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INTERVENTIONAL RADIOLOGY

ORIGINAL ARTICLE

Safety and efficacy of combined ethanol and bleomycin sclerotherapy via percutaneous pigtail catheter for benign cervical cystic lesions: a single-center retrospective study

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PURPOSE

To evaluate the safety and efficacy of combined ethanol lavage and bleomycin sclerotherapy administered via a percutaneous pigtail catheter for the treatment of benign cervical cystic lesions.

METHODS

This retrospective study included 29 patients (mean age, 30 years; range, 4–60 years; male-to-female ratio, 16:13) who underwent bleomycin sclerotherapy following ethanol lavage via a pigtail catheter for benign cervical cystic lesions, including branchial cleft cysts, ranulas, thyroglossal duct cysts, lymphatic malformations, and epidermoid cysts, between March 2009 and September 2022. To explore potential predictors of treatment response, clinical diagnosis, baseline cyst size, and the total volume of injected sclerosant were evaluated. Statistical analyses included the paired t-test, chi-square test, and Mann–Whitney U test.

RESULTS

All patients were followed up for a mean duration of 18.2 months (range, 3–72 months) after the final treatment session. Complete cyst resolution was achieved in 17 of the 29 patients (59%), 8 patients (27%) demonstrated a volume reduction greater than 75%, and 2 patients (7%) exhibited a reduction of less than 75%; recurrence occurred in 2 patients (7%) despite repeated sclerotherapy. There were no significant differences between responders and nonresponders with respect to clinical diagnosis, baseline cyst volume, or total sclerosant dose. Minor procedure-related complications occurred in three patients (10.34%); no major complications were observed.

CONCLUSION

Combined ethanol lavage and bleomycin sclerotherapy administered via a percutaneous pigtail catheter is a safe and feasible treatment option for benign cervical cystic lesions.

CLINICAL SIGNIFICANCE

Combined ethanol and bleomycin sclerotherapy represents a safe, minimally invasive treatment option for benign cervical cystic lesions in routine clinical practice, with favorable outcomes and potential to reduce the need for surgical intervention.

KEYWORDS

Sclerotherapy, bleomycin, ethanol, neck, cysts

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Benign neck cysts are non-neoplastic cystic lesions of the neck that are typically congenital or developmental in origin. They are pathologically characterized by an epithelial or endothelial lining with a benign clinical course and have traditionally been managed with surgical excision. Surgical treatment offers definitive resolution with very low recurrence rates.[1] However, open surgery is associated with inherent risks, including injury to adjacent neurovascular structures, infection, and bleeding, particularly in lesions that are poorly defined or demonstrate expansile growth.[2] Therefore, increasing attention has been directed toward non-surgical, minimally invasive treatment strategies for benign neck cysts. Sclerotherapy has emerged as a promising alternative to surgical excision, employing chemical ablation agents such as OK-432 (Picibanil), tetracycline, doxycycline, bleomycin, and ethanol.[2] Of these, OK-432 is the most frequently reported sclerosant for this procedure.[2,3] Although intracystic injection of OK-432 is generally considered safe, recurrence rates of up to 47% have been reported, and routine clinical access to OK-432 remains limited in many settings.[3,4] These limitations highlight the need for effective and readily available alternative sclerosants.

Ethanol is widely used in sclerotherapy and exerts its effects through cellular dehydration and protein denaturation, leading to coagulation, vascular wall necrosis, thrombosis, and eventual vascular occlusion.[5] Ethanol ablation has demonstrated safety and efficacy in the treatment of cystic thyroid nodules, thyroglossal duct cysts, and lymphatic malformations.[6-8] Standard ethanol sclerotherapy typically involves aspiration of cyst contents followed by instillation of ethanol without lavage, patient repositioning, and subsequent aspiration of the sclerosant after a predefined dwell time. In most prior reports, this procedure has been performed using a single percutaneous needle puncture, without placement of a pigtail catheter to allow continuous irrigation or drainage.

Bleomycin represents another commonly used sclerosant with broad availability and a favorable safety profile, with reported adverse effects generally mild and transient.[9] However, ethanol may demonstrate limited efficacy in mucus-filled cysts due to insufficient contact with the cyst wall, and bleomycin often necessitates repeated treatment sessions to achieve adequate sclerosis.[10,11] From a mechanistic standpoint, ethanol induces chemical denudation of the cystic epithelium and facilitates evacuation of viscous intracystic contents, whereas bleomycin promotes endothelial injury and subsequent fibrosis. Accordingly, the sequential application of ethanol lavage followed by bleomycin instillation was conceived to offer theoretical complementarity between these agents rather than proven therapeutic superiority.

