

Original Research Article

A modified bag-valve-mask positive-pressure technique for removal of nasal foreign bodies in young children: a retrospective study from a rural pediatric practice

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ABSTRACT

Background: Nasal foreign bodies are common in young children, and their removal can be difficult because of fear, distress, and poor cooperation. Positive-pressure techniques provide a non-instrumental alternative, but conventional approaches may require direct mouth-to-mouth contact.

Methods: This retrospective, single-center chart review included 28 consecutive children aged 1-5 years with clinically diagnosed, anteriorly located nasal foreign bodies treated at a rural pediatric outpatient and emergency setting. A modified bag-valve-mask (BVM) technique was used to deliver a brief, controlled positive-pressure puff through the mouth while the contralateral nostril was occluded. Children were observed for at least 30 minutes.

Results: Successful removal was achieved in 26 of 28 children (92.9%; 95% CI=77.4-98.0%). Among successful cases, 22 of 26 (84.6%; 95% CI=66.5-93.9%) were successful on the first attempt. No major complications were recorded during the procedure or observation period.

Conclusions: In this single-operator, single-center pilot series, the modified BVM technique achieved a high removal rate for anteriorly located nasal foreign bodies using equipment commonly available in rural clinical settings. Larger, multicenter comparative studies with standardized pressure protocols are required before broader clinical adoption.

Keywords: Nasal foreign body, Bag-valve-mask, Positive pressure, Children, Pediatric emergency, Rural practice

INTRODUCTION

Nasal foreign bodies are a frequent pediatric emergency. A large 10-year cohort of 562 children demonstrated that complications were associated with foreign body type, posterior insertion, and multiple removal attempts. Instrumental removal can be complicated by child distress and mucosal trauma; conventional approaches include forceps, hooks, suction, and balloon catheters.¹⁻⁴

Positive-pressure techniques, notably the parent's kiss, provide a non-instrumental alternative and have demonstrated clinically useful effectiveness in a prospective observational study of 31 children. A systematic review of eight studies involving 152 removal attempts reported an overall success rate of 59.9% for the

parent's kiss, with no adverse effects reported; however, the authors noted limitations in study quality.^{5,6}

Conventional positive-pressure maneuvers require direct mouth-to-mouth contact between the caregiver and child, and a BVM device offers a potential alternative that avoids this limitation. A prior case report described successful oral BVM insufflation for removal of a friable nasal foreign body in a single patient, but this approach has not previously been evaluated in a retrospective clinical case series or demonstrated outside a tertiary or specialist setting.⁷

Despite evidence supporting positive-pressure techniques, awareness and adoption remain limited among general pediatricians and primary care physicians,

particularly in rural and resource-constrained practice environments, where dedicated nasal foreign body devices, otolaryngology support, and sedation facilities may be unavailable. In contrast, the BVM is commonly available in pediatric clinical settings for resuscitation.

This study evaluated the effectiveness, with successful removal as the primary outcome, and safety, including complications and the need for alternative management, as secondary outcomes, of a modified BVM positive-pressure technique in children aged 1-5 years presenting with anteriorly located nasal foreign bodies at a rural pediatric practice.

METHODS

Study design and setting

This retrospective, single-center observational chart review was conducted in the pediatric outpatient and emergency setting at Mahavir Institute of Medical Sciences in Vikarabad, India, without on-site otolaryngology or sedation services. Existing medical records from 5th March 2021 to 5th March 2025 were reviewed.

Study population and selection criteria

Existing medical records of children aged 1-5 years with a clinically diagnosed nasal foreign body during the study period were screened for inclusion. Records were eligible when they documented an anteriorly located foreign body that was visible or presumed visible on anterior rhinoscopy, without signs of posterior displacement, active significant bleeding, or high aspiration risk.

Foreign bodies with a priori high risk of tissue injury, specifically button batteries, were eligible for a single attempt only, with immediate transition to urgent specialist referral if unsuccessful, consistent with established urgent-removal principles for such objects.

The records of 28 consecutive children who met the criteria were included. Written informed consent was obtained from the parents or guardians for the procedure and for publication of anonymized data.

Sample size justification

For descriptive precision, the standard formula for estimating a single proportion was expressed as $n = Z^2 p(1-p)/d^2$, where Z is the standard normal deviate (1.96 for 95% confidence), p is the anticipated success proportion (0.85-0.90, based on prior positive-pressure technique studies), and d is the desired absolute precision (0.15), following the method described by Charan and Biswas.⁸ Applying these parameters produced an approximate benchmark of 22-24 records. Because this was a retrospective review, all 28 consecutive eligible records available within the study period were included.

