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Ultrasound in Emergency Medicine

EVIDENCE-BASED MEDICINE IMPROVES THE EMERGENT MANAGEMENT OF PERITONSILLAR ABSCESSES USING POINT-OF-CARE ULTRASOUND

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□ **Abstract—Background: Physical examination for peritonsillar abscess (PTA) has limited sensitivity. Traditional management involves blind needle aspiration, which has a false negative rate of 10–24%. A randomized controlled trial by Costantino et al. demonstrated that point-of-care ultrasound (POCUS) improves PTA management. Objectives: Compare the use and impact of POCUS between patient cohorts prior to and after the trial by Costantino et al. Methods: Retrospective cohort study of adult patients diagnosed with PTA. Cohort 1 presented to the emergency department (ED) January 2007–December 2008. Cohort 2 presented between January 2013 and December 2014. Data were separated into those with POCUS vs. without ultrasound (NUS). Primary endpoint was POCUS utilization. Secondary endpoints were successful aspiration, otolaryngology (ear, nose, and throat [ENT]) consultation, computed tomography (CT) imaging, unscheduled return visits, and length of stay (LOS). The Fisher's exact and *t*-tests analyzed data. Results: Cohort 1 enrolled 48 patients, vs. 114 patients for cohort 2. Twelve patients in cohort 1 had a POCUS (25%) vs 89 in cohort 2 (78%) ($p < 0.0001$; odds ratio [OR] 0.09 (95% confidence interval [CI] 0.04–0.20). Emergency physician (EP) successful aspiration: 89.1% POCUS vs. 24.5% NUS ($p < 0.0001$; OR 25 [95% CI 10–59]). Combined EP/ENT successful aspiration: 99.0% POCUS vs. 80.3% NUS ($p < 0.0001$; OR 24 [95% CI 3–193]). ENT consultation:12.9% POCUS vs. 65.6% NUS ($p < 0.0001$; OR 0.07 [95% CI 0.03–0.17]). CT usage: 23.8% POCUS vs. 37.7% NUS ($p = 0.07$; OR 0.51 [95% CI 0.25–1.02]). Return visits: 3.96% POCUS vs. 18.0% NUS ($p = 0.004$; OR 0.18 [95% CI 0.05–0.61]). Conclusion: POCUS use has increased for PTA treatment, improves aspiration, and decreases consultations, CTs, return visits, and LOS.** © **2020 Elsevier Inc. All rights reserved.**

□ **Keywords—point-of-care ultrasound; peritonsillar abscess; evidence-based medicine**

INTRODUCTION

Peritonsillar abscesses (PTAs) are purulent collections between the tonsillar capsule and pharyngeal constrictor muscles (1–3). Numerous etiologies have been proposed, including tonsillar crypt obstruction in acute tonsillitis or abscess formation in the supratonsillar salivary glands, known as Weber glands, which may account for the occurrence of PTAs post-tonsillectomy (1–4). With an annual incidence of 9–41 per 100,000 patients, it is the most common deep space neck infection, comprising 30% of all head and neck abscesses and accounting for $150 million in annual health care costs (1,3,5). Polymicrobial infections are not uncommon, but *Fusobacterium necrophorum* and *Streptococcus pyogenes* are the most frequent causative organisms (3,5,6).

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Adolescents (> 10 years old) and young adults (< 40 years old) are most often affected, with a slight male predominance after childhood (2,5–7). Individuals who smoke, are immunocompromised, and those with periodontal disease are at increased risk for PTAs (8–10). Complications are rare but severe, including airway obstruction, necrotizing soft tissue infection, mediastinitis, and extension into surrounding structures, including the internal carotid artery (7,11).

Typical physical examination signs are pharyngeal exudate and erythema with asymmetric edema causing uvular deviation to the contralateral side (7). Despite these common findings, distinguishing between peritonsillar cellulitis and abscess is challenging. In fact, physical examination has a sensitivity and specificity of only 78% and 50%, respectively (12). Furthermore, trismus occasionally limits inspection. Conventional diagnosis has relied on computed tomography (CT) of the neck, given its superior sensitivity of 100% (12). However, patient instability, kidney function, and contrast allergy often limit the utility of CT scans, not to mention the cost and time delay to diagnosis.

