttonholing, variability in thickness and suture-related problems. These procedures require clearing the conjunctiva and Tenon capsule site for good exposure. The flap/tunnel procedures in which a conjunctival flap is raised are associated with a greater risk of scar-induced failure. Moreover, creating the flap/tunnel involves multiple steps, and the scleral flap/tunnel is triplanar **[2].** Stab incision glaucoma surgery (SIGS) is done to avoid many of the aforementioned disadvantages while simultaneously making filtration surgery easier, faster, less traumatic, and more likely to succeed **[3].** The advantages of this technique include simplicity, effectiveness, and lack of need for special instruments & devices. It is easier, faster, and more cost effective than many of the currently popular micro incision glaucoma surgeries (MIGS) devices while performing well compared to the gold standard - trabeculectomy. The entire surgery may be done through a single 2.8 mm conjunctival incision placed well away from the scleral cut. Therefore, it is less traumatic, and there is a lesser risk of scarring and failure. Virgin conjunctiva is maximized for other possible future surgeries. A biplanar scleral tunnel is preferred to a triplanar flap. A controlled posteriorly directed flow with a diffuse bleb is obtained. The more physiological hydrostatic expansion creates a bleb. All sub-conjunctival drainage channels are intact. There are less suture and flap-related complications. It is easier to tackle expulsive haemorrhage **[4,5,6].**

2. Patients and Methods

Patients indicated for glaucoma surgery were selected for this prospective interventional study (January 2020 – the last follow up at May 2022) from the Outpatient Ophthalmology Clinics at Research Institute of Ophthalmology and Al-Zahraa University Hospital Cairo, Egypt. Twenty-four eyes of 24 consecutive patients were included in this study. A written informed consecutive consent was obtained from each participant after an explanation of the study protocol was provided. The Local Ethics Committee approved the study. The procedure is in accordance with the declaration of Helsinki. Each participant underwent a comprehensive ophthalmic examination, including a review of medical history, best-corrected visual acuity was measured with Snellen acuity charts, slit-lamp biomicroscopy, intraocular pressure measurement using Goldmann applanation tonometry, gonioscopy, fundus examination using a 90-diopter lens, and visual field testing on automated perimetry using a 24-2 Swedish Interactive Threshold Algorithm (Humphrey; Carl Zeiss Meditec Inc., Dublin, California, USA). Primary angle closure glaucoma (PACG) cases diagnosed by gonioscopy were not controlled medically and required surgical interference were included. Average mean deviations on visual field: −12 dB to −6 dB moderate by standard automated perimetry. Baseline cup to disc ratio: ≥ 0.5. Participants with a history of previous glaucoma surgery, patients with another possible cause of glaucoma, single-eyed patients with poor vision in the other eye, ocular trauma or surgery, coexisting retinal disease, uveitis, non-glaucomatous optic disc neuropathy, and diabetic patients were excluded from the study.

For every case, before giving the peribulbar anaesthesia, 0.1mL of 0.02% mitomycin C (MMC) was injected sub-conjunctivally in the planned place for the Bleb. After preparation of the eye and draping, the speculum was applied and was loosened slightly to make the conjunctiva more mobile and avoid pulling it towards the fornices. Paracentesis was then done by (Micro Vitro Retinal Blade) MVR, and

