Toxic Anterior Segment Syndrome: A Comprehensive Review of Literature

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ABSTRACT

Toxic anterior segment syndrome (TASS) is a sterile, acute, uncommon inflammatory response that occurs after surgery. This literature review aims to investigate TASS epidemiology, diagnosis, and management and provide updated evidence from previous TASS cases. Determining the specific TASS reason is usually challenging. TASS is associated with several complications, such as apoptosis, necrosis, and toxic cell damage. Some studies suggest that it may occur after cataract surgery among about 1 per 1,000 people who undergo surgery. Diagnosis of TASS is challenging because its signs and symptoms are like infectious endophthalmitis. The diagnosis of TASS involves laboratory tests and clinical evaluation as follows: slit lamp examination, tonometry, and examination of corrected distance visual acuity are used to distinguish the clinical characteristics of TASS. Although the treatment for TASS varies based on the severity of cases, topical corticosteroids remain the cornerstone of therapy.

Keywords: Diagnosis; Management; Toxic anterior segment syndrome; Treatment

INTRODUCTION

Toxic anterior segment syndrome (TASS) is a sterile, acute, uncommon inflammatory response that occurs after surgery[1]. Monson and colleagues[2] introduced the TASS phrase first in 1992. TASS is also known as localized endophthalmitis, toxic endothelial cell destruction syndrome, sterile postoperative endophthalmitis, and toxic lens syndrome[3-7]. Although TASS predominantly arises after cataract operations, it is also reported after posterior segment and keratoplasty surgeries[8-11]. TASS typically develops within 12 to 48 hours after surgery[5]. Still, late-onset cases are documented in the literature[12-14]. Moreover, it can present in clustered and sporadic outbreaks[15].

Determining the specific TASS reason is usually challenging[15], as it can develop due to multiple agents that can enter the anterior segment instantly following or during surgery and cause toxic tissue damage[1,3]. These agents include ocular medications' additives or preservatives, detergents, denatured ophthalmic viscoelastic devices, intraocular irrigation solutions whose osmotic pressure, pH, or chemical composition are incompatible with preserving ocular tissue, and bacterial endotoxins[16-26].

TASS is associated with several complications, such as apoptosis, necrosis, and toxic cell damage[5], in addition to other long-term complications, including iris transillumination defects, mydriasis, iris damage, corneal endothelial damage, cystoid macular edema, chronic inflammation, and glaucoma[3]. With the advancement of surgical techniques, technology, and new medications and substances for intraocular procedures, the frequency of these complications has increased, and new approaches have been suggested to reduce them[5,27-30].

TASS is preventable; therefore, it is a significant interest for surgeons[31]. TASS can be prevented by regularly researching and providing updated information about TASS to ophthalmic surgeons[9]. These may also contribute to preventing many TASS-related serious complications. Hence, this literature review aims to investigate TASS epidemiology, diagnosis, and management and provide updated evidence from previous TASS cases.

EPIDEMIOLOGY

Because TASS occurs in rare sporadic and clustered outbreaks, it is challenging to estimate its incidence. Some studies suggest that it may occur after cataract surgery among about 1 per 1,000 people who undergo surgery[15,32]. In India, a previous study analyzed more than 20,000 cataract surgeries at Aravind Eye Hospital and found that the incidence of TASS among these cases was 0.22%[32]. In another prior study, 909 cases of TASS occurred in eye surgery centers in Romania, Spain, Mexico, Italy, Brazil, Argentina, and the United States after 50,114 cataract surgeries were performed at these centers from 2007 to 2009[33]. In Addition to equipment and solutions required during surgery, patient risk factors such as hyperlipidemia, systemic hypertension, and uncontrolled type 2 diabetes may increase the risk of TASS[34].

DIAGNOSIS

Diagnosis of TASS is challenging because its signs and symptoms are like infectious endophthalmitis[35,36]. Regardless of these similarities, their treatment is different[37], and both are associated with poor visual outcomes[38]. Therefore, differentiation between them is essential[37]; the features in Table 1 can aid in this differentiation.

The diagnosis of TASS involves laboratory tests and clinical evaluation as follows: slit lamp examination, tonometry, and examination of corrected distance visual acuity (CDVA) are used to distinguish the clinical characteristics of TASS; B-scan is utilized in cases with severe anterior chamber reaction if viewing the posterior pole is challenging; and fungal culture and bacterial culture are performed to rule out any infections[38,42,45].

MANAGEMENT

Although the treatment for TASS varies based on the severity of cases, topical corticosteroids remain the cornerstone of therapy. Topical dexamethasone or prednisolone are used for mild cases, subconjunctival corticosteroids may be mandated for moderate cases, and oral corticosteroids may be required for severe cases[46]. If patients

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Table 1. Clinical features for infectious endophthalmitis vs TASS[3,15,31,38-44].