Traditional management involves landmark-based blind needle aspiration, which has a false-negative rate of 10–24%; incision and drainage; and, in more complex cases, surgical intervention (12–15). The implementation of point-of-care ultrasound (POCUS) has changed the management of PTAs dramatically by improving diagnostic accuracy and successful aspiration, while reducing CT usage and specialty consultation (16). Early otolaryngology (ear, nose, and throat [ENT]) literature demonstrated sensitivities of 89–92%, with specificities of 80–100% (12,15,17). Emergency medicine (EM) case reports and series date back to 2003, and more current ENT and EM evidence has established sensitivities of 95–100% with a negative predictive value of 100% for POCUS (16,18–21).

The objective of this study was to determine how the use of POCUS in management of PTAs has changed since the randomized controlled trial by Costantino et al., compared with data from prior to this study (16). The primary endpoint was POCUS utilization between cohorts. Secondary endpoints for the combined cohorts were successful aspiration, frequency of specialty consultation, need for advanced imaging, unscheduled return visits within 1 week, and length of stay (LOS).

MATERIALS AND METHODS

Study Design and Setting

This was an institutional review board-approved single-center, retrospective, case control study. This study took place at an urban, academic, Level I emergency department (ED) with approximately 105,000 combined pediatric and adult visits annually. All of our emergency physicians (EP) are credentialed in the core American College of Emergency Physicians POCUS applications, including intra-oral sonography (22). All patients with a clinical suspicion of PTA were eligible to be scanned.

Selection of Participants

All adult patients ≥ 18 years old with a final diagnosis of PTA were enrolled. Cohort 1 includes all patients who presented to the ED between January 2007 and January 2008. Patients who presented between January 2013 through December 2014 were enrolled in cohort 2.

Study Protocol

The electronic health record, Medhost (Franklin, TN), was queried to identify all patients diagnosed with a PTA (determined by the International Classification of Diseases, Ninth Revision Diagnosis Code 475 and searched using the term "peritonsillar abscess") in the ED between January 1, 2007 and January 31, 2008 and January 1, 2013 and December 31, 2014. A retrospective chart review and abstraction were performed on these patients, and data were separated into those who had POCUS performed as part of the PTA management vs. individuals who had no ultrasound performed (NUS). Patients were excluded if they had peritonsillar cellulitis, phlegmonous changes, had a CT performed prior to POCUS, or were transferred from an outside facility.

POCUS was performed by a postgraduate year (PGY)-1, -2, or -3 EM resident under the supervision of an attending EP. In patients who received a POCUS, no CT was done prior to the completion of the POCUS. PGY-1, -2, or -3 EM residents aspirated PTAs under POCUS guidance utilizing the protocol described by Costantino et al. (16). ENT consultants performed traditional landmark-based drainage.

Outcome Measures

The primary endpoint was POCUS utilization between cohorts. Secondary endpoints for the combined cohorts were successful aspiration, frequency of specialty consultation, need for advanced imaging, unscheduled return visits within 1 week, and LOS (defined as time in minutes from initial EP evaluation to final disposition).

Data Analysis

Data are presented as means or proportions with 95% confidence intervals (CIs). Success rate comparisons between groups were analyzed with Fisher's exact method

Table 1. Patient Outcomes for Cohort 1 (January 2007–January 2008)

	POCUS (n = 12)	NUS (n = 36)	*p* Value	OR (95% CI)
ED success	11 (91.6%)	14 (38.8%)	0.002	17.2 (2–148)
ED & ENT success	11 (91.6%)	27 (75.0%)	0.41	3.6 (0.41–32.4)
ENT consult	1 (8.3%)	16 (44.4%)	0.03	0.11 (0.01–0.97)
CT usage	0 (0%)	7 (19.4%)	0.16	0.15 (0.01–2.97)
Return visits	0 (0%)	8 (22.2%)	0.17	0.13 (0.01–2.50)

POCUS = point-of-care ultrasound; NUS = no ultrasound performed; OR = odds ratio; CI = confidence interval; ED = emergency department; ENT = otolaryngology (ear, nose, and throat); CT = computed tomography.

of summing small *p*-values. Differences in LOS times were compared using Student's *t*-test. A *p*-value of 0.05 was considered significant.