Viscoelastic dispersive material, methylcellulose, was injected into the anterior chamber (AC) to form it. The conjunctival tissue at the planned side of the wound, avoiding major blood vessels, was displaced anteriorly toward the limbus by a blunt instrument and a stab incision was done through the conjunctiva. (Shown in Figure .1a) While fixating the eye by a firm grip at the limbus, a scleral tunnel was created just 2.5 mm posterior to the limbus in a lamellar fashion toward the cornea by a 2.8 mm keratome. (The blade is visible through the sclera while creating the tunnel). (Shown in Figure .1. b, c, d). After reaching the limbus, the tunnel was continued through the cornea horizontally for 1 mm, side to side carefully, avoiding downward pressure to prevent trapdoor formation then the A.C. was entered (Shown in Figure .1 e). The blade was gently withdrawn in a single smooth movement without allowing aqueous leakage through the incision, and the methylcellulose was reinjected through the paracentesis or the tunnel pushing the iris away. Kelly's punch was introduced through the tunnel into the A.C., faced downwards, the posterior lip of the corneal section was punched backwards till the limbus, and additional punches were done to settle the tunnel. (Shown in Figure .1 f) Through the created tunnel, the methylcellulose was washed. The tunnel was tested through the side port irrigation, and more punches were done in case of inadequate leakage till the free fluid flow was reached. Following this, with non-toothed forceps, the iris was grasped and excised by curved Vannas scissors performing a peripheral iridectomy (P.I.). The conjunctival wound was then closed with a running 10-0 nylon suture. Finally, a balanced salt solution was injected through the side port to form a physiological hydrostatic ballooned bleb. If minimal bleeding occurred at the time of tunnel creation, it was rinsed out by the irrigating fluid. The cases with intraoperative complications were managed but excluded from the study's statistics. A small basal punch was done for the premature entry and Excision of the hinged lip for the cases of internal corneal lip trapdoor formation. IOP was measured by the Goldmann applanation tonometer preoperatively and in the follow-ups on the first day, the seventh day, the first month, the third month and the sixth month.

3. Results

24 cases of glaucoma underwent SIGS surgery, 15 (62.5%) were phakic, and 9 (37.5%) were Pseudophakic. The mean age of our patients was 58.0±7. In the phakic patients, Range age of patients was from 29 to 67years old. the mean age was 56.1±7.6 years and 61.1±5.0 years in the pseudophakic, which was statistically insignificant. P- value was 0.096. 14 (58.3%) patients were male, and 10 (41.7%) were female. P- value was 0.210 as in Table 1.

3.1 Preoperative data

Mean BCVA (Log. MAR) was 0.5±0.2, 0.5±0.2 in phakic eyes and 0.5±0.1 in pseudophakic eyes. Only one of the cases (4.2%) was pseudo-exfoliation glaucoma. The case was pseudophakic. MMC was used in 22 (91.7%) cases, in all phakic cases and 7 (77.8%) of the pseudophakic. Phacoemulsification combined with the SIGS: 3 (12.5%) cases underwent PhacoSIGS, which is (20.0%) of the phakic cases (as shown in figure 2). No significant difference according to phakic status regarding demographic characteristics as in Table 2.

3.2 Preoperative IOP

Table 3 reports univariate comparisons of mean and standard deviation values of IOP. The last row reports the t-statistics for differences in means of the Wilcoxon test for differences in means between the IOP. ***, **, and * indicate significance for a two-tailed test at the 1%, 5% and 10% levels, respectively.

Mean IOP was 28 mmHg (SD 5.1). Postoperative IOP Changes. Mean Post-

operative IOP on the first day was 9.5 mmHg (SD 5.1). The range of IOP was (4:22mmHg). The reduction was statistically significant compared to the mean Preoperative IOP (P < 0.001). The number of cases with IOP reduction ≥ 30 % was 22 (91.7 % of the total cases).

IOP range in third postoperative day was (8: 20 mmHg). Mean Postoperative IOP on the third day was 10.9 mmHg (SD 3.1). The reduction was statistically significant compared to the mean Preoperative IOP (P < 0.001). The number of cases with IOP reduction ≥ 30 % was 23 (95.8 % of the total number of cases)

Mean Postoperative in the first week was 13.2 mmHg (SD 3.7). The range of IOP was (8:22mmHg). The reduction was statistically significant compared to the mean Preoperative IOP (P < 0.001). The number of cases with IOP reduction ≥ 30 % was 22 (91.7 % of the total number of cases) (Table 2).