Feature	Infectious endophthalmitis	TASS
Pain	Moderate to severe	Non or mild
Onset	3–7 days after surgery	12–48 hours after surgery
Corneal edema	Focal or no corneal edema	Limbus-to limbus corneal edema
Intraocular pressure (IOP)	Variable	Normal to elevated
Vitreous involvement	Present	Rare
Visual acuity decrease	Moderate to severe	Mild
Culture	Gram stain Culture positive	Gram stain Culture negative
Anterior chamber	Severe inflammation with hypopyon	Mild to severe inflammation with fibrin, hypopyon, flare, and/or cells
Inflammation	Involved the entire ocular cavity	Limited to the anterior chamber
Steroids treatment response	Cloud worsens, antibiotics required	Rapid response

TASS, toxic anterior segment syndrome.

Table 2. Summary of TASS cases from 16 prior studies.

Authors, year	Country	Aim	Sample size [M/F, years of age or mean age, if available]	Surgery type	Symptoms (All or some patients)	Treatment	Outcome(s)
Choi et al., 2008 [49]	Korea	Study the causalities of TASS post-phacoemulsification.	15 patients [2/13, mean age: 64.7±10.9]	Phacoemulsification	Moderate corneal edema.	Steroids NaCl solution	Conventional treatments have not shown a benefit. Using steam sterilization instead of ethylene oxide sterilization hindered the occurrence of TASS.
Ozcelik et al., 2010 [24]	Turkey	Assess the treatment response and the outcomes of anterior segment examination for post-uncomplicated cataract operation TASS patients.	14 patients [mean age: 64.07±5.40]	Cataract surgery	Corneal edema, visual impairment, fibrin, and hypopyon.	Steroids Antibiotic drops	It has been treated successfully.
Jun et al., 2010 [60]	Korea	Document a TASS case that was assumed to result from antiseptic solution usage.	1 patient [F, age: 78]	Cataract surgery	Anterior chamber inflammation and diffuse corneal edema.	Topical antibiotic Steroid eyedrops	Corneal edema continued, but the anterior chamber inflammation declined extensively.
Huang et al., 2010 [61]	China	Document the clinical outcomes of a child TASS case following an uneventful congenital cataract operation.	1 patient [M, age: 8]	Congenital cataract surgery	Mild mydriasis, fibrin, and diffuse corneal edema.	Topical and oral steroids	Endothelial cell count declined. Visual acuity improved. Corneal edema gradually enhanced.
van Philips, 2011 [62]	Netherlands	Report TASS cases that emerged sequentially or post-implant foldable iris-fixated pIOL.	2 patients C1: [F, age: 45] C2: [F, age: 33]	Foldable iris-fixated pIOL implantation	Intense anterior chamber inflammation, conjunctival and ciliary injection, fibrin, hypopyon, and slight decrease in CDVA.	Intensive topical steroid	Resolved without complications.

Moyle et al., 2013 [47]	USA	Investigate causes and clinical observations of two TASS consecutive sets following uncomplicated phacoemulsification cataract operation.	11 patients [M, mean age: 68.73±6.84]	Corneal phacoemulsification	Hypopyon, fibrin, inflammatory plaques, mild to severe vision impairment, anterior chamber white blood cells, and severe stromal edema.	Steroid. Antibiotic. Diclofenac.	Corneal edema and inflammation resolved. Vision 20/20.
Koban et al., 2014 [50]	Turkey	Document a post-cataract operation TASS case that developed due to an accidental high gentamicin dose injection in the corneal stroma and anterior chamber.	1 patient [F, age: 72]	Corneal phacoemulsification	Hemorrhagic fibrinous reaction, severe corneal edema, hyphema, generalized Descemet's folds, and mild conjunctival chemosis.	Topical and oral steroids Cyclopentolate hydrochloride NaCl solution Antibiotics Ophthalmic ointment	Corneal edema persists. Descemet's folds improved. Bullous keratopathy developed. She needed penetrating keratoplasty.
Suzuki et al., 2015 [12]	Japan	Present the clinical outcomes of TASS following implantation of aluminum-contaminated IOLs.	251 patients [89/162, mean age: 72.85]	IOL implantation	Hypopyon, fibrin, conjunctival injection, and anterior chamber cells.	57% treated with antibiotics and steroids 43% underwent surgery	BCVA improved significantly after treatment.
Sevimli et al., 2016 [10]	Turkey	Report a post-uncomplicated DALK TASS case.	1 patient [F, age: 31]	DALK	Corneal edema and severe vision loss.	Oral steroids and high-dose topical steroids	Corneal edema: decreased. Visual acuity: increased.
Lee et al., 2017 [63]	Australia	Differentiate between the diagnosis of TASS and endophthalmitis.	1 patient [F, age: 74]	Cataract surgery	Small hypopyon, mild corneal edema, and inflammation.	Steroid Antibiotic	TASS: Overall, the prognosis was good. Steroids improve symptoms, while antibiotics worsen the condition.
Ahmad et al., 2021 [64]	Syria	Document a post-LASIK surgery TASS case.	1 patient [M, age: 42]	LASIK		Steroids	Vision recovered. Pain relieved. Inflammatory response resolved.
Arıcı et al., 2022 [65]	Turkey	Report a post-uneventful pterygium operation severe corneal edema case and investigate the potential causes.	1 patient [F, age: 29]	Pterygium excision surgery with conjunctival autografting	Conjunctival hyperemia, Descemet folds, and diffuse corneal edema.	Topical steroid	Within two weeks of treatment, a complete response was achieved.
Gil-Martínez et al., 2022 [66]	Venezuela	Document two post-sequential uneventful trabeculectomy operations TASS cases.	2 patients C1; [M, age: 45] C2: [F, age 63]	Trabeculectomy	Hypopyon, fibrin, moderate corneal edema, and conjunctival hyperemia.	Steroids Antibiotics	Favorable outcomes were reported.