Modified BVM technique

The child was positioned supine, and the head was stabilized in a neutral position by an assistant. A small BVM mouthpiece was sealed over the child's mouth, and the nostril opposite the foreign body was manually occluded while the affected nostril remained unobstructed.

A brief, controlled positive-pressure puff was delivered by gentle BVM compression, generating a pressure gradient intended to expel the foreign body through the patent nostril. The same operator performed all procedures using the same device and a consistent, qualitatively judged compression force to maximize procedural consistency across all cases.

The maneuver was performed under direct observation. If unsuccessful after up to two attempts, the child was transitioned to conventional instrumentation or referral rather than undergoing repeated positive-pressure attempts.

Outcome measures and follow-up

The primary outcome was treatment success, defined as successful expulsion of the nasal foreign body without conventional nasal instrumentation. The secondary outcome was safety, defined as clinically apparent complications, including bleeding, mucosal injury, or barotrauma, occurring during the procedure or during a minimum 30-minute post-procedure observation period. The need for alternative management after an unsuccessful attempt was also recorded.

Safety considerations

The technique was performed under direct clinical supervision, with attention to avoiding excessive positive pressure. Foreign bodies with a high risk of tissue injury, including button batteries, were limited to a single attempt before urgent referral.

Statistical analysis

Descriptive statistics were used, given the retrospective, descriptive design of the study. Categorical variables are reported as frequencies and percentages with two-sided 95% Wilson score confidence intervals. Continuous variables are reported as mean (range) or median (interquartile range). Given the small cell counts across foreign-body subtypes, a formal statistical comparison of success by foreign body category was not performed.

Ethical considerations

This retrospective record review involved human participants and used anonymized data from existing clinical records. Written informed consent for the clinical procedure and publication of anonymized clinical data

had been obtained from each child's parent or legal guardian at the time of care. No ethics committee approval certificate was available for this retrospective record review.

RESULTS

Patient characteristics

Twenty-eight children (16 boys and 12 girls) whose records met the eligibility criteria were included. The mean age was 3.2 years (range, 1-5 years). The right nostril was affected in 15 children and the left nostril in 13 children. The median duration of symptoms was 6 hours (range, 1-48 hours).

Table 1: Demographic and clinical characteristics (n=28).

Characteristics	Values
Age, mean (range), (in years)	3.2 (1-5)
Sex male:female	16:12
Affected side, right: left	15:13
Duration of symptoms, median (range)	6 hours (1-48 hours)
Successful BVM removal [95% CI]	26 (92.9%) [77.4-98.0%]
Unsuccessful removal, [95% CI]	2 (7.1%) [2.0-22.6%]
Single-attempt success, n=26 [95% CI]	22 (84.6%) [66.5-93.9%]
Second-attempt success among successes, n=26	4 (15.4%)

Treatment success

Successful removal was achieved in 26 of 28 children (92.9%; 95% CI=77.4-98.0%). Two children (7.1%; 95% CI=2.0-22.6%) did not have successful removal using the BVM technique and were transitioned to alternative management.

Among the 26 successful cases, 22 children (84.6%; 95% CI=66.5-93.9%) had successful removal on the first attempt. Four children (15.4%) required a second attempt. No child required more than two attempts, consistent with the predefined protocol limiting repeated positive-pressure attempts.

Foreign-body outcomes

Twenty-eight cases were included, of which 26 were successfully treated and two were unsuccessful. Given the small cell counts across foreign-body subtypes, a formal statistical comparison of success rates between categories was not performed.

Table 2: Foreign-body type and outcome.

Foreign bodies	N	Success/failure
Plastic balls	4	4/0
Erasers	2	2/0
Stones	2	2/0
Peanuts	3	2/1
Grains	2	2/0
Chalk-pencil fragments	2	2/0
Earring beads	3	3/0
Button-cell battery	1	0/1
Thermocol balls	2	2/0
Tamarind seeds	2	2/0
Thick paper roll	1	1/0
Broken plastic toy pieces	2	2/0
Shirt buttons	1	1/0
Small pencils	1	1/0
Total	28	26/2

Safety outcomes

No major complications were recorded in any of the 28 children during the procedure or the minimum 30-minute post-procedure observation period (0%; 95% CI=0-12.1%). Both unsuccessful cases were transitioned to alternative management without delay or documented adverse sequelae. One unsuccessful case involved a button-cell battery and required urgent specialist referral after a single attempt, in accordance with the study protocol. The other unsuccessful case involved an impacted fragmented peanut and required instrumental removal under brief sedation.

Table 3: Safety outcomes and management after unsuccessful attempts (n=28).