Mean Postoperative IOP in the first month was 15.5 mmHg (SD 5.5). The range of IOP was (8:30mmHg). The reduction was statistically significant compared to the mean Preoperative IOP (P < 0.001). The number of cases with IOP reduction ≥ 30 % was 18 (75 % of the total number of cases)

Mean Postoperative IOP in the third month was 15 mmHg (SD 4). The range of IOP was (8:26mmHg). The reduction was statistically significant compared to the mean Preoperative IOP (P < 0.001).

The number of cases with IOP reduction ≥ 30 % was 19 (79.2 % of the total number of cases)

Mean Postoperative in the sixth month was 14.3 mmHg (SD 2.4). The range of IOP was (8:20mmHg). The reduction was statistically significant compared to the mean Preoperative IOP (P < 0.001).

The number of cases with IOP reduction ≥ 30 % was 22 (91.7 % of the total number of cases)

Postoperative titrations and Complications among the studied cases: 8 (33.3%) of cases required needling, Mainly at 1st month, which was statistically significant→(P value 0.025 %). 11 (45.8 %) of cases required massage, which was statistically significant→(P value 0.000 %).

4 (16.7 %) of cases required another filtering glaucoma surgery, which was statistically significant→(P value 0.004 %). 6 (25 %) of cases required anti-glaucoma drops, which was statistically significant→(P value 0.021 %). Hyphema occurred in 1 case (4.2 %) of cases.

Table (1): Demographic characteristics of the studied cases: Mean IOP preoperatively according to phakic status. Independent t-test.

Variables		Total (N=24)	Phakic (N=15)	Pseudophakic (N=9)	P
Age (years)		58.0±7.1	56.1±7.6	61.1±5.0	^0.096
Sex	Male	14 (58.3%)	7 (46.7%)	7 (77.8%)	#0.210
	Female	10 (41.7%)	8 (53.3%)	2 (22.2%)	
Visual acuity (Log mar)		0.5±0.2	0.5±0.2	0.5±0.1	^0.395
MMC		22 (91.7%)	15 (100.0%)	7 (77.8%)	#0.130
PhacoSIGS		3 (12.5%)	3 (20.0%)	0 (0.0%)	#0.226
Pseudo-exfoliation		1 (4.2%)	0 (0.0%)	1 (11.1%)	#0.375

