• Clinical Research •

Endogenous endophthalmitis due to *Klebsiella pneumoniae* liver abscess: a retrospective study of clinical course, treatment pattern, and prognosis

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Abstract

● **AIM:** To report the demographic and systemic characteristics of patients, clinical progression of endophthalmitis, and the efficacy of various treatment strategies, with a focus on identifying key factors for preserving vision in eyes with endogenous endophthalmitis due to *Klebsiella pneumoniae* (*K. pneumoniae*) liver abscess.

● **METHODS:** In this single-center, retrospective case series of 18 patients with endogenous endophthalmitis due to *K. pneumoniae* liver abscess were analyzed. Ophthalmologic features of endophthalmitis at early, intermediate and advanced stages were obtained from eyes with endophthalmitis of different severities. Prompt vitrectomy was considered primarily for all eyes except for very early endophthalmitis. Intravitreal injections of antibiotics were performed in eyes with endophthalmitis in the very early stages and in eyes where vitrectomy was not available, and additional control of infection was needed after vitrectomy. Evisceration was performed in eyes with corneoscleral perforation, advanced endophthalmitis, perforation with preseptal or orbital cellulitis, uncontrolled infection, or severe pain with no vision.

● **RESULTS:** Mean (±standard deviation) age of the 18 patients with endophthalmitis was 64.5±12.2 (range: 32-84)y, and 14 patients (77.8%) were males. Endophthalmitis tended to involve the retinal parenchyma first and then progressed into the vitreous cavity and anterior segments. However, it presented a tendency to cause massive subretinal abscesses even after vitrectomy with silicone oil tamponade. Very high intraocular pressure with new vessels on the iris (41.7%) were also commonly observed. Although all but three patients had systemic disease such as diabetes or hypertension, visual prognosis after treatment did not appear to depend significantly on underlying comorbidities. A final best-corrected visual acuity better than 20/60 was achieved only when lesions were detected very early, with relatively good initial visual acuity, likely reflecting lower bacterial inoculation in the eye.

● **CONCLUSION:** Detection of early endophthalmitis lesions appears to be the only way to preserve good vision in patients with *K. pneumoniae* liver abscesses. Therefore, proper guidelines for ophthalmologic screening remain to be established for subjects at a high risk of endophthalmitis.

● **KEYWORDS:** endogenous endophthalmitis; *Klebsiella pneumoniae*; liver abscess; treatment pattern
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INTRODUCTION

Endogenous endophthalmitis is an infectious inflammation of the eye caused mainly by the hematogenous spread of pathogens such as bacteria or fungi from a distant primary focus. It accounts for 2%-8% of all endophthalmitis cases[1-3]. Because the causative organism breaches the blood-retinal barrier and infects the retina at a very early stage of the disease, endogenous endophthalmitis has a poorer visual prognosis

than other types of endophthalmitis[4-5]. Among all endogenous endophthalmitis cases in Republic of Korea, pyogenic liver abscess (PLA) is the primary site of infection in 25%-48% of cases, and *Klebsiella pneumoniae* (*K. pneumoniae*) is the primary pathogen accounting for 45.8%-60% of cases[6-8]. We have previously reported that the prevalence of endophthalmitis secondary to a *K. pneumoniae* liver abscess was 7.3% in patients who were admitted to a single university hospital over an 11-year period[9]. *K. pneumoniae* is particularly virulent[10-11], capable of causing invasive liver abscess syndrome, which includes a primary liver abscess and extrahepatic infections in organs such as the lung, brain, kidney, or eye, along with a risk of mortality from systemic complications[12-13]. In a population-based study in Republic of Korea, extrahepatic involvement was found in 1.74% of patients with PLA, with the eye being the most common site of distant infection[14]. Similarly, in our previous single-center report, extrahepatic infections other than the eye were found in 10.5% of patients with *K. pneumoniae* liver abscesses, with the lung as the most common metastatic site, followed by the eye[9].