RESULTS

Cohort 1 enrolled 48 patients between January 2007 and January 2008, 12 of whom (25%) had a POCUS performed. Nine different EPs utilized POCUS during this time to evaluate for a PTA, only one of whom completed an emergency ultrasound (EUS) fellowship. The median age was 33 years, with a range between 19 and 68 years (39% female). The results listed in Table 1 include: Successful aspiration by EP: POCUS 91.6% vs. NUS 38.8% ($p = 0.002$; OR 17.2 [95% CI 2–148]). Overall success (including ENT consultant): POCUS 91.6% vs. NUS 75% ($p = 0.41$; OR 3.6 [95% CI 0.41–32.4]). ENT consultation rate: POCUS 8.3% vs. NUS 44.4% ($p = 0.03$; OR 0.11 [95% CI 0.01–0.97]). CT usage: POCUS 0% vs. NUS 19.4% ($p = 0.16$; OR 0.15 [95% CI 0.008–2.97]). Return visits: POCUS 0% vs. NUS 22.2% ($p = 0.17$; OR 0.13 [95% CI 0.007–2.50]). No LOS data were available for this cohort (Table 1).

From January 2013 through December 2014, 114 patients with a median age of 32 years (range 18–62 years, 48% female) were diagnosed with a PTA (Table 2), 89 of whom (78%) had a POCUS performed by an EP. Thirty-six different EPs used POCUS to evaluate a PTA in this cohort; only two of whom completed an EUS fellowship. Only one of the 36 EPs in cohort 2 was involved in cohort 1. EPs successfully aspirated 88.7% of patients (n = 79) who received a POCUS, but only 4% of patients (n = 1) who did not receive a POCUS ($p < 0.0001$; OR 189.6 [95% CI 23–1157]). Overall rates of successful aspiration, including ENT performed, were 100% for patients who received a POCUS, vs. 88% for the NUS group ($p = 0.009$; OR 27.8 [95% CI 1.38–558]); 13.5% of the POCUS group required an ENT consultation, compared with 96% for the NUS ($p < 0.0001$; OR 0.0065 [95% CI 0.0008–0.0525]). CT usage was 26.9% for POCUS, vs. 64% for NUS ($p = 0.001$; OR 0.207 [95% CI 0.081–0.532]); 4.5% of POCUS patients had return visits, compared with 12% for NUS ($p = 0.17$; OR 0.34 [95% CI 0.07–1.65]). Average LOS (in minutes) for POCUS was 166, and 267 for NUS ($p = 0.0002$ [95% CI 146–310]) (Table 2).

The combined cohorts demonstrate similar results (Table 3). Overall, 62.3% of patients received a POCUS. Forty-five different EPs utilized POCUS, only two who completed an EUS fellowship. None of the 43 EPs, who were not EUS fellowship trained, had more than 10 prior PTA POCUS scans. EP successful aspiration was 89.1% for POCUS, compared with 24.5% for NUS ($p < 0.0001$; OR 25 [95% CI 10–59]). Combined ED and ENT successful aspiration utilizing POCUS was 99.0% and 80.3% for NUS ($p < 0.0001$; OR 24 [95% CI 3–193]). ENT consultation rates were markedly less for the POCUS group (12.9%), compared with 65.6% for NUS ($p < 0.0001$; OR 0.07 [95% CI 0.03–0.17]). Likewise, CT usage was less for the POCUS group (23.8%) vs. 37.7% NUS ($p = 0.07$; OR 0.51 [95% CI 0.25–1.02]). Similarly, return visits were fewer when utilizing POCUS