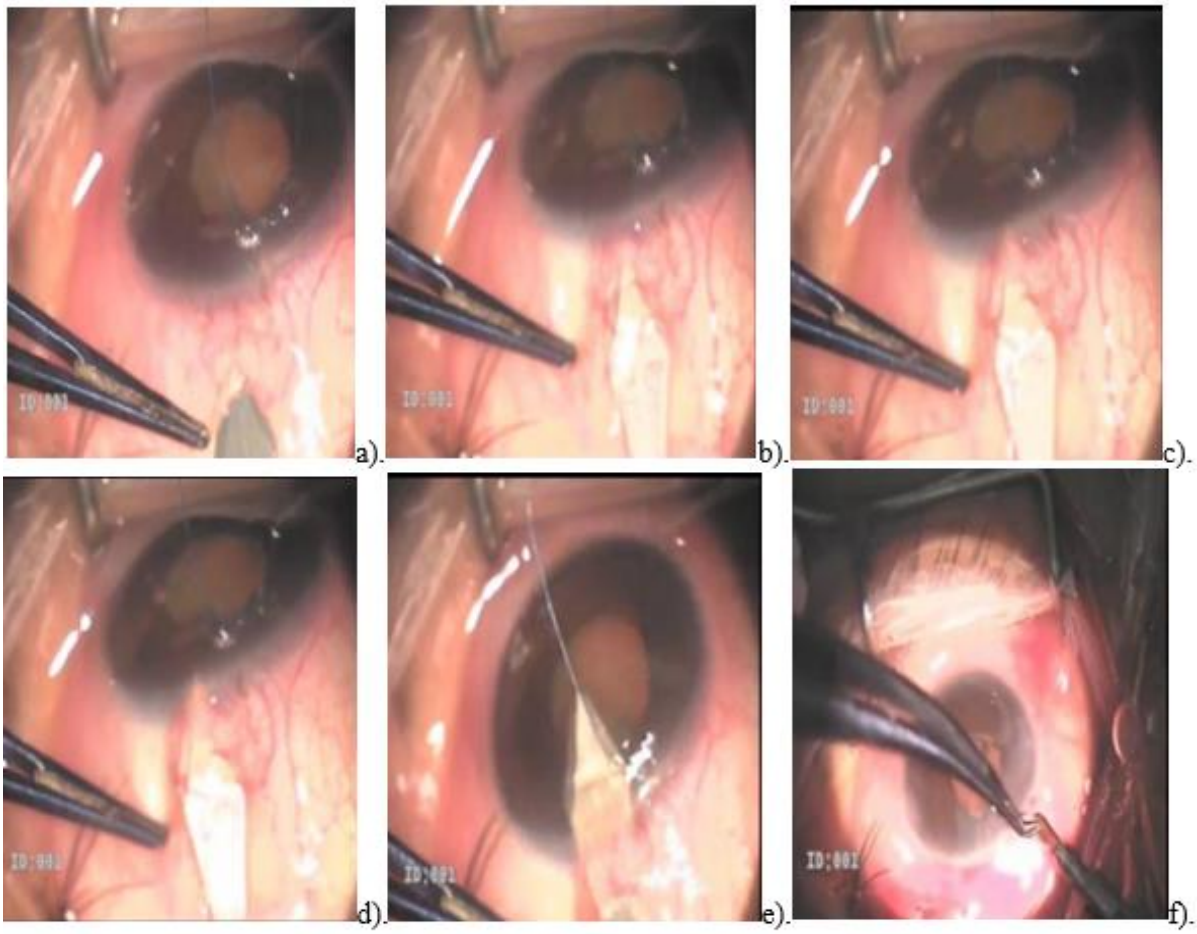

Figure (1): Stab incision glaucoma surgery (SIGS). a). Superior conjunctiva is slid downwards over the cornea b). a 2.8 mm bevel-up metal keratome is introduced 1.5 mm behind the limbus. c), d), e) Keratome is passed through the conjunctiva and into lamellar sclera and a superficial lamellar scleral tunnel is then dissected. d)& e). Keratome is introduced about 0.5–1 mm into the clear cornea and the anterior chamber (AC) is then entered. (f) punch the internal lip of the cornea.

