

Case Series: Iodopovidone Pleurodesis for Pediatric Spontaneous Pneumothorax

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BACKGROUND: Treatment of pediatric primary spontaneous pneumothorax (PSP) with tube thoracostomy alone has been associated with a 66% recurrence rate at our institution. We sought to decrease recurrence with a simple and cost-effective intervention: iodopovidone chemical pleurodesis. An institutional protocol was developed and implemented, addressing indications, informed consent, iodopovidone (povidone iodine) concentration, mixture with lidocaine, method of administration, dwell time, pain control, and safety measures. Iodopovidone pleurodesis was offered to children who would have otherwise been treated with tube thoracostomy alone on our existing PSP protocol.

CASE PRESENTATION: Three patients aged 15-17 years, including one with shellfish allergy, were admitted for treatment of PSP. After informed consent was obtained, all patients underwent iodopovidone chemical pleurodesis under our institutional protocol. In all cases, pain control was excellent with 0-3 doses of post-procedure opioid administered. Air leak was absent on post-procedure day 1 in all patients. All patients were discharged on post-procedure day 3 or 4 in excellent condition, and remain free of pneumothorax recurrence at 4-9 months.

DISCUSSION: Pediatric PSP has a high rate of recurrence both locally and in the published literature. Ideal treatment would accomplish a rapid and durable resolution of PSP, with minimal healthcare utilization and costs, and minimal recurrence risk. Iodopovidone is cost-effective, readily available, easy to handle, antibacterial, safe, and effective for pleurodesis. Our initial experience demonstrates this approach is feasible in the pediatric population.

CONCLUSION: Iodopovidone pleurodesis is a simple, cost-effective, and well-tolerated treatment for PSP. In patients receiving tube thoracostomy for PSP, iodopovidone pleurodesis may reduce recurrence and need for operative intervention.

Keywords: Pediatric Surgery, Case Report, Case Series, Spontaneous Pneumothorax, Chemical Pleurodesis, Iodine Pleurodesis, Iodopovidone Pleurodesis, Povidone Iodine Pleurodesis

DISCLAIMER

Information published in this article is not intended to replace clinical judgement or establish a protocol for the care of all children with spontaneous pneumothorax (pediatric spontaneous pneumothorax, PSP). The treatment protocol included in this article is not intended as the sole source of guidance in the management of children and adolescents with this condition, and may not provide the only appropriate approach to the management of children with this condition. The views expressed in this article are solely those of the authors and do not reflect the views of The Pacific Northwest Journal of Surgery or its Editorial Board.

BACKGROUND

Primary spontaneous pneumothorax (PSP) is a life-threatening event that occurs in 3.4 per 100,000 pediatric patients annually in the United States.¹ Treatment strategies vary widely, ranging from observation to surgical intervention. Treatment with tube thoracostomy occurs in 48-61% of cases, thoracoscopic surgery occurs in 22-50% of cases, and the average inpatient hospital admission is 6 days.²⁻⁴ Thus, PSP is associated with a high burden of healthcare utilization.

Recent data suggest selected cases of small, minimally symptomatic pneumothoraces may be safely treated with observation alone.⁵ However, larger pneumothoraces remain challenging, as recurrences are frequent. Recurrences usually occur within the first year, with an overall recurrence rate across all PSP patients of 37-49%.⁶⁻⁸ This risk persists through various levels of intervention, with recurrence rates of 45-53% after tube thoracostomy drainage, and 20-25% after thoracoscopic surgery.^{4,10}

At our institution, Oregon Health & Science University (OHSU), quality improvement monitoring revealed a 66% recurrence rate of pediatric PSP in the last 3 years after treatment with tube thoracostomy alone (unpublished data). As such, we sought to implement a standardized institutional protocol, in an effort to lower PSP recurrence rates.

Some pediatric surgical groups have advocated for earlier progression to surgery, since the likelihood of successful treatment with chest tube alone decreases with each day of continued air leak.³ However, while surgery is more effective than thoracostomy alone, recurrence remains frequent, and at the cost of significant healthcare utilization. The ideal therapy would accomplish a rapid and durable resolution, with minimal healthcare utilization and costs, and minimal recurrence risk.