Kaplan et al., 2022 [37]	Turkey	Represent the clinical treatment and characteristics considered when determining reasons for an unexpected inflammatory reaction after a post-cataract operation.	13 patients [7/6, mean age: 68.84±11.34]	Cataract surgery	Severe hypopyon, vitiritis, corneal edema, pain, and blurred vision.	Topical steroid IV steroid	After 2 days of treatment, hypopyon and edema decreased. After 3 days of treatment, the hypopyon and edema completely resolved.
Ruiz-Lozano et al., 2023 [52]	Mexico	Report a bilateral TASS case with vitreous following bilateral phaco-refractive operation.	1 patient [F, age: 59]	Phacorefractive surgery with multifocal IOL implantation	Erythema, eyelid edema, conjunctival chemosis, anterior chamber inflammation, and ciliary injection.	High-dose oral steroids and topical steroids	Significant clinical improvement has been reported.
Ginger-Eke et al., 2023 [51]	Nigeria	Emphasize TASS preventive measures and potential causes and notify surgeons of the potential of TASS after anterior segment operations, such as trabeculectomy.	1 patient [M, age: 58]	Trabeculectomy	Deteriorating visual acuity, profound Descemet's folds, and severe corneal edema.	Topical steroid Systemic oral acetazolamide and steroid Timolol NaCl solution	Bullous keratopathy developed. Cornea edema continued. He was referred to another center for penetrating keratoplasty but rejected any additional intervention.

TASS, toxic anterior segment syndrome; NaCl, sodium chloride; M, male; F, female; C, case; pIOL, phakic intraocular lens; CDVA, Corrected distance visual acuity; IOLs, intraocular lenses; BCVA, best-corrected visual acuity; DALK, deep anterior lamellar keratoplasty; LASIK, laser in situ keratomileusis; IV, intravenous.

have pain, topical non-steroidal anti-inflammatory drugs (NSAIDs) can be administered[47]. Topical atropine[48] or sodium chloride (NaCl)[49-52] may be utilized in some cases. Broad-spectrum antibiotic therapy is recommended because research reported that up to 30% of bacterial endophthalmitis cases can have a negative microbial culture[53]. In subjects with elevated IOP, topical beta-blockers[54] or acetazolamide[55] are administered.

In addition, some patients may need surgical interventions. For instance, filtering procedures and penetrating keratoplasty may be required if IOP remains high among patients after medication therapy[56]. Moreover, penetrating or endothelial keratoplasty can be performed for patients with corneal decomposition[12,57]. Anterior chamber washout, intraocular lens (IOL) removal, and vitrectomy are other reported required surgical interventions for TASS patients[58]. Finally, increasing awareness about TASS preventive strategies, such as minimizing enzymatic detergents and sterilizing ophthalmic instruments[15,59], is the most crucial measure for prevention[9].

REVIEW OF CASES

We reviewed 16 previous studies[10,12,24,37,47,49-52,60-66] from 2008 to 2023, including 317 reported TASS cases from Korea, Turkey, China, Netherlands, USA, Japan, Australia, Syria, Venezuela, Mexico, and Nigeria. The age ranges from 8 to over 80 years, with most cases observed among older ages. The majority of cases occurred after cataract surgery. Anterior chamber inflammation and diffuse corneal edema were the most clinical presentation among patients. Besides, most cases were treated successfully with steroids (Table 2).

CONCLUSIONS

Toxic anterior segment syndrome (TASS) remains a serious postoperative complication that arises primarily after cataract surgery. The most reported reasons for TASS include toxic intraocular agents, inadequate instrumental sterilizations, and contaminated intraocular solutions. Corticosteroids continue to be an effective therapy for the majority of TASS cases. Additional medications, like topical NaCl, timolol, and atropine, may be added based on patients' clinical presentations. Still, some cases required surgical intervention, such as keratoplasty, anterior chamber washout, IOL removal, and vitrectomy. Preventive strategies, such as sterilizing ophthalmic instruments, can decrease the incidence of TASS more and more.

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