Table 2. Patient Outcomes for Cohort 2 (January 2013–December 2014)

	POCUS (n = 89)	NUS (n = 25)	*p*-Value	OR (95% CI)
ED success	79 (88.7%)	1 (4.0%)	0.0001	189 (23–1157)
ED & ENT success	89 (100%)	22 (88.0%)*	0.009	27.8 (1.38–558)
ENT consult	12 (13.5%)	24 (96.0%)	0.0001	0.006 (0.0008–0.05)
CT usage	24 (26.9%)	16 (64.0%)	0.001	0.2 (0.08–0.53)
Return visits	4 (4.5%)	3 (12.0%)	0.17	0.39 (0.08–1.86)

POCUS = point-of-care ultrasound; NUS = no ultrasound performed; OR = odds ratio; CI = confidence interval; ED = emergency department; ENT = otolaryngology (ear, nose, and throat); CT = computed tomography.
* 2 patients had <2cc peritonsillar abscesses (PTAs) and were discharged home with oral antibiotics without incision & drainage or needle aspiration. ENT failed to drain 1 PTA. This patient was admitted for i.v. antibiotics and Decadron (Merck, Kenilworth, NJ). The PTA resolved without complications.

Table 3. Patient Outcomes for Combined Cohorts

	POCUS (n = 101)	NUS (n = 61)	*p*-Value	OR (95% CI)
ED success	90 (89.1%)	15 (24.5%)	0.0001	25 (10–59)
ED & ENT success	100 (99.0%)	49 (80.3%)	0.0001	24 (3–193)
ENT consult	13 (12.9%)	40 (65.6%)	0.0001	0.07 (0.03–0.17)
CT usage	24 (23.8%)	23 (37.7%)	0.07	0.51 (0.25–1.02)
Return visits	4 (3.9%)	11 (18.0%)	0.004	0.18 (0.05–0.61)

POCUS = point-of-care ultrasound; NUS = no ultrasound performed; OR = odds ratio; CI = confidence interval; ED = emergency department; ENT = otolaryngology (ear, nose, and throat); CT = computed tomography.

(3.9%), compared with 18.0% for NUS ($p = 0.004$; OR 0.18 [95% CI 0.05–0.61]) (Table 3).

Since the results of the randomized controlled trial by Costantino et al., EP use of POCUS has increased significantly from 25% to 78% ($p < 0.0001$; OR 0.09 [95% CI 0.04–0.20]). Moreover, the number of EPs utilizing POCUS increased from 9 to 44. Similar to previous literature, the data demonstrate that POCUS improved diagnostic accuracy and successful aspiration of PTAs, while reducing CT usage, ENT consultations, return visits, and LOS.

DISCUSSION

Costantino et al. conducted a randomized control trial between October 2008 and December 2010 (16). Each patient was randomized into a POCUS group or NUS group. That trial validated the use of POCUS in the management of PTAs. POCUS had a diagnostic accuracy of 100%, vs. 64% for NUS. Furthermore, POCUS had a successful aspiration rate of 100%, compared with 50% for NUS. Similarly, the study re-demonstrated a reduction of CT usage (0% POCUS vs. 35% NUS) and ENT consultations when utilizing POCUS (7% POCUS vs. 50% NUS).

Our combined cohort of 162 patients adds considerable statistically significant evidence supporting the use of POCUS in the management of PTA. Ninety percent of patients who receive a POCUS had successful drainage by EPs, compared with only 24% without POCUS. Our goal in this study was not only to compare POCUS and NUS, but more importantly to assess physician behavior prior to and after the randomized control trial by Costantino et al. (16). As an academic center, our ED strives to practice the most current evidence-based medicine and to train our EPs and residents in this manner. After the completion of the randomized control trial, we hypothesized that our PTA management had improved with respect to the routine implementation of POCUS. At present, our physicians utilize POCUS in 78% of PTA cases, a > 200% increase since 2007, when it was used in only 25% of patients.