Multiple groups globally have reported success with chemical pleurodesis using iodine-based sclerosis for malignant pleural effusion and for PSP, with success rates in PSP of 93-100% in several adult studies.¹¹⁻¹³ Iodopovidone pleurodesis has been shown to be safe in adults as well as children.¹³⁻¹⁵ Primary reported side effects include pain and fever, while hypotension occurs infrequently.^{12,13} The theoretical risk of thyrotoxicosis in patients with subclinical hyperthyroidism has been discussed but never documented in the literature.^{12,13}

Iodopovidone is used worldwide as a low-cost, readily available, easy to handle, antibacterial, safe, and efficacious agent for pleurodesis.¹³ Though no North American group has reported clinical experience with iodopovidone pleurodesis for pediatric PSP, we find it has a favorable clinical safety and efficacy profile.

An institutional pediatric iodopovidone pleurodesis protocol was developed by our faculty Pediatric Surgeons, based on literature review and modeled on our institutional protocol for PSP in adult patients. It is intended for children who would have otherwise been treated with tube thoracostomy alone. On this protocol, patients received iodopovidone pleurodesis at time of tube thoracostomy placement, or upon inter-institutional transfer arrival to our facility with a tube thoracostomy already in place.

CASE PRESENTATIONS

Written consent for de-identified publication in the Pacific Northwest Journal of Surgery was provided by all three patients and their parents/guardians. Review by the local Institutional Review Board was completed (IRB# 28707). Patient ages and outcomes are reported in **Table 1**. The Oregon Health & Science University institutional protocol for iodopovidone pleurodesis in pediatric PSP is displayed in **Table 2**.

Case No. 1

An otherwise healthy 15-year-old male was transferred to our institution for treatment of PSP after chest tube placement at a referring emergency department. Initial pneumothorax size was approximately 3 rib spaces. On arrival, there was a small residual pneumothorax, and an air leak was present. Iodopovidone pleurodesis was offered to reduce recurrence, and the patient and family elected to undergo this procedure after full discussion of risks, benefits, and alternatives. Iodopovidone pleurodesis was performed according to our institutional protocol (**Table 2**). The procedure was well-tolerated with sedation. Post-procedure pain scale ratings ranged from 0 to 4 out of 10. Pain was well-controlled with a multimodal regimen and 3 doses of opioid medication. On post-pleurodesis day 1, air leak was resolved, and the chest tube was placed to water seal. On day 2, an exudative pleural reaction was noted (**Figure 1**) with high chest tube output (500 mL/day). Output subsequently decreased and the tube was removed by 72 hours. Post-pleurodesis length-of-stay was 3 days. The child was discharged home in good condition and remains free of recurrence at 9 months.

Case No. 2

A healthy 15-year-old male with shellfish allergy was transferred to our institution for treatment of PSP after chest tube placement at a referring emergency department. Initial pneumothorax size was approximately 4 rib spaces without air leak. On arrival, the lung was not fully expanded, and the existing 9-French chest tube appeared kinked and positioned within a lung fissure. Chest tube exchange and up-sizing was indicated, and additionally iodopovidone pleurodesis was offered to reduce recurrence. The patient and family elected to undergo pleurodesis after full discussion of risks, benefits, and alternatives. The chest tube exchange and iodopovidone pleurodesis were performed according to our institutional protocol (**Table 2**). Antihistamine premedication was not given; despite common belief, there is no increased risk of allergic reaction to iodine in those with shellfish allergy.¹⁶ The procedure was well-tolerated with sedation. Post-procedure pain scale ratings ranged from 0 to 2 out of 10. Pain was well controlled without opioid requirement. On post-pleurodesis day 1, air leak was absent, and the chest tube was placed to water seal. On day 2, an exudative pleural reaction was noted with high chest tube output (730 mL/day). Output subsequently decreased and the tube was removed by 72 hours. Post-pleurodesis length of stay was 3 days. The child was discharged home in good condition and remains free of recurrence 4 months later.

Case No. 3

An otherwise healthy 17-year-old female was transferred to our institution for treatment of PSP after chest tube placement at a referring emergency department. Initial pneumothorax size was approximately 5 rib spaces. On arrival, there was a persistent small pneumothorax without air leak. The patient and family elected to undergo iodopovidone pleurodesis after full discussion of risks, benefits, and alternatives. Iodopovidone pleurodesis was performed according to our novel institutional protocol (**Table 2**). The procedure was well-tolerated with sedation. Post-procedure pain scale ratings ranged from 0 to 4 out of 10. Pain was well controlled without any opioid medication. On post-pleurodesis day 1, air leak was absent and on day 2 the chest tube was placed to water seal. On day 3, an exudative pleural reaction was noted with high chest tube output (1,040 mL/day). Output subsequently decreased and the tube was removed by 96 hours. Post-pleurodesis length of stay was 4 days. The child was discharged home in good condition, remaining recurrence free 4 months later.