Endogenous endophthalmitis is regarded as the most devastating morbidity associated with invasive liver abscess syndrome, often resulting in irreversible vision loss[15]. Risk factors for endophthalmitis due to *K. pneumoniae* liver abscess include diabetes[12,16], East Asian ethnicity[16], larger liver abscesses (>5 cm)[9,16], K1 capsular serotype[17], and others[9,18]. Patients with endophthalmitis were shown to have accompanying systemic complications, for example, acute cholangitis, portal or hepatic vein thrombophlebitis, disseminated intravascular coagulation (DIC), or extrahepatic infections other than the eye, more frequently than those without endophthalmitis[9]. These complex systemic conditions pose significant challenges to early diagnosis and aggressive treatment. Prompt intervention, such as early vitrectomy, has been associated with higher anatomical success rates, including globe preservation and retinal attachment[19-20]. However, the final visual outcome often depends on the stage of endophthalmitis at detection[8,21], highlighting the need for standardized staging systems and treatment protocols.

Given the increasing incidence of *K. pneumoniae* endophthalmitis and the challenges posed by its virulence and emerging antibiotic resistance, early detection and comprehensive ophthalmologic screening are critical[4,8-9]. In our previous study, approximately 73.7% of patients with PLA underwent ophthalmologic examinations over an 11-year period, and while the incidence of endophthalmitis increased, the proportion of eyes with poor final visual outcomes (hand motion and worse) and evisceration decreased over time[9]. Investigating the clinical course, treatment patterns, and outcomes of *K. pneumoniae* endophthalmitis is essential for improving therapeutic strategies and developing effective screening guidelines tailored to the disease stage.

Here, we report the clinical features of eyes with endophthalmitis in patients with *K. pneumoniae* liver abscesses in our previous study[9]. The demographic characteristics of patients, radiologic features of liver abscesses, systemic conditions of patients associated with the aforementioned risk factors, initial vision, clinical course of endophthalmitis, treatment flow, follow-up period, mortality associated with systemic complications, and prognosis of each patient were described.

PARTICIPANTS AND METHODS

Ethical Approval This retrospective case series was conducted in accordance with the tenets set forth in the Declaration of Helsinki and was approved by the Institutional Review Board of Pusan National University Hospital (approval number: 2306-010-128). Informed consent, which included information on the prognosis of endophthalmitis and the benefits and risks associated with each treatment option, was obtained from all the patients.

Study Design and Population Patients admitted for the treatment of PLA between January 2012 and November 2022 who were diagnosed with endophthalmitis due to *K. pneumoniae* liver abscess were included in this single-center, retrospective case series.

Endophthalmitis caused by a *K. pneumoniae* liver abscess was previously defined as inflammatory eye manifestations and relevant sequelae and culture positivity for blood, vitreous or aqueous without any other possible cause, such as surgery or open-globe trauma, in patients with *K. pneumoniae* liver abscesses[9]. All patients were treated with systemic antibiotics and percutaneous drainage of the liver abscesses. The attending physicians managed any accompanying systemic complications.

Data Collection Demographic characteristics (age and sex), underlying diseases (diabetes, hypertension, *etc*.), radiologic findings (size, location, multiplicity of liver abscesses, and presence of cholangitis or thrombophlebitis), systemic complications (bacteremia, sepsis, and DIC), presence of extrahepatic infections in organs other than the eye, culture positivity rate from blood samples and eyes, and follow-up period of 18 patients with endophthalmitis due to a *K. pneumoniae* liver abscess were retrospectively collected and described. Cases were excluded if *K. pneumoniae* was not the sole organism detected, such as in polymicrobial infections involving liver abscesses or blood samples. Best-corrected visual acuity (BCVA) at the time of diagnosis and final follow-up, presence of concomitant preseptal or orbital cellulitis, lens status, and presence of new vessels on the iris (NVI) or elevated intraocular pressure (IOP) of each eye with endophthalmitis were reviewed. The treatment methods for each eye were

retrieved chronologically from the medical records. Mortality due to systemic complications was assessed.