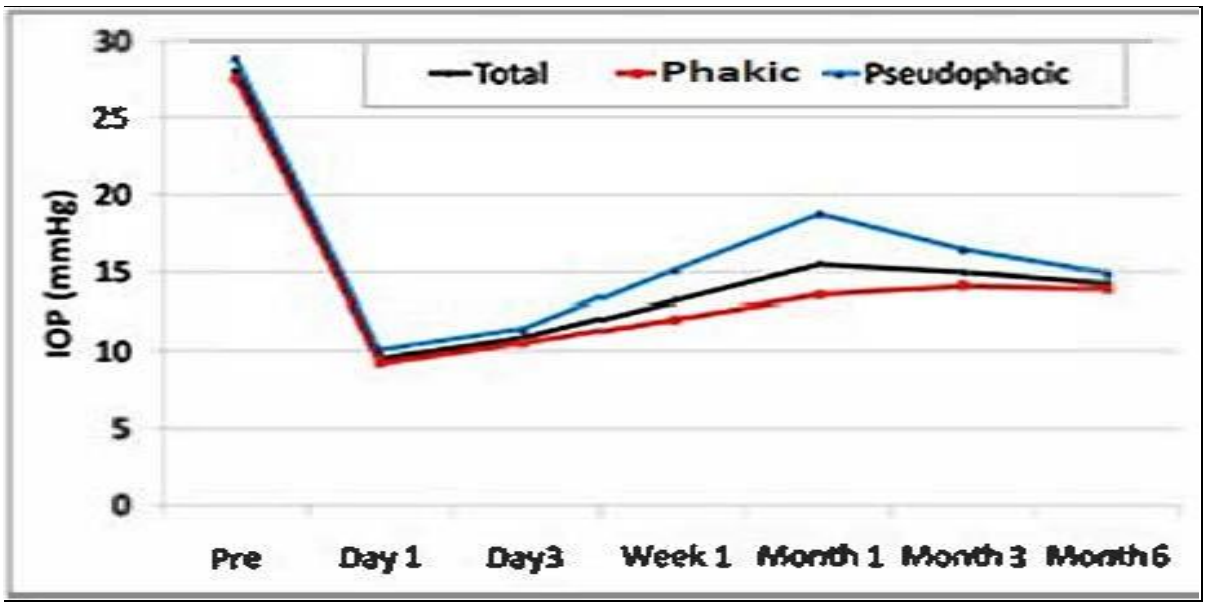

Figure (2): Mean IOP among the studied cases and according to phakic status.

Table (2): IOP reduction ≥30.0% from preoperative level among the studied cases and according to phakic status.

Variables	Total (N=24)	Phakic (N=15)	Pseudophakic (N=9)	#P
Day-1	22 (91.7%)	14 (93.3%)	8 (88.9%)	1.000
Day-3	23 (95.8%)	15 (100.0%)	8 (88.9%)	0.375
Week-1	22 (91.7%)	15 (100.0%)	7 (77.8%)	0.130
Month-1	18 (75.0%)	13 (86.7%)	5 (55.6%)	0.150
Month-3	19 (79.2%)	13 (86.7%)	6 (66.7%)	0.326
Month-6	22 (91.7%)	14 (93.3%)	8 (88.9%)	1.000

 # Fisher's Exact test. *Significant

Table (3): IOP (mmHg) among the studied cases and according to phakic status. Independent t-test (comparison between phakic and pseudophakic).

Time	Findings	Total (N=24)	Phakic (N=15)	Pseudophakic (N=9)	^P
Pre	Mean ± SD	28.0±5.1	27.5±5.4	28.9±4.8	0.541
Day -1	Mean ± SD	9.5±5.1	9.2±5.4	10.1±4.7	0.681
	#P	<0.001*	<0.001*	<0.001*	
Day- 3	Mean ± SD	10.9±3.1	10.5±2.5	11.4±3.9	0.492
	#P	<0.001*	<0.001*	<0.001*	
	§P	0.118	0.311	0.088	
Week-1	Mean ± SD	13.2±3.7	12.0±3.0	15.1±4.3	0.046*
	#P	<0.001*	<0.001*	<0.001*	
	§P	0.001*	0.048*	0.004*	
Month-1	Mean ± SD	15.5±5.5	13.5±4.0	18.8±6.3	0.019*
	#P	<0.001*	<0.001*	0.010*	
	§P	<0.001*	0.033*	0.005*	
Month-3	Mean ± SD	15.0±4.0	14.1±2.8	16.4±5.2	0.234
	#P	<0.001*	<0.001*	0.001*	
	§P	<0.001*	0.001*	0.004*	
Month-6	Mean ± SD	14.3±2.4	13.9±2.4	14.9±2.4	0.327
	#P	<0.001*	<0.001*	<0.001*	
	§P	<0.001*	0.002*	0.013*	

#Paired t-test (comparison between pre and follow-up). §Paired t-test (comparison between day two and further follow-up). *Significant

4. Discussion

Traditional sub scleral trabeculectomy is a widely adopted procedure of choice. Surgical management of glaucoma by filtering surgeries with mitomycin C and glaucoma drainage devices remains the standard of surgical care **[2].** Many technique modifications have been introduced to have an optimum outcome and decrease complications; tunnel trabeculectomies that use a scleral tunnel were described in the past as a successful mode of filtration surgery **[3].** If the manipulation of the conjunctiva is decreased during the surgery, the fibrosis will be less, and the aqueous drainage will be better in the long term. This corresponds with the SIGS technique, which was first described by **Jacop et al. [2].** Nontraumatic subconjunctival dissection has also been tried to prevent inadvertent conjunctival handling.

