



## Research Article

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# Branchial Cleft Excision in the Adult Population

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## Abstract

**Purpose:** Branchial clefts are most often associated with the pediatric population but can also affect adults. The adult population undergoing branchial cleft excision is poorly described. This study sought to describe the population and outcomes of those undergoing branchial cleft excision.

**Materials and methods:** An analysis of the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database (2015 to 2018) was performed, capturing patients with a postoperative diagnosis of a branchial cleft malformation. Patients were stratified into two groups of superficial or deep excision based upon procedure code. Demographics, perioperative variables, surgeon specialty, lesion type, and outcomes were compared between the two groups.

**Results:** A total of 399 patients undergoing surgical treatment of branchial cleft anomalies were captured. Most of these patients were white (66.67%), female (53.88%) and middle-aged ( $36.89 \pm 15.42$  years). For those undergoing superficial excision versus deep excision, there were no significant differences in demographics, comorbidities, or perioperative variables. Unsurprisingly, mean operative time was longer in the deep excision group ( $90 \pm 50$  versus  $73 \pm 52$  minutes for superficial excision,  $p = 0.0013$ ). There were no deaths at 30 days. Length of stay, readmission rate, wound infection, and discharge destination were similar among both groups.

**Conclusions:** Given the low rate of complications associated with branchial cleft excision, differences between surgical specialty, pathology, or procedural type can be difficult to distinguish. Based on these data, branchial cleft excision is a safe procedure with little clinical difference between excision of superficial or deep lesions.

## Introduction

Branchial cleft anomalies are typically associated with the pediatric population, representing approximately 20% of pediatric head and neck lesions [1-3]. In the adult population, head and neck lesions most commonly represent cancer, either primary or metastatic [4]. Lateral cystic neck masses have been thought to be most commonly caused by branchial cleft anomalies. While neoplastic, other cystic processes, infectious, and reactive processes can mimic branchial cleft anomalies [3,5-7]. Though biopsy can aid in the differential, complete excision is often recommended to rule out neoplasm [8].

Branchial cleft excision has been well described in the pediatric population; however, little data exists regarding the demographics or perioperative outcomes in the adult population. Branchial cleft anomalies are not necessarily comparable to other head and neck lesions undergoing similar procedures, and they may not have had radiation or chemotherapy like cancerous lesions. Case reports and small institutional cohorts exist, but even these are scarce [9-11]. Workup may include biopsy or imaging, and treatment in adults is typically surgical excision due to the risk of infection or an increase in size [5].

The present study's objectives were to describe a national population of patients undergoing excision of branchial cleft malformations. The aim was not only to define the demographics but also to describe and compare surgical outcomes of superficial and deep excision of branchial cleft lesions. We hypothesized that the length of operation in the deep excision group would be longer. Still, otherwise, clinical outcomes, as they are available in NSQIP, would be similar between superficial and deep excision.

## Materials and Methods

### Clinical data

Data used was from the American College of Surgeons National Quality Surgical Improvement Program (ACS NSQIP),

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years 2015 to 2018 [12]. This database contains patient-level, aggregate data, and is compliant with the Health Insurance Portability and Accountability Act as it does not identify hospitals, physicians, or patients. This data is free to ACS NSQIP participating hospitals. The benefit of this particular national dataset is that it collects more granular data of specific perioperative risk factors and outcomes. The Institutional Review Board of the University of Kansas Medical Center approved this study.

### Participant classifications

The study included all patients 18 years of age and older with a postoperative diagnosis of branchial cleft malformation, according to The International Classification of Diseases ninth and tenth editions. These codes were 744.4, 744.41, 744.42, 744.43, 744.46, 744.47, 744.49, Q18.0, Q18.1, or Q18.2. Patients were then stratified into two groups, those who underwent superficial excisional procedures (CPT 42810) or deep excisional procedures (CPT 42815) by current procedural terminology coding. The age, sex, race, comorbidities, perioperative variables, elective operation, wound class, preoperative laboratory values, admission quarter, mortality, length of operation, length of stay, discharge destination, surgeon specialty, and postoperative outcomes, such as re-admission and return to the operating room, as well as complications such as deep vein thrombosis or wound infection, were included in the analysis as available in NSQIP.