To our knowledge, the safety and efficacy of this combined sclerotherapy approach for benign neck cysts have not been previously evaluated. The present study therefore aimed to assess the therapeutic efficacy and safety profile of combined ethanol lavage and bleomycin sclerotherapy administered via a percutaneous pigtail catheter.

Main points

- Combined ethanol lavage and bleomycin sclerotherapy administered via a percutaneous pigtail catheter is a safe and feasible minimally invasive treatment option for benign cervical cystic lesions.
- This approach was applied to patients with symptomatic benign cervical cystic lesions, particularly in cases where surgical excision was unsuitable, declined by the patient, or when a minimally invasive alternative was preferred.
- Clinical outcomes were evaluated based on cyst volume reduction and recurrence during follow-up.

Methods

Patients

This retrospective study was approved by the Institutional Review Board of Chung-Ang University Hospital (IRB number: 2507-014-2741, date: July 22, 2025), which waived the requirement for written informed consent. Between March 2009 and September 2022, 44 patients underwent bleomycin sclerotherapy following ethanol lavage for benign neck cysts at our institution. Of these, 15 patients were excluded because follow-up imaging was unavailable to assess treatment response. The final study cohort therefore comprised 29 patients (mean age, 30 years; range, 4–60 years; male-to-female ratio, 16:13). The diagnosis of benign neck cyst was established on the basis of characteristic clinical presentation and imaging findings obtained using ultrasonography (US) and computed tomography (CT). Routine histopathologic confirmation was not performed, given the minimally invasive nature of the treatment strategy. An overview of patient selection and cohort characteristics is provided in Figure 1 and Table 1.

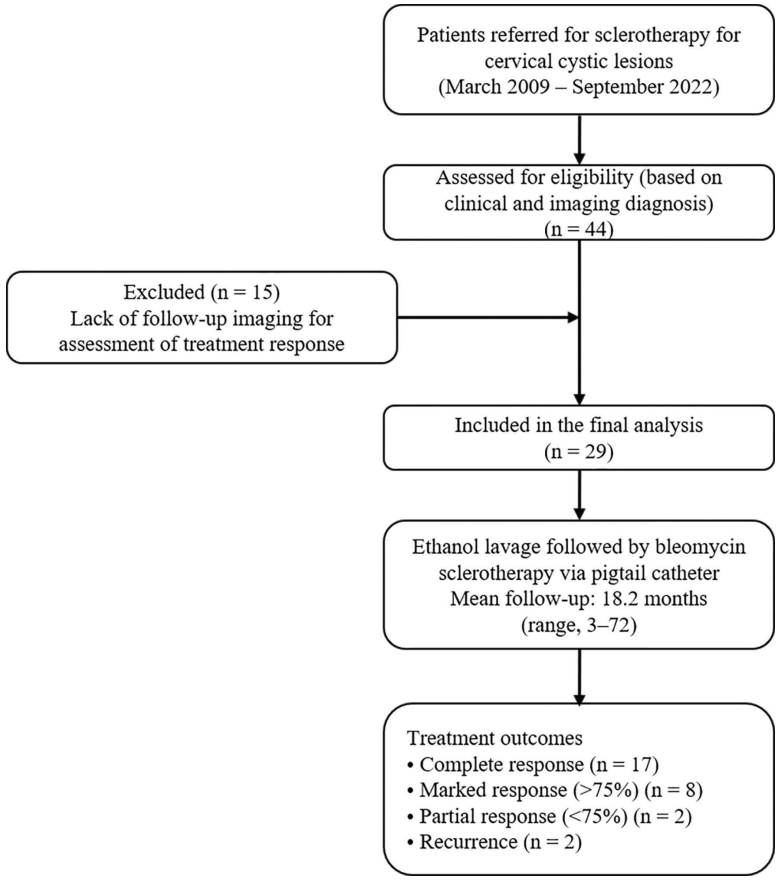

Figure 1. Study flow diagram illustrating patient selection and clinical outcomes.