All eyes with endophthalmitis received at least one treatment, the natural course of the disease could not be determined. However, the ophthalmological features of endophthalmitis at the early, intermediate, and advanced stages could be obtained from eyes with endophthalmitis of different severities. Prompt vitrectomy with or without encircling buckling was considered primarily for all eyes except for those with very early endophthalmitis. However, vitrectomy could not be performed at the discretion of the attending physician in patients with poor general condition. Sometimes patients refused surgical treatment because they worried about the possible worsening of their general condition after major surgery or because of poor economic status. For some patients, the preservation of vision or the eyeball was not the first priority after they were informed that the visual prognosis was poor for advanced endophthalmitis.

Intravitreal injection with vancomycin (1.0 mg/0.1 mL) and ceftazidime (2.25 mg/0.1 mL) was performed in eyes with endophthalmitis in very early stages (infection was limited only to a small area of the retina with little or no vitritis), in eyes where vitrectomy was not available, and for those in which additional control of infection was needed after vitrectomy. Evisceration was performed in eyes with eyeball perforation with advanced endophthalmitis, perforation with preseptal or orbital cellulitis, uncontrolled infection, or severe pain with no vision. Topical antibiotics and steroid eye drops were prescribed every 2-6h, as needed. Maximal tolerable medical therapy was applied for elevation of IOP and intravitreal bevacizumab injection (0.75 mg/0.03 mL to 1.25 mg/0.05 mL) was applied for eyes with NVI. Samples from the aqueous or vitreous humor were obtained at the time of the first intravitreal injection, vitrectomy, or evisceration.

RESULTS

During the study period, 18 patients (24 eyes) had been diagnosed with endophthalmitis due to *K. pneumoniae* liver abscess[21]. Seven patients had endophthalmitis only in the right eye; five patients had endophthalmitis only in the left eye; and six patients (33.3%) had bilateral endophthalmitis. Table 1 summarizes the demographic characteristics, systemic complications, ophthalmologic manifestations, treatment flow, prognosis, and culture positivity of each endophthalmitis patient. Visual disturbance of subacute onset was the chief complaint of 3 patients (cases A, B, and C) who first visited the ophthalmology department. The mean (±standard deviation) age of the 18 patients with endophthalmitis was 64.5±12.2 (range: 32-84)y and 14 patients (77.8%) were males. Mean follow-up period of the 18 patients was 22.9±33.9mo (1.0mo to 15.9mo). BCVA at the time of diagnosis was ≥ 20/40 in 4 eyes (16.7%), finger count in 2 eyes (8.3%), hand motion in 11 eyes (45.8%), light perception in 3 eyes (12.5%), and no light perception in 4 eyes (16.7%).

Ten patients (55.6%) had diabetes and seven had poorly controlled diabetes (glycosylated hemoglobin A1c level ≥7.2%). Hypertension was found in seven individuals (38.9%), and three (16.7%) had concomitant malignancies other than hepatocellular cancer. Liver abscesses were located in the right lobe of the liver in eight patients (44.4%), left lobe in eight patients (44.4%), and both lobes in two patients (11.1%). Multiple liver abscesses (≥2) were found in three patients (16.7%) and nine (50.0%) had portal or hepatic vein thrombophlebitis. Five patients (27.8%) had sepsis, five (27.8%) had acute cholangitis, and seven (38.9%) had DIC. Two patients (11.1%) died from systemic complications. Preseptal or orbital cellulitis was observed in four patients (22.2%) concurrently with ipsilateral endophthalmitis. Monomicrobial *K. pneumoniae* was isolated in 72.2% of cases (13/18 patients) from blood samples and in 45.8% (11/24 eyes) from eyes. No hypervirulent or multidrug-resistant strains were detected in this study.