### Statistical analysis

Baseline characteristics were compared by the chi-square test or two-sample t-test, using Fischer’s exact test where necessary. Postoperative outcomes were analyzed utilizing the same tests. Multivariable regression modeling was not carried out due to the low sample size and homogeneity between preoperative variables. Statistical analysis and data management were performed using SPSS (IBM Corp. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp) and Excel (from Microsoft version 16.32). Significance is indicated by  $p < 0.05$ .

### Results

A total of 399 patients were included in the study, with 147 (36.84%) undergoing superficial excision and 252 (63.16%) undergoing deep excision. The average age was  $36.89 \pm 15.42$  years, and 46.12% were male. Age and sex did not vary between superficial or deep excision groups, but more patients underwent deep excision among white patients, 86 (58.80%) versus 180 (71.43%),  $p = 0.0082$ . Comorbidities such as diabetes, hypertension, smoking status, COPD, and steroid use were similar among both groups (Table 1).

The vast majority of operations were elective (98.50%), and none were noted to be emergency operations (Table 2). Distribution among admission quarters was even between both groups. There were no differences between groups in

**Table 1:** Baseline demographics and comorbidities.

Characteristic	Total 399	Superficial Excision 147 36.84%	Deep Excision 252 63.16%	p Value
Age (years)	36.89 15.42	34.98 15.29	38.01 15.43	0.0577
Sex				
Male	184 46.12%	68 46.26%	116 46.03%	0.965
Female	215 53.88%	79 53.74%	136 53.97%	0.965
Race				
White	266 66.67%	86 58.50%	180 71.43%	0.0082
Black	33 8.27%	14 9.52%	19 7.54%	0.4876
Hispanic	35 8.77%	8 5.44%	27 10.71%	0.0725
Unknown/not reported	64 16.04%	32 21.77%	32 12.70%	0.0172
Comorbidities				
Wound infection	2 0.50%	0 0.00%	2 0.79%	0.5335
Diabetes	24 6.02%	10 6.80%	14 5.56%	0.6133
Current smoker	83 20.80%	34 23.13%	49 19.44%	0.3817
No dyspnea	393 98.50%	145 98.64%	248 98.41%	0.8575
COPD	6 1.50%	0 0.00%	6 2.38%	0.0894
HTN	13 3.26%	5 3.40%	8 3.17%	0.9021
Weight loss	0 0.00%	0 0.00%	0 0.00%	1
Steroid use	6 1.50%	3 2.04%	3 1.19%	0.6738
Independent	394 98.75%	147 100.00%	247 98.02%	0.0857
ASA 3 or greater	59 14.79%	20 13.61%	39 15.48%	0.6116
Body mass index (kg/m <sup>2</sup> )	28.45 7.24	28.09 8.1	28.66 6.69	0.4723

**Table 2:** Perioperative Variables.

	<b>Total 399</b>	<b>Superficial Excision 147 36.84%</b>	<b>Deep Excision 252 63.16%</b>	<b>p Value</b>
Elective operation	393 98.50%	145 98.64%	248 98.41%	0.8575
Emergency case	0 0.00%	0 0.00%	0 0.00%	1
Admission quarter				
1	93 23.31%	32 21.77%	61 24.21%	0.5785
2	102 25.56%	39 26.53%	63 25.00%	0.7353
3	98 24.56%	35 23.81%	63 25.00%	0.7899
4	106 26.57%	41 27.89%	65 25.79%	0.6473
Wound class				
Clean	292 73.18%	111 75.51%	181 71.83%	0.4229
Clean/Contaminated	65 16.29%	19 12.93%	46 18.25%	0.1644
Contaminated	13 3.26%	5 3.40%	8 3.17%	0.9021
Dirty/Infected	29 7.27%	12 8.16%	17 6.75%	0.5989
Preoperative Labs				
Sodium	139.6 2.5	139.2 2.3	139.7 2.6	0.1627
BUN	13.4 4.7	13.7 4.5	13.2 4.8	0.4898
Creatinine	0.8 0.2	0.8 0.2	0.8 0.2	0.8718
Albumin	4.2 0.6	4.2 0.4	4.2 0.4	0.3976
Bili	0.6 0.3	0.6 0.3	0.6 0.3	0.5181
AST	22.4 31.2	22.8 9.4	22.2 12.5	0.7966
ALP	70.0 38.3	67.1 20.2	71.1 19.1	0.3863
WBC	7.7 1.6	7.2 2.7	8.0 2.6	0.0355
HCT	41.3 4.0	41.1 4.7	41.4 3.6	0.5948
PLT	263.2 70.7	265.2 63.0	262.3 69.1	0.7623
PTT	30.9 4.8	30.5 4.5	31.2 4.6	0.5512
INR	1.0 0.1	1.0 0.1	1.0 0.1	0.266