Table 1. Patient characteristics and treatment outcomes of sclerotherapy for benign cervical cystic lesions

Case	Sex	Age (y)	Clinical diagnosis	Prior treatment	Measured volume (mL)	Number of treatments	Follow-up duration (months)	Outcome
1	F	38	BCC		8.8		3	PR
2	M	30	Plunging ranula	SMG excision	9.9	3	72	NR
3	M	32	Ranula		10.4	2	8	NR
4	F	27	Ranula		7.4		9	CR
5	M	39	Lymphangioma		162.0		18	MR
6	M	19	Ranula		18.0		22	CR
7	M	48	Lymphangioma		30.4		4	MR
8	M	25	Ranula		4.1		6	MR
9	F	33	Epidermoid cyst		2.2		4	PR
10	F	28	BCC		7.7		9	CR
11	M	25	Plunging ranula		34.9		9	CR
12	M	35	BCC		18.0		48	CR
13	M	35	Epidermoid cyst		6.1		9	MR
14	F	13	BCC		10.1		44	CR
15	F	29	Lymphangioma		60.5		12	MR
16	F	4	Ranula		5.9		12	CR
17	M	7	Plunging ranula		6.3		16	CR
18	M	14	Lymphangioma		30.6		20	CR
19	M	24	Plunging ranula		14.1	2	31	CR
20	F	60	BCC		14.0		32	CR
21	F	24	BCC		29.3	2	36	CR
22	M	20	Plunging ranula		8.8		4	CR
23	F	35	BCC		29.7		18	CR
24	M	36	BCC		69.7		15	MR
25	F	38	TGDC		32.9		24	CR
26	M	49	TGDC		13.3		6	CR
27	F	28	Ranula		6.9		6	MR
28	F	52	BCC		17.4		18	CR
29	M	24	Plunging ranula		27.2		12	MR

CR, complete response; MR, marked response; PR, partial response; NR, no response; TGDC, thyroglossal duct cyst; BCC, branchial cleft cyst; F, female; M, male; SMG, submandibular gland.

Technique

All procedures were performed by a board-certified interventional radiologist with 30 years of clinical experience in an interventional radiology suite. Cyst size and anatomical location were confirmed using US, and local anesthesia was administered at the puncture site with 2% lidocaine. Initial cyst access was achieved using a 21-gauge needle, followed by placement of a 7-Fr or 8.5-Fr pigtail catheter (Cook Medical, Bloomington, IN, USA) within the cystic cavity. Ultrasound guidance was used for initial cyst puncture, whereas fluoroscopic guidance was employed for pigtail catheter placement and contrast injection to confirm appropriate intracystic positioning and exclude extravasation. Cyst contents were aspirated as completely as possible. Alcohol lavage using 99% ethanol was then performed between the syringe and the cyst lumen for 3–5 cycles to remove mucinous components, with syringe contents discarded after each cycle. Lavage was considered complete once visual and tactile feedback indicated the absence of highly viscous mucus in the aspirate. The volume of ethanol instilled corresponded to one-third of the aspirated cyst volume, with a maximum volume of 100 mL.

Bleomycin (Hikma Pharmaceuticals, Berkeley Heights, NJ, USA) was prepared by reconstituting one or two vials in 1–2 mL of normal saline and diluting the solution to a total volume of 10 or 20 mL. Each vial contained 15 mg of bleomycin, and one or two vials were used per treatment session at the operator's discretion. When the aspirated cyst volume was less than 10 mL, an equivalent volume of bleomycin solution was instilled; when the aspirated volume was 10 mL or greater, up to 20 mL was instilled. Bleomycin was subsequently instilled into the cyst without aspiration, and the procedure was completed (Figures 2 and 3). The pigtail catheter was routinely removed the following day.

Data collection and follow-up

The following variables were extracted from the electronic medical record for each patient: age, sex, lesion location, presenting