DISCUSSION

Pediatric PSP has a high rate of recurrence both locally and in published literature. The ideal treatment would accomplish a rapid and durable cure, with minimal healthcare utilization and costs, and minimal recurrence risk. Current treatment strategies, including tube thoracostomy alone or thoracoscopic surgery, are associated with high recurrence rates and high burden of healthcare utilization.

Iodopovidone is inexpensive, readily available, easy to handle, antibacterial, safe, and effective for pleurodesis as reported in other applications. Our initial experience demonstrates that this approach is feasible and easily applied in the pediatric population for PSP. Though all patients in this case series were teenagers, in the authors' clinical practice at OHSU, children as young as 10 may be treated with this protocol using appropriate dosing (**Table 2**). There were no procedural complications, no adverse reactions to iodopovidone, and excellent pain control with minimal opioid use (**Table 1**). Recovery was rapid, with length of stay 3 to 4 days in our series versus 6 days in published literature.²⁻⁴ All patients remain free of recurrence at 4-9 months post-procedure.

Though further experience and follow up will be necessary, iodopovidone pleurodesis has the potential to broaden the options for pediatric PSP management in the future. Iodopovidone

pleurodesis offers a rapid, safe, simple method for durable cure, while decreasing operating room utilization and inpatient length of stay. Based on our positive initial experience, we plan to continue this approach with ongoing outcomes monitoring within our quality improvement program.

CONCLUSION

Iodopovidone pleurodesis for PSP was well-tolerated with sedation in three teenagers (15-17 years old) at our institution, and represents a simple, cost-effective treatment. In patients receiving tube thoracostomy for PSP, iodopovidone pleurodesis may potentially reduce recurrences of pneumothorax and avoid the need for operative intervention.

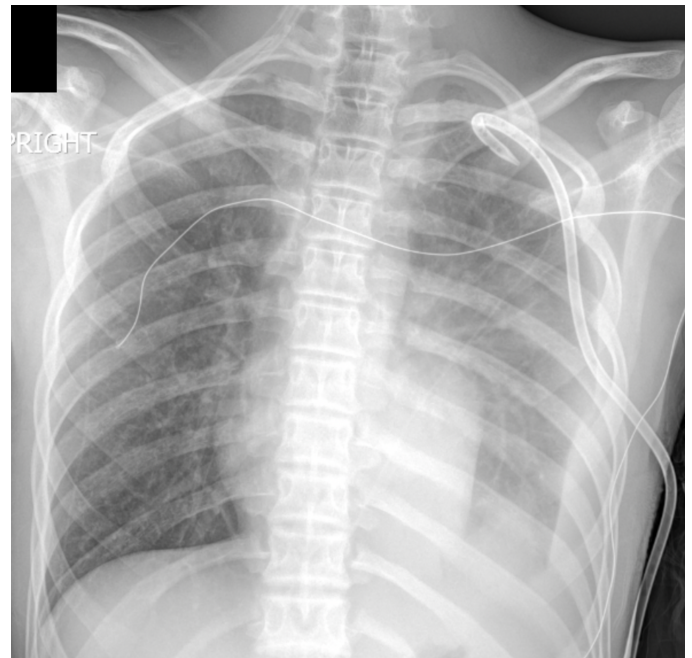


Figure 1. Left exudative pleural effusion on post-procedure day 2 in response to iodopovidone pleurodesis (Case No. 1).

Table 1

Pleurodesis Outcomes	Case 2	Case 2	Case 3
Age	15	15	17
Max. pain score (scale 0-10)	4	2	4
Post-pleurodesis opioid doses	3	0	0
Post-pleurodesis air leak	Not present	Not present	Not present
Maximum chest tube output (ml/24hr)	500	730	1040
Post-pleurodesis time to chest tube removal (days)	3	3	4
Post-pleurodesis length of stay (days)	3	3	4
Follow-up period (months)	9	4	4
Recurrence at follow-up	None	None	None

Table 1. Summary of iodopovidone pleurodesis outcomes in a series of three pediatric patients.