Vitrectomy was performed in nine eyes (8 patients), and four in those eyes underwent vitrectomy twice. Encircling buckling was performed in four eyes: at the time of primary vitrectomy in 1 eye and during secondary vitrectomy in three eyes. Phacoemulsification with intraocular lens (IOL) implantation was performed concurrently with vitrectomy in four eyes, and lensectomy without IOL implantation was performed in two eyes. The IOL was removed at the time of the second vitrectomy in one eye (Case A) because of weakened zonules. Evisceration was performed in three eyes: one for uncontrolled infection despite active treatment (Case A), another for corneal perforation during treatment with intravitreal injections for a poor systemic condition (Case D), and the last for a perforated corneal ulcer in the eye with concurrent preseptal and orbital cellulitis with endophthalmitis (Case E). Fourteen eyes (11 patients) were treated solely with intravitreal injections of antibiotics, and one eye required evisceration.

Among the three patients who first visited the ophthalmology department for severe decline of vision within a span of 3-7d; two (Cases A and B) were referred for intractable panuveitis that did not respond to systemic steroids for a few days, whereas one patient (Case C) was referred with a diagnosis of severe infectious endophthalmitis of unknown origin from a local eye clinic. All three patients had underlying diabetes and mild fever. Under a diagnosis of presumed endogenous endophthalmitis, these patients were referred to the department of internal medicine for systemic evaluation to identify the primary focus of the possible infection. The patients were later diagnosed with PLA caused by *K. pneumoniae*.

Table 1 Baseline characteristics and treatment flow of 24 eyes of 18 patients with endogenous endophthalmitis from a *K. pneumoniae* liver abscess

Age (y) /sex	DM, HTN, cancer	Status of liver abscess and comorbid conditions					Sepsis, DIC	Distant infections	Follow-up (mo)	Case	Eye	Culture positivity	BCVA		Orbital cellulitis	Lens status	Cause of IIOP	Treatment and prognosis flow
		Lobe	Size ≥5 cm	Number ≥2	Thrombo-phlebitis	Acute cholan-gitis							Initial	Final				
59/F	DM	Left	7	No	Yes	No	None	CNS, kidney	4.1	A	OS	Blood, eye	HM	—	No	Phakia	Other	IVI →phacovitrectomy →AC irrigation, IOL removal →evisceration
64/F	DM (U), HTN, rectal cancer	Left	Yes	No	Yes	No	None	Lung	7.3	B	OD	Blood, eye	HM	NLP	Yes	IOL	NVI	IVI →vitrectomy, lensectomy
83/M	DM, HTN	Right	Yes	No	No	No	None	None	38.8	C	OS	Eye	NLP	NLP	No	IOL	NVI	Vitrectomy →IVI
75/M	HTN	Right	No	No	Yes	No	None	Lung, CNS	1.4	D	OD	Blood	HM	—	No	Phakia	-	IVI →evisceration
74/M	Colon cancer	Right	No	Yes	Yes	No	Sepsis	Lung	3.8	E	OD	Blood	NLP	—	Yes	Phakia	-	Evisceration →expired
										F	OS	Blood	HM	FC	No	Phakia	NVI	Vitrectomy, lensectomy →IVI →EB,vitrectomy →expired
68/M	DM (U), HTN	Left	No	No	Yes	No	Sepsis DIC	Lung, CNS	115.9	G	OD	Blood	HM	LP	No	Phakia	-	Phacovitrectomy →EB, vitrectomy
										H	OS	Blood	HM	NLP	No	Phakia	NVI	EB, phacovitrectomy →IVI
53/M	None	Right	Yes	No	No	No	None	Lung	7.5	I	OD	Blood	20/20	20/20	No	Phakia	-	IVI
										J	OS	Blood	LP	HM	No	Phakia	NVI	Vitrectomy →EB,vitrectomy →IVI
55/M	DM (U)	Left	No	Yes	Yes	No	None	Lung, prostate	95.3	K	OS	Eye	HM	HM	Yes	Phakia	-	IVI →vitrectomy, lensectomy →vitrectomy
66/M	DM (U), HTN	Right	Yes	No	Yes	Yes	None	None	14.3	L	OS	Blood, eye	LP	LP	Yes	Phakia	NVI	IVI →phacovitrectomy →IVI
66/F	Alcoholism	Right	Yes	No	Yes	Yes	DIC	Lung	26.5	M	OD	Blood	LP	NLP	No	Phakia	NVI	IVI
67/F	GB cancer	Left	Yes	No	No	Yes	DIC	Lung	58.5	N	OS	Blood	HM	LP	No	Phakia	Other	IVI
32/M	DM (U)	Right	Yes	No	No	No	None	None	3.8	O	OD	Eye	HM	20/125	No	IOL	-	IVI
54/M	DM (U)	Left	Yes	No	No	No	None	Lung, prostate, soft tissue	18.3	P	OD	Blood	HM	NLP	No	Phakia	NVI	IVI
										Q	OS	Blood	HM	NLP	No	Phakia	NVI	IVI
84/M	CKD	Both	Yes	Yes	No	Yes	Sepsis DIC	None	1.0	R	OD	Blood, eye	FC	FC	No	Phakia	-	IVI →expired
										S	OS	Blood, eye	NLP	NLP	No	Phakia	NVI	IVI →expired
54/M	DM, HTN	Left	No	No	No	No	DIC	CNS	2.9	T	OD	Eye	20/20	20/20	No	Phakia	-	IVI
72/M	None	Right	No	No	No	No	None	Lung, prostate	1.7	U	OD	Eye	NLP	NLP	No	Phakia	-	IVI
67/M	None	Left	Yes	No	Yes	Yes	Sepsis DIC	Lung, CNS	8.2	V	OD	Blood, eye	FC	HM	No	Phakia	-	IVI
68/M	DM (U), HTN	Both	Yes	No	No	No	Sepsis DIC	None	3.0	W	OD	Blood	20/32	20/20	No	IOL	-	IVI
										X	OS		20/40	20/25	No	IOL	-	IVI