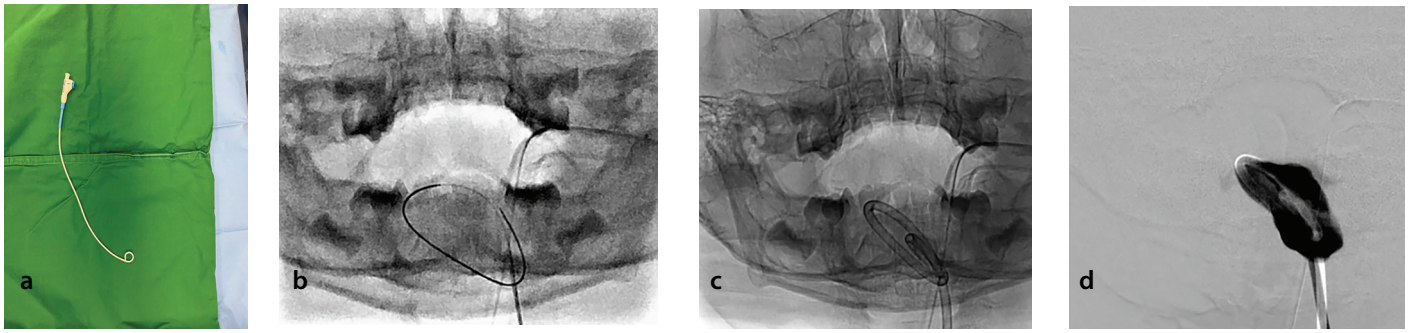

Figure 2. Procedural steps: (**a**) placement of a 7-Fr pigtail catheter; (**b, c**) catheter insertion into a left sublingual ranula under ultrasonographic and fluoroscopic guidance with aspiration of cyst fluid as completely as possible; (**d**) contrast injection to confirm the absence of extravasation into adjacent soft tissues, followed by sequential ethanol lavage and bleomycin sclerotherapy.

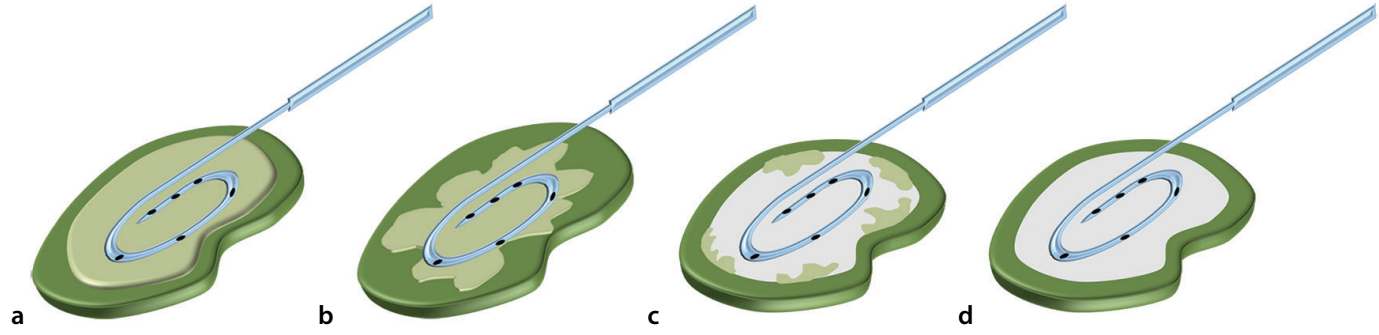

Figure 3. Illustrations of ethanol lavage: (**a**) insertion of a 7-Fr pigtail catheter into a benign neck cyst; (**b**) aspiration of cyst contents as completely as possible; (**c, d**) ethanol lavage demonstrating clearance of residual adherent fluid from the cyst wall.

symptoms, injected volumes (mL) of ethanol and bleomycin, number of bleomycin treatment sessions, and cumulative bleomycin dose. Procedure-related complications were classified as major or minor in accordance with the Society of Interventional Radiology Standards of Practice guidelines.[12] Major complications were defined as events requiring major therapy, prolonged hospitalization exceeding 48 hours, or unplanned escalation of care. Minor complications were defined as events requiring only nominal therapy or no therapy and could include overnight admission for observation.

Induration and erythema at the injection site were assessed on the day following the procedure. Patients were subsequently followed up in the outpatient setting. At each follow-up visit, a focused clinical history and physical examination were performed. If recurrence of a benign neck cyst was suspected based on symptoms or examination findings, follow-up imaging with US or CT was obtained. Treatment response was assessed by calculating the percentage of volume reduction using cyst measurements obtained from baseline and post-sclerotherapy US or CT scans. Lesion volume was calculated using the prolate ellipse formula (V = 0.5 × length × width × thickness). Complete response was defined as complete disappearance of the lesion, marked response as a reduction greater than 75%, and partial response as a reduction of less than 75%. Recurrence was defined as any clinically meaningful increase in lesion volume during follow-up.