Understandably, intraoral POCUS and aspiration of PTAs is technically challenging, and often a reason for CT usage and ENT consultation. Our study cohorts show that a diverse group of EPs, namely 43 different EPs without additional EUS training beyond traditional POCUS experience in Accreditation Council for Graduate Medical Education-accredited EM residency training, can learn to manage PTAs successfully at the bedside using POCUS. By doing so, patients will have a greater likelihood of successful aspiration while reducing LOS, return visits, and cost.

More importantly, the thyroid is one of the most radiosensitive organs. Although contemporary CT scanners have reduced the amount of radiation exposure significantly, the risk of a soft tissue neck CT is not insignificant. Secko and Sivitz provide a concise review of this topic. In short, the thyroid receives an effective radiation dose of 15–52 mSv, well above the acceptable limit of 3 mSv annually, which significantly increases the risk of cancer, especially among the young patient population most commonly affected by PTAs (2,5–7,23,24).

Limitations

This study suffers from the limitations of a single-center, retrospective study and the convenience sampling of the patients initially evaluated with POCUS, resulting in a selection bias. Furthermore, we did not account for patients diagnosed with peritonsillar cellulitis and how POCUS affected management in those instances.

Our ED is not representative of the broader EM community. We have an active ultrasound division with numerous faculty and fellows. All ED attendings are credentialed in POCUS. In our department, residents are the treating clinicians and typically have more POCUS experience compared with most practicing EPs. Moreover, few residents have proficiency with landmark-guided drainage. This causes a bias toward success with POCUS guidance compared with landmark.

Finally, we are unable to rationalize the persistent lack of POCUS utilization by certain EPs in our department despite the evidence supporting its use. Nevertheless, the implementation of POCUS in the diagnostic and therapeutic approach to PTAs by our EPs has increased from 9 to 44 physicians, only two of whom are EUS fellowship trained.

CONCLUSIONS

In short, our study validates POCUS for the management of PTAs, while demonstrating that evidence-based medicine can amend EP practice patterns to provide safer, more accurate, and more efficient patient care without significant additional EUS training.

More recent literature suggests that the transcutaneous approach provides additional diagnostic value in the setting of trismus, while improving patient comfort and real-time needle tip visualization during aspiration (21). Future prospective studies are necessary to evaluate this technique and its impact on PTA management and EP behavior.