AC: Anterior chamber; BCVA: Best-corrected visual acuity; CKD: Chronic kidney disease; CNS: Central nervous system; DIC: Disseminated intravascular coagulation; DM: Diabetes mellitus; EB: Encircling buckling; FC: Finger count; GB: Gallbladder; HM: Hand motion; HTN: Hypertension; IIOP: Increased intraocular pressure; IOL: Intraocular lens; LP: Light perception; NLP: No light perception; NVI: New vessel on the iris; IVI: Intravitreal injection of antibiotics; S: Segment of the liver, U: Uncontrolled; OD: Right eye; OS: Left eye.

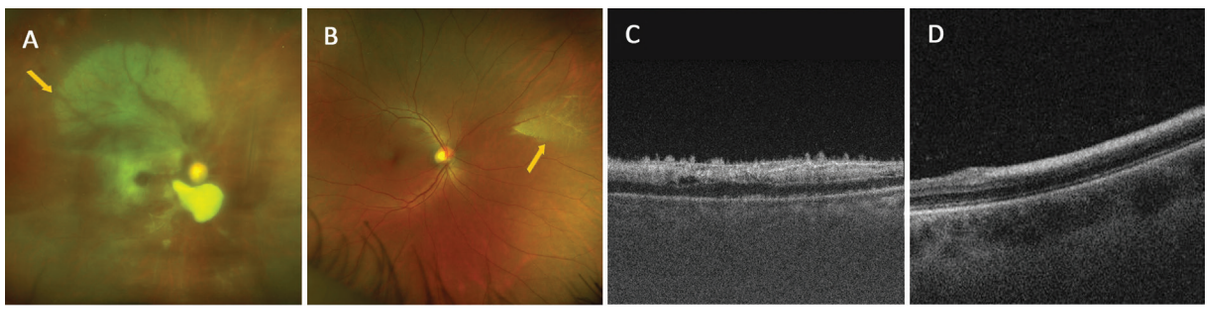

Figure 1 Fundus and optical coherence tomography (OCT) features of retinal infiltrates in endophthalmitis A: Whitish retinal infiltration with discrete margin (orange arrow) is seen in color fundus photograph of an eye after removing vitreous abscess by vitrectomy and silicone oil tamponade (Case G). B: Yellowish white retinal infiltration at the nasal retina (orange arrow) in the right eye with no visual symptoms (Case I). C: Inner retinal reflectivity with feathery spikes into the vitreous cavity is seen in the OCT of A (Case G). D: Inner retinal hyperreflectivity is shown in the OCT of B (Case I).

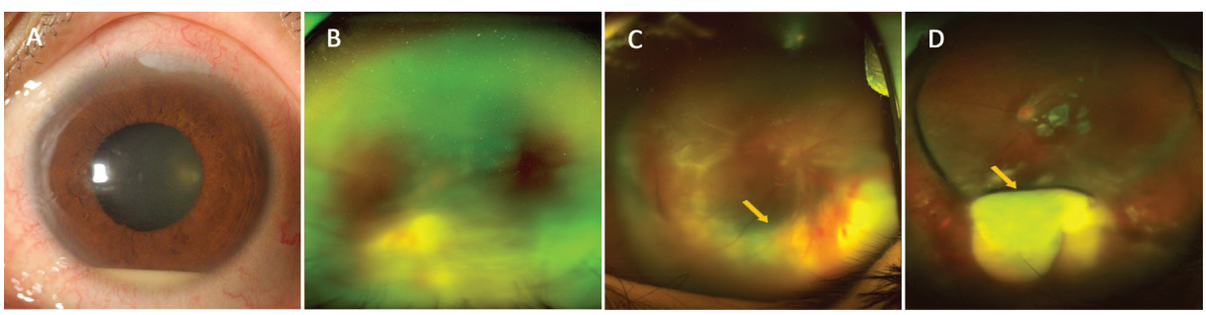

Figure 2 Anterior and posterior segments findings in endophthalmitis with subretinal abscess Findings in anterior segments of an eye with endogenous endophthalmitis (A) looks less severe than that of the posterior segments (B) of the same day (Case A). C: Massive subretinal abscess with serous retinal detachment (orange arrow) formed even after vitrectomy and silicone oil injection (Case J), which needed secondary vitrectomy. D: Protrusion of subretinal abscess into the vitreous cavity (orange arrow) is seen with retinal necrosis overlying the abscess (Case F).