Statistical analysis

Pre- and post-sclerotherapy cyst volumes were compared using the paired t-test. Categorical variables stratified by etiology were analyzed using the chi-square test. Differences in baseline cyst volume and injected sclerosant dose between the complete-response and noncomplete-response groups were evaluated using the independent t-test or the Mann–Whitney U test, as appropriate. All statistical analyses were performed using MedCalc Statistical Software (version 18.6, MedCalc Software Ltd., Ostend, Belgium). A two-sided *P* value < 0.05 was considered statistically significant.

Results

A total of 29 patients were followed up for a mean duration of 18.2 months (range, 3–72 months); 4 patients (13.8%) had a follow-up period of less than 6 months. Complete response was achieved in 17 patients (59%), and 8 patients (27%) demonstrated a marked response, defined as a volume reduction greater than 75%. Partial response, defined as a volume reduction of less than 75%, was observed in two patients (7%). Recurrence despite repeated sclerotherapy occurred in two patients (7%). The two cases with recurrence were clinically diagnosed as a plunging ranula and a simple ranula. Overall, cyst volume decreased significantly following combined ethanol lavage and bleomycin sclerotherapy administered via a percutaneous pigtail catheter, from a mean baseline volume of 24.03 [95% confidence interval (CI) 12.23–35.82] to 1.25 mL (95% CI: 0.22–2.28) after treatment (*P* = 0.0005). No major complications were observed. Minor procedure-related symptoms occurred in three patients and included fever (n = 1) and pain (n = 2); all symptoms resolved within 3 days.

The mean number of procedures per patient was 1.17. When stratified by clinical diagnosis, the mean number of procedures was 1.11 for branchial cleft cysts, 1.00 for epidermoid cysts, 1.33 for ranulas, 1.00 for thyroglossal duct cysts, and 1.00 for lymphangiomas. Among the 17 patients who achieved a complete response, 15 responded after a single procedure (Figure 4) and 2 required two procedures. Two patients experienced relapse despite repeated sclerotherapy (Figure 5). One patient in the cohort had previously undergone surgical excision as an initial treatment.

To evaluate outcomes according to clinical diagnosis, patients were dichotomized into a complete-response group and a non-complete-response group and compared statistically. Among the 17 patients with complete response, 7 (41%) were diagnosed with ranula, 7 (41%) with branchial cleft cyst, 2 (12%) with thyroglossal duct cyst, 1 (6%) with lymphangioma, and none with epidermoid cyst. Among the 12 patients with non-complete response, diagnoses included ranula in 5 patients (42%), lymphatic malformation in 3 (25%), thyroglossal duct cyst in 2 (17%), and epidermoid cyst in 2 (17%). The distribution of diagnoses did not differ significantly between the complete-response and non-complete-response groups ($P = 0.745$; Table 2).

The potential impact of cyst size on treatment response was also evaluated. Baseline cyst volume did not differ significantly between the complete-response and non-complete-response groups ($P = 0.790$). Similarly, there was no significant difference in the injected sclerosant dose between the groups ($P = 0.655$). Across the entire cohort, the mean cumulative intralesional bleomycin dose was 16.84 ± 11.56 mg per patient.