The mean IOP significantly decreased at all follow-ups compared to the preoperative level. IOP reduction ≥ 30.0% was in more than 90.0% of cases beginning from day one, then decreased down to less than 80.0% at month-1 and month-3, then increased at month-6. IOP reductions≥ 30.0% were non-significantly more frequent among phakic than among pseudophakic.

Jacop et al. [2] described that, the mean preoperative IOP was 27.41±5.54 mmHg (range 21–39 mm Hg) and the mean postoperative IOP was 16.47 ± 4.81 mmHg (range 9–28 mmHg). There was significant reduction in IOP from preoperative values (Wilcoxon signed rank test, $p < 0.000$). The mean reduction in IOP was 38.81 ± 16.55%.

Studying the titrations required and the complications data, 33.3% of cases required needling, 45.8 % required massage, 16.7 % required surgery, and 25 % required glaucoma medications. These procedures were statistically significant but were controlled and included in the final statistical results of IOP control.

Jacop et al. [2] described that, postoperative complications encountered were microhyphema (2 cases), more than grade 2 AC reaction (one case), hypotony (one case), and uncontrolled IOP (6 cases). No sight threatening complications such as bleb inflammation/infection or cystoid macular edema seen in any of the cases.

Subconjunctival fibrosis of the bleb is a common cause of glaucoma surgery failure. Therefore, minimizing unnecessary intraoperative manipulation of conjunctiva and tenon's capsule seems to decrease the process of fibrosis and the possibility of conjunctival tearing and buttonhole formation, which will decrease the incidence of fibrosis as well **[7,8,9].** Since the conjunctival and scleral wounds are not opposed in SIGS, the risk of fibrosis between the two wounds is reduced due to the anterior displacement of the conjunctiva. This is enhanced by the mechanical effect of the conjunctival sutures.

SIGS technique depends on making the entrance of the keratome linear and smooth. This lessens the dissection of the conjunctiva and preserves the subconjunctival drainage channels to a great extent that makes the subconjunctival drainage and fibrosis more optimal compared to trabeculectomy. Also, the Bleb is formed through a preserved virgin subconjunctival tissue which is mainly elevated hydrostatically, in addition to keeping enough intact conjunctiva for the possibility of any other required glaucoma surgery. The aqueous is directed only posteriorly because a single step creates the tunnel compared to three-direction leakage, which happens in classic trabeculectomy and decreases the bleb complications such as overhanging. A significant advantage of this technique is that it can be closed rapidly in case of expulsive haemorrhage **[10].**

The disadvantages of this technique include subconjunctival bleeding because it is not available to do cautery, and this can be avoided by stopping the anti-platelets for a

sufficient duration for the patients using it. In addition, choosing the place of the incision away from seen conjunctival and scleral vessels **[11].**

Another disadvantage is that the technique appears partially blinded, but it was available that the scleral tunnel entrance under the conjunctiva, the keratome passage, the lip of the corneal entry, the corneal punch, and the formation of the Bleb to be seen in all of the study cases.

Complete success was defined as an intraocular pressure of <18 mmHg without medications and qualified success was defined as reduction in IOP to <18 mmHg with two or less medications. Failure was defined as need for more than 2 medicines postoperatively for IOP control. Intraoperative or postsurgical events which required conversion to conventional trabeculectomy to decrease IOP were also considered as failure. Any ocular adverse effect which required surgical or medical intervention for management apart from regular postoperative regimen was considered as complication of the surgery.

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