Whitish retinal infiltration and perivascular sheathing were observed in the eye of Case G after the vitreous abscess was removed with vitrectomy and silicone oil tamponade and in the eye of Case I who had severe endophthalmitis in the contralateral eye (Figure 1). The latter eye showed no inflammatory cells and flares in the anterior chamber or vitreous cavity, with normal vision of 20/20. Optical coherence tomography in Case I showed inner retinal reflectivity with highly reflective feathery spikes that grew into the vitreous cavity. The hyperreflectivity was confined to the inner retinal tissue (Figure 1). Therefore, retinal infiltration first formed in the inner retinal tissue located near the retinal vessels and spread into the vitreous cavity during the disease course.

Retinal infiltration, inflammation, edema and hemorrhage were observed in eyes with more progressive endophthalmitis. Consecutive vitreous infiltration and abscesses, subretinal abscesses, and serous retinal detachments developed. Although cells and flares, cyclitic membranes, posterior synechiae, or hypopyon were observed in the anterior chamber, the manifestations in the posterior segments were more severe in the affected eye (Case A, Figure 2). A subretinal abscess with serous retinal detachment progressed to form a massive abscess in 4 eyes even after vitrectomy with silicone oil tamponade. The retina overlying the abscess eventually necrotized allowing the subretinal abscess to protrude into the vitreous cavity (Case F, Figure 2). When not necrotized, the involved retina later became fibrosed and contracted to form a tractional retinal detachment. Fibrovascularization involved the entire retinal layer, the subretinal space, and the superior choroid which were observed intraoperatively. Encircling scleral buckling helped keep the retina attached (Case J). Retinectomy with silicone oil tamponade during vitrectomy can be performed to remove subretinal abscesses and necrotized or fibrosed retina to keep the normal retina attached. This was maintained for at least 3 years postoperatively (Case K, Figure 3).