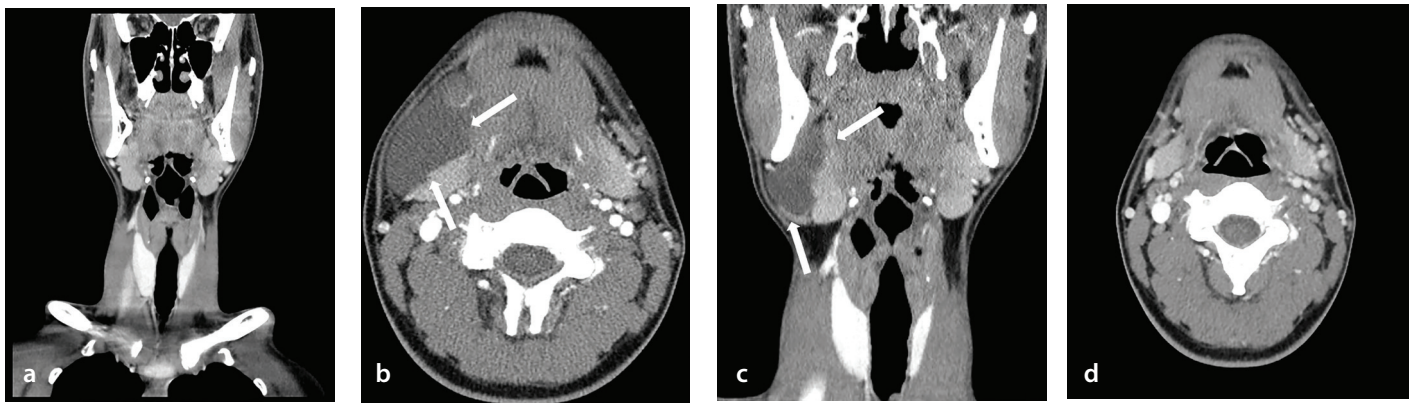

Figure 4. (**a, b**) Initial computed tomography (CT) images demonstrating a 5.8 × 4.3 × 2.7-cm plunging ranula (arrows) in the right submandibular space on axial and coronal views, respectively. (**c, d**) Follow-up CT obtained 1 year after ethanol lavage and bleomycin sclerotherapy showing complete resolution of the plunging ranula.

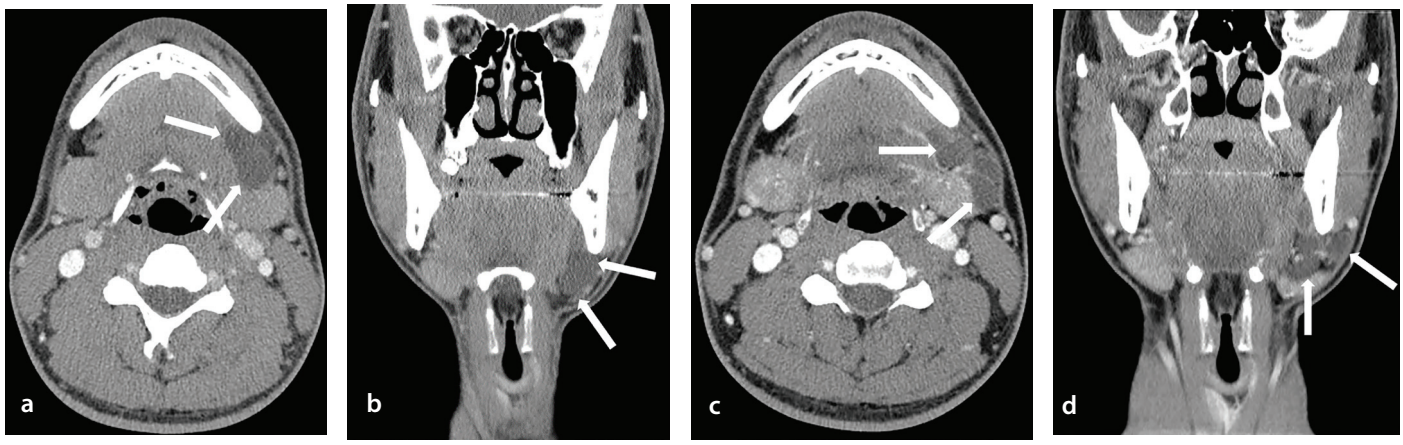

Figure 5. (**a, b**) Initial computed tomography (CT) images demonstrating a 3.2 × 2.0 × 3.1-cm cystic lesion (arrows) in the left submandibular space on axial and sagittal views, respectively. (**c, d**) Follow-up CT obtained 2 years after two sessions of ethanol lavage and bleomycin sclerotherapy showing recurrence of the cystic lesion (arrows).

Table 2. Treatment response according to cyst type

Cyst type	Complete response (n = 17)	Other response (n = 12)	Total (n = 29)
Ranula	7 (41%)	5 (42%)	12
BCC	7 (41%)	0	7
TGDC	2 (12%)	2 (17%)	4
Lymphangioma	1 (6%)	3 (25%)	4
Epidermoid cyst	0	2 (17%)	2
Total	**17**	**12**	**29**

$P = 0.745$. BCC, branchial cleft cyst; TGDC, thyroglossal duct cyst.

Discussion

Surgical excision remains the standard treatment for benign neck cysts. However, complete resection can be technically challenging, and the risk of recurrence is not negligible. In addition, surgical management carries the potential for complications, including muscle weakness, neurovascular injury, infection, and unfavorable cosmetic outcomes such as scarring and stitch granuloma.[13,14] These considerations have contributed to growing interest in minimally invasive alternatives. Sclerotherapy is now widely accepted in this context. Among available sclerosants, OK-432 (Picibanil) has been commonly used; however, access to this agent can be limited, and recurrence as well as inflammatory reactions following OK-432 sclerotherapy have been reported.