Table 2

Iodopovidone Pleurodesis Protocol at Oregon Health & Science University	
<u>Overview:</u> For pediatric primary spontaneous pneumothorax (PSP) treated with tube thoracostomy alone, recurrence at OHSU is 66% in the last 5 years. Chemical pleurodesis with iodopovidone has been associated with a recurrence rate <7% in published series, and is in active clinical use by the Adult Thoracic Surgery team at OHSU for post-operative air leak with good results. At surgeon discretion, iodopovidone pleurodesis may be offered to reduce the chance of recurrence for pediatric patients with PSP being treated with tube thoracostomy.	
<u>Inclusion Criteria:</u> • 10 to 18 years of age with PSP. • Under the care of the Pediatric Surgery service. • Has a chest tube in place, or with plan for immediate chest tube placement.	
<u>Exclusion Criteria:</u> • If a patient would not require chest tube per standard spontaneous pneumothorax protocol, iodopovidone pleurodesis not indicated. • Thoracic trauma requiring hospital admission in the preceding 2 weeks. • Pulmonary or pleural requiring antibiotic therapy in the preceding 2 weeks. • Thyroid disorder. • Possible or known connective tissue disorder (e.g. aneurysmal disease, Ehlers-Danlos Syndrome, Marfan Syndrome).	
<u>Consent Process:</u> • Procedure is to be performed under sedation. • If patient already has a chest tube in place from referring hospital, obtain procedural consent for Chemical Pleurodesis with Iodopovidone. Risks include pain, recurrence, need for increased respiratory support, and need for further procedures. • If patient does not already have a chest tube, obtain procedural consent for chest tube placement with chemical pleurodesis with iodopovidone. Risks remain standard for the chest tube placement, plus risks as above for the chemical pleurodesis.	
<u>Procedural Workflow:</u> Pre-Medication - Administer IV ketorolac 0.5 mg/kg (max 15 mg), once. - Administer PO acetaminophen 15 mg/kg, once. - Administer IV morphine 0.1 mg/kg (or alternative if allergic), once. - Procedural sedation to be provided by credentialed sedation provider other than the provider performing the procedure. Chest Tube Placement (if not already in place) - Standard percutaneous modified Seldinger technique using 14 French pigtail catheter kit or comparable. - Connect tube to -20 cm H₂O suction via PleurEvac or similar, for at least 10 minutes. Chemical Pleurodesis - In a single 60mL syringe, mix 40 mL of 0.25% lidocaine without epinephrine, and 20 mL of 10% iodopovidone, to reach a final volume of 60 mL and final iodopovidone concentration of 3.3%. - Instill entire 60 mL of lidocaine/iodopovidone mix into the chest via the chest tube and flush with 3 mL saline to clear tube. - Clamp the chest tube catheter closed and begin dwell time. Dwell Time - With chest tube clamped, position the patient in mild Trendelenburg position (head down 10-15 degrees) for 1 hour, alternating turning to left and right every 15 min. Patient advised to not ambulate or move from position during this 1 hour. - After 1 hour of dwell time, return the chest tube to -20 cm H₂O suction and liberalize bed position/activity. <u>Indications to immediately return the chest tube to suction before completing the full 1-hour dwell:</u> - Desaturations in SaO₂ less than 88% for greater than 2 minutes. - Hemodynamic instability. - Severe or worsening dyspnea. - Severe pain unresponsive to sedation after an additional dose of IV morphine was given (0.1 mg/kg). Post-Procedure Management - Obtain CXR after completing the dwell time to ensure lung has expanded with chest tube on suction. - Maintain chest tube to suction for at least 48 hours at -20 cm H₂O. Duration may be adjusted at attending discretion. - After 48 hours on suction, obtain another CXR. If the lung is fully expanded and no air leak is present, transition back to standard Spontaneous Pneumothorax Protocol management (e.g. water seal for 1 day, then remove chest tube if lung remains expanded without air leak).	
<u>Pathway Quality and Safety Monitoring</u> • During the procedure, Vital signs continuously monitored, and patient directly examined by a Surgical clinician at bedside. • For all patients treated with this protocol, relevant Pediatric Surgery service line faculty must be informed. • If there are any questions or concerns at any time, Pediatric Surgery service line faculty can be informed. • Outcomes will be reviewed on an annual basis and presented to the Pediatric Surgery group for revisions as necessary.	

Table 2. Iodopovidone Pleurodesis Protocol at Oregon Health & Science University.

Patient Consent: Written informed consent was obtained from the parents/guardians of all three patients by the authors for publication of this case report and images in The Pacific Northwest Journal of Surgery. Identifying personal information has been removed. Copies of the written consents are retained by the Journal.

Competing Interests: The authors attest to having no financial or commercial associations that may create conflicts of interest with the information presented in the manuscript.

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Abbreviations: Primary spontaneous pneumothorax (PSP), Chest X-Ray (CXR).

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