NVI was observed in 10 eyes (41.7%) with significant IOP elevation (40-50 mm Hg). Intravitreal bevacizumab injection (0.75 mg/0.03 mL to 1.25 mg/0.05 mL) was administered in 4 eyes (Cases D, E, J, and L), and IOP was maintained <20 mm Hg with maximum tolerable medical therapy in those eyes. Gross hyphema occurred in a patient with advanced endophthalmitis (Case M, Figure 3). An increase in IOP also resulted from uncontrolled inflammation, hypopyon formation, and total posterior synechiae formation. The final BCVA of 21 eyes that were not eviscerated was poor: ≥20/25 in four eyes (19.0%), 20/125 in one eye (4.8%), finger count

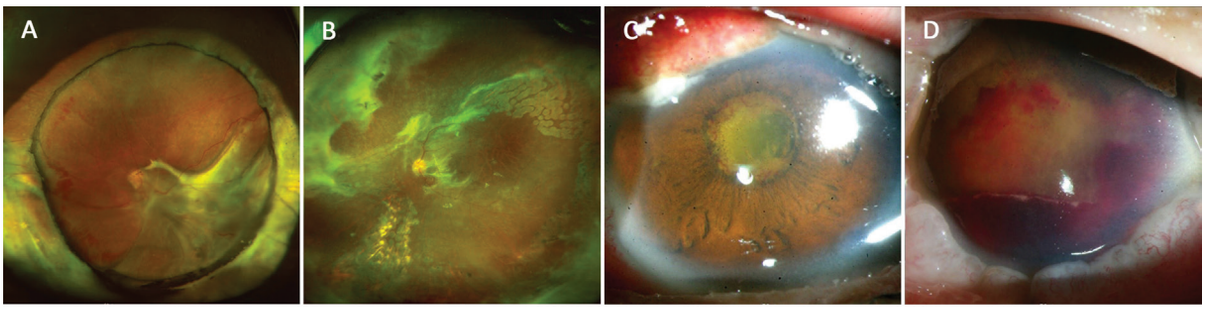

Figure 3 Fibrotic changes, surgical Interventions, and vascular complications in advanced endophthalmitis A: Severely fibrosed and contracted temporal retina after the infection has been subsided (Case J); B: Retinectomy and barrier photocoagulation with silicone oil injection during vitrectomy helped the retina keep attached (Case K); C: New vessels in iris prominent at the pupillary margin attached on anterior surface of the lens (Case P); D: Gross hyphema and exudative reaction in the eye with advanced endophthalmitis (Case M).

in two eyes (9.5%), hand motion in three eyes (14.3%), light perception in three eyes (14.3%) and no light perception in eight eyes (38.1%). Although our previous study[9] demonstrated that poorly controlled diabetes was associated with a higher prevalence of endophthalmitis, visual prognosis after treatment did not appear to depend significantly on underlying comorbidities such as diabetes in this case series. A final BCVA better than 20/60 was achieved only when lesions were detected very early, with relatively good initial BCVA, likely reflecting lower bacterial inoculation in the eye. Preservation of the eyeball was successful in eight of nine eyes that underwent vitrectomy, emphasizing the critical importance of early detection and intervention in improving outcomes, regardless of underlying comorbidities.