In the present study, combined ethanol lavage and bleomycin sclerotherapy administered via a percutaneous pigtail catheter demonstrated favorable clinical outcomes with an acceptable safety profile. The observed response rates were comparable to those reported for commonly used sclerosants, including OK-432, ethanol, and bleomycin monotherapy, as described in previous studies.[2,3,15-18] Notably, sustained treatment responses were observed over a relatively long mean follow-up period of 18.2 months, whereas prior reports have primarily emphasized short-term outcomes.[1,15]

The absence of major complications and the low incidence of minor, self-limited adverse events in this cohort are consistent with the established safety profiles of intralesional bleomycin and ethanol sclerotherapy.[9,11] Treatment failure occurred in a patient with a history of surgical excision and subsequent recurrence, suggesting that altered anatomy or postoperative fibrosis may adversely affect the efficacy of subsequent sclerotherapy. Collectively, these findings support the feasibility of this minimally invasive approach as an alternative treatment option in selected patients while acknowledging that direct comparisons with other techniques require prospective, controlled evaluation.

Although reported outcomes vary across studies, ethanol or bleomycin monotherapy has generally yielded favorable responses in the treatment of benign cystic lesions of the head and neck.[2,9,15] The outcomes observed in the present study fall within the range reported in the existing literature. Importantly, the relatively long follow-up period provides additional insight into the durability of treatment response beyond the early post-treatment phase.

In many cases, cyst contents were dense and adhesive, limiting effective evacuation using the standard 16- or 18-gauge needles typically employed for sclerotherapy. To address this limitation, a 7-Fr or 8.5-Fr pigtail catheter was inserted, allowing more effective aspiration of viscous intracystic material. Ethanol irrigation was subsequently performed through the catheter to clear residual thick contents and facilitate closer contact between the sclerosant and the cyst wall. Bleomycin was then instilled and left *in situ* without drainage in accordance with the procedural protocol.

Bleomycin is a sclerosing agent associated with a low rate of complications. However, large cumulative doses exceeding 400 mg or 5 mg/kg have been associated with an increased risk of pulmonary fibrosis.[19,20] This risk is greatest among older adults, patients with renal dysfunction, and individuals receiving systemic bleomycin therapy for malignancy.[21] In the present study, the mean cumulative intralesional bleomycin dose was 16.84 ± 11.56 mg per patient, well below thresholds associated with pulmonary toxicity. No cases of pulmonary complications were observed. Nevertheless, larger cohorts with longer follow-up durations are needed to more precisely estimate the incidence of rare adverse events.

Alcohol lavage may play a supportive role in the management of mucus-filled cysts by reducing intracystic viscosity and removing adherent contents, thereby potentially allowing closer contact between the sclerosant and the cyst wall. In sclerotherapy performed without lavage, residual mucinous material may act as a physical barrier that limits effective interaction between the sclerosant and the cyst intima. Although the present study was not designed to evaluate the incremental benefit of lavage, this technical step may be considered a feasible adjunct in selected cystic lesions characterized by thick intracystic contents.

Several limitations of this study should be acknowledged. First, the retrospective design spanning an extended period resulted in some missing data, although the sclerotherapy technique itself did not change over time. Second, diagnoses of benign cervical cystic lesions were based on clinical and imaging findings rather than histopathologic confirmation, reflecting an inherent limitation of minimally invasive treatment strategies that aim to avoid surgical excision. Third, the sample size was insufficient to identify factors associated with treatment effectiveness, and no direct comparison with other sclerosants was performed. In addition, all patients underwent routine next-day removal of the pigtail catheter, and the necessity of overnight catheter retention was not systematically evaluated. As a result, the impact of catheter retention on recurrence rates and procedural invasiveness could not be assessed. Prospective, adequately powered studies with head-to-head comparisons are therefore warranted.

In conclusion, combined ethanol lavage and bleomycin sclerotherapy administered via a percutaneous pigtail catheter represents a safe and feasible treatment option for benign cervical cystic lesions.

Footnotes

Conflict of interest disclosure

The authors declared no conflicts of interest.

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