Outcomes	N [95% CI]
Major complications	0 (0%) [0-12.1%]
No adverse events recorded during observation	28 (100%)
Unsuccessful cases requiring alternative management	2 (7.1%) [2.0-22.6%]
Button-cell battery, urgent specialist referral after single attempt per protocol	1 case
Impacted fragmented peanut, instrumental removal under brief sedation	1 case

DISCUSSION

The principal finding of this study was a 92.9% success rate (95% CI, 77.4-98.0%) for removal of anteriorly located nasal foreign bodies using a modified BVM positive-pressure technique, with no major complications recorded during the observation period.

These findings are descriptively comparable to, but cannot be statistically compared with, previous positive-

pressure approaches evaluated in different settings and populations. Alleemudder et al reported a 62.5% success rate in eight children using a positive-pressure technique, whereas de la O-Cavazos et al reported a 94.4% success rate in 18 children using a dedicated nasal occlusion device.^{9,10} A systematic review of the conventional mother's kiss technique reported an overall success rate of approximately 60% across 152 attempts.⁶ Because the present study did not include a concurrent comparator group, these figures should be interpreted as descriptive comparisons rather than evidence of comparative superiority.

The BVM modification addresses an important practical limitation of the conventional parent's kiss, namely the requirement for direct mouth-to-mouth contacts between the caregiver and child. The BVM allows the clinician to control pressure delivery while using equipment that is already commonly available in pediatric clinical settings. A previous case report described successful oral BVM insufflation for removal of a nasal foreign body in a single patient, supporting the feasibility of this general approach.⁷

A distinctive feature of the present study is its evaluation in a rural pediatric outpatient and emergency setting, where dedicated positive-pressure nasal foreign-body devices, pediatric otolaryngology support, and sedation facilities may not be readily available. Previous positive-pressure approaches, including the parent's kiss and specialized nasal occlusion devices, have primarily been described in emergency or specialist settings.^{5,6,10}

Patient selection was critical for safety in this series. Eligibility was restricted to anteriorly located foreign bodies without evidence of posterior displacement or significant bleeding. Button batteries were limited to a single attempt before urgent referral, consistent with established principles of urgent removal of high-risk nasal foreign bodies.¹¹ The single button-cell battery case in this series was unsuccessful with the BVM maneuver on the permitted single attempt and was referred without delay. This outcome emphasizes that the technique should not delay definitive management of high-risk foreign bodies.

Although no complications occurred during the observation period in this cohort, barotrauma has been reported as a rare complication of positive-pressure nasal foreign-body removal.¹² This reinforces the importance of brief, controlled pressure delivery rather than forceful or repeated compression.

Retrospective and clinical reports have also described positive-pressure removal and broader pediatric nasal foreign-body patterns in community and otolaryngology settings.¹³⁻¹⁵

The modified BVM technique should therefore be regarded as an adjunct to, rather than a replacement for,

standard instrumental removal. Its potential role may be greatest as an early, non-instrumental option in appropriately selected, anxious, or poorly cooperative children with anteriorly located foreign bodies, particularly when specialist referral or dedicated equipment is not immediately available.

Given the single-operator, single-center, uncontrolled design of the study, the present findings demonstrate feasibility and a promising preliminary success signal rather than comparative efficacy. Larger studies involving multiple operators, centers, and standardized pressure protocols are required before the technique can be considered for routine first-line use.

Limitations

This study has several limitations. Its retrospective design made the analysis dependent on the completeness and accuracy of existing records. It was conducted by a single operator at a single center, so the results may not be generalizable to other clinicians or settings. There was no comparator group, such as the parent's kiss technique or standard instrumental removal, limiting direct comparison with other methods.

Although 28 children were included, the sample was relatively small and did not allow meaningful subgroup comparisons. Pressure during BVM compression was assessed subjectively rather than measured objectively, so the optimal pressure, duration, and number of attempts remain uncertain. Procedural pain and distress were also not formally assessed. Finally, the 30-minute observation period may not have detected delayed complications. Larger multicenter studies with objective pressure measurement, standardized safety assessment, and longer follow-up are needed.

CONCLUSION

This pilot review suggests that the modified BVM technique is a feasible, potentially safe approach for removing appropriately selected anterior nasal foreign bodies in young children.

The method uses equipment commonly available in primary-care settings and may offer a simple, low-resource alternative to instrumental removal. However, the single-center, single-operator design and lack of a comparison group limit the strength of these findings. Larger multicenter studies with standardized pressure protocols, objective pressure measurement, assessment of procedural distress, and longer follow-up are needed before recommending the technique for routine use.

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