DISCUSSION

Similar to other types of endogenous endophthalmitis, endophthalmitis due to a *K. pneumoniae* liver abscess tends to involve the retinal parenchyma first and progresses into the vitreous cavity and then to the anterior segments. However, it tends to cause massive subretinal abscesses even after vitrectomy with silicone oil tamponade. Very high IOP with NVI (41.7%) was also commonly observed. Bilateral endophthalmitis caused by *K. pneumoniae* liver abscesses was observed in one-third of the patients in this study. The prevalence of endogenous endophthalmitis by all pathogens was 47.4% and 32.5% in studies by Chen *et al*[4] and Lim *et al*[8] respectively. Bilateral endogenous endophthalmitis can be present in different stages (Cases I and J), and comprehensive ophthalmologic examination should always be performed meticulously in both eyes.

Three patients in our study visited the ophthalmology department first and were later diagnosed with *K. pneumoniae* liver abscess. Two patients received systemic steroids for several days for panuveitis, underscoring the possibility of endophthalmitis. Therefore, endophthalmitis should be considered a possible cause of intractable uveitis[22]. Furthermore, when patients with endophthalmitis due to *K. pneumoniae* liver abscess presented with ophthalmic symptoms, the visual prognosis was poorer than that in those who presented with systemic symptoms[15]. Careful history taking, physical examination, and prompt referral to the departments of internal medicine can be helpful in patients with systemic symptoms such as abdominal pain, fever, and chills[23]. The presence of ophthalmic symptoms was not always indicative of endophthalmitis in the remaining 15 patients (21 eyes)[9].

Repeated surgery was needed in four eyes with progressive infection despite vitrectomy with silicone oil injection. Unlike exogenous endophthalmitis, where most pathogens can be removed through vitrectomy, a substantial number of bacteria residing in the retina and recruited from the blood may persist in patients with *K. pneumoniae* endogenous endophthalmitis[17]. Patients and their guardians should be informed of the possibility of additional treatments for disease progression or complications.

Many previous studies have shown that the aggressive treatment of endogenous endophthalmitis has an excellent anatomical success rate (*i.e.*, preservation of the globe and retinal attachment)[19-20,24]. However, improvements in the final BCVA from the initial BCVA are limited[4,8]. The prognosis of 24 eyes in the present study was also restricted; a final BCVA of >20/60 was achieved only in those in which the lesion was detected very early. Additionally, 11 eyes (45.8%) had hand motion (HM) or worse vision at the initial diagnosis, despite comprehensive ophthalmologic examinations to detect endophthalmitis in 73.7% of all patients with PLA[9]. Furthermore, 13 out of 21 eyes (61.9%) had a BCVA of HM or worse at the last follow-up despite treatment. Therefore, treatment is mainly aimed at preserving at least some vision by the early detection and treatment of endophthalmitis.

Treatment of endogenous endophthalmitis caused by *K. pneumoniae* liver abscesses is challenging for several reasons. 1) Detection of endophthalmitis could not be dependent on the presence of ophthalmic symptoms but on the comprehensive

ophthalmologic screening for all patients with PLAs; 2) patients who presented with visual symptoms first had a very poor prognosis because they already had far-advanced endophthalmitis; 3) BCVAs at the time of diagnosis of endophthalmitis were HM or worse in 45.8% of eyes despite an ophthalmologic examination rate of 73.7%; 4) patients with endophthalmitis often have grave systemic complications, such as sepsis, DIC, and other extrahepatic infections, so early surgical management with vitrectomy can be a risk to patients' systemic conditions; 5) infections involved retinal parenchyma first and later invaded the vitreous and subretinal space, which tended to progress despite surgical treatment, eventually resulting in massive subretinal abscess formation, retinal necrosis, fibrosis, or tractional retinal detachment (TRD); 6) overall, improvement in BCVA of the eyes with endophthalmitis was quite limited despite treatment.

In conclusion, the detection of the earliest endophthalmitis lesions appears to be the only way to preserve good vision in patients with *K. pneumoniae* liver abscesses. Therefore, proper guidelines for ophthalmologic screening remain to be established for subjects at a high risk of endophthalmitis.

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