REFERENCES

1. Herzon FS, Harris P. Mosher Award Thesis. Peritonsillar abscess: incidence, current management practices, and a proposal for treatment guidelines. Laryngoscope 1995;105(8 Pt 3 suppl 74):1–17.
2. Blair AB, Booth R, Baugh R. A unifying theory of tonsillitis, intratonsillar abscess and peritonsillar abscess. Am J Otolarygol 2015; 36:517–20.
3. Klug TE, Rusan M, Fuursted K, et al. Peritonsillar abscess: complication of acute tonsillitis or Weber's glands infection? J Otolaryngol Head Neck Surg 2016;155:199–207.
4. Farmer SJ, Khatwa MA, Zeitoun HM. Peritonsillar abscess after tonsillectomy: a review of the literature. Ann R Coll Surg Engl 2011;93:353–7.
5. Johnson RF, Stewart MG, Wright CC. An evidence-based review of the treatment of peritonsillar abscess. J Otolarygol Head Neck Surg 2003;128:332–43.
6. Mazur E, Czerwińska E, Korona-Głowniak I, Grocholwalska A, Kozioł-Montewka M. Epidemiology, clinical history and microbiology of peritonsillar abscess. Eur J Clin Microbiol Infect Dis 2015;34:549–54.
7. Klug TE. Peritonsillar abscess: clinical aspects of microbiology, risk factors, and the association with parapharyngeal abscess. Dan Med J 2017;64:B5333.
8. Powell EL, Powell J, Samuel JR, et al. A review of the pathogenesis of adult peritonsillar abscess: time for a re-evaluation. J Antimicrob Chemother 2013;68:1941–50.
9. Georgalas C, Kanagalingam J, Zainal A, et al. The association between periodontal disease and peritonsillar infection: a prospective study. J Otolaryngol Head Neck Surg 2002;126:91–4.
10. Lehnerdt G, Senska K, Fischer M, Jahnke K. Smoking promotes the formation of peritonsillar abscesses. Laryngorhinootologie 2005; 84:676–9. [in German].
11. Powell J, Wilson JA. An evidence-based review of peritonsillar abscess. Clin Otolaryngol 2012;37:136–45.
12. Scott PM, Loftus WK, Kew J, Ahuja A, Yue V, van Hasselt CA. Diagnosis of peritonsillar infections: a prospective study of ultrasound, computed tomography, and clinical diagnosis. J Laryngol Otol 1999;113:229–32.
13. Snow DG, Campbell JB, Morgan DW. The management of peritonsillar sepsis by needle aspiration. Clin Otolaryngol 1991;16: 245–7.
14. Spires JR, Ownes JJ, Woodson GE, Miller RH. Treatment of peritonsillar abscess: a prospective study of aspiration vs incision and drainage. Arch Otolaryngol Head Neck Surg 1987; 113:984–8.
15. Buckley AR, Moss EH, Blokmanis A. Diagnosis of peritonsillar abscess: value of intraoral sonography. AJR Am J Roentgenol 1994; 162:961–4.
16. Costantino TG, Satz WA, Dehnkamp W, Goett H. Randomized trial comparing intraoral ultrasound to landmark-based needle aspiration in patients with suspected peritonsillar abscess. Acad Emerg Med 2012;19:626–31.
17. Strong EB, Woodward PJ, Johnson LP. Intraoral ultrasound evaluation of peritonsillar abscess. Laryngoscope 1995;105: 779–82.
18. Blaivas M, Theodoro D, Duggal S. Ultrasound guided drainage of peritonsillar abscess by the emergency physician. Am J Emerg Med 2003;21:155–8.
19. Lyon M, Blavias M. Intraoral ultrasound in the diagnosis and treatment of suspected peritonsillar abscess in the emergency department. Acad Emerg Med 2005;12:85–8.
20. Nogan S, Jandali D, Cipolla M. The use of ultrasound imaging in evaluation of peritonsillar infections. Laryngoscope 2015;125: 2604–7.
21. Araujo Filho BC, Sakae FA, Sennes LU, Imamura R, de Menezes MR. Intraoral and transcutaneous cervical ultrasound in the differential diagnosis of peritonsillar cellulitis and abscesses. Braz J Otorhinolaryngol 2006;72:377–81.
22. American College of Emergency Physicians. Policy Statement. Ultrasound guidelines: emergency, point-of-care, and clinical ultrasound guidelines in medicine. Available at: https://www.acep.org/patient-care/policy-statements/ultrasound-guidelines-emergency-point-of–care-and-clinical-ultrasound-guidelines-in-medicine/. Accessed October 1, 2019.
23. Secko M, Sivitz A. Think ultrasound first for peritonsillar swelling. Am J Emerg Med 2015;33:569–72.
24. Mazonakis M, Tzedakis A, Damilakis J, Gourtsoyiannis N. Thyroid dose from common head and neck CT examinations in children: is there an excess risk for thyroid cancer induction? Eur Radiol 2007; 17:1352–7.

ARTICLE SUMMARY

1. Why is this topic important?

Management of peritonsillar abscesses is a standard skill for emergency physicians.

2. What does this study attempt to show?

The utility of point-of-care ultrasound to diagnosis and treat peritonsillar abscesses.

3. What are the key findings?

Point-of-care ultrasound improves diagnostic accuracy and successful aspiration of peritonsillar abscesses.

4. How is patient care impacted?

Point-of-care ultrasound facilitates accurate diagnosis and treatment of peritonsillar abscesses, while limiting computed tomography scans, otolaryngology consults, and length of stay.