**Table 3:** Surgeon Specialty.

	<b>Total 399</b>	<b>Superficial Excision 147 36.84%</b>	<b>Deep Excision 252 63.16%</b>	<b>p Value</b>
Surgeon Specialty				
General Surgery	29 7.27%	13 8.84%	16 6.35%	0.3546
Otolaryngology	364 91.23%	130 88.44%	234 92.86%	0.132
Plastic Surgery	5 1.25%	4 2.72%	1 0.40%	0.0638
Vascular Surgery	1 0.25%	0 0.00%	1 0.40%	1

rates of clean, clean/contaminated, contaminated, or dirty/infected wound classifications. Values for preoperative labs were all clinically and statistically similar, except for white blood cell count, which was higher in the deep excision group ( $7.2 \pm 2.7$  versus  $8.0 \pm 2.6$  thousand/microliter) ( $p = 0.0355$ ). Operations were most often performed by otolaryngology surgeons (91.23%), though general, plastic, and vascular surgeons were represented. Rates of operations among the two groups by the specialists did not show statistical significance (Table 3).

The length of stay and time to the operation was not significantly different between the two groups (Table 4). Operative time was shorter in the superficial excision group compared to the deep excision group,  $73 \pm 52$  versus  $90 \pm 50$  minutes ( $p = 0.0013$ ). All patients were discharged home. There was no observed 30-day mortality. Rates of technical complications were not statistically different between the two groups; however, the rate of readmission related to the initial operation was greater in the superficial group, 3 (2.04%) versus 0 (0%) ( $p = 0.0494$ ) (Table 5).

**Table 4: Lesion Type.**

	<b>Total 399</b>	<b>Superficial Excision 147 36.84%</b>	<b>Deep Excision 252 63.16%</b>	<b>p Value</b>
Branchial Cleft Cyst, Sinus, Fistula	337 84.46%	114 77.55%	223 88.49%	0.0036
Preauricular Cyst, Sinus, Fistula	40 10.03%	24 16.33%	16 6.35%	0.0014
Other Branchial Cleft Malformations	22 5.51%	9 6.12%	13 5.16%	0.6841

**Table 5: Perioperative Outcomes.**

	<b>Total 399</b>	<b>Superficial Excision 147 36.84%</b>	<b>Deep Excision 252 63.16%</b>	<b>p Value</b>
Hospital days to operation	0.09 1.56	0.02 0.14	0.13 1.95	0.3729
Hospital length of stay (days)	0.44 1.73	0.27 0.59	0.54 2.13	0.0605
Operative time (minutes)	84 51	73 52	90 50	0.0013
30-Day mortality	0 0.00%	0 0.00%	0 0.00%	1
Discharge destination (home)	398 99.75%	147 100.00%	251 99.60%	0.4444
<b>Complication</b>				
Readmission	4 1.00%	3 2.04%	1 0.40%	0.1436
Related to initial operation	3 0.75%	3 2.04%	0 0.00%	0.0494
Return to Operating Room	2 0.50%	2 1.36%	0 0.00%	0.1351
Related to initial operation	2 0.50%	2 1.36%	0 0.00%	0.1351
Unplanned intubation	2 0.50%	2 1.36%	0 0.00%	0.1351
On ventilator > 48 hours	0 0.00%	0 0.00%	0 0.00%	1
Wound infection (superficial)	1 0.25%	1 0.68%	0 0.00%	0.3684
Wound infection (deep)	2 0.50%	2 1.36%	0 0.00%	0.1351
Organ space SSI	0 0.00%	0 0.00%	0 0.00%	1
Wound dehiscence	0 0.00%	0 0.00%	0 0.00%	1
Pneumonia	0 0.00%	0 0.00%	0 0.00%	1
Urinary tract infection	0 0.00%	0 0.00%	0 0.00%	1
DVT	1 0.25%	0 0.00%	1 0.40%	1
Pulmonary embolism	0 0.00%	0 0.00%	0 0.00%	1
Cardiac arrest requiring CPR	0 0.00%	0 0.00%	0 0.00%	1
Myocardial infarction	0 0.00%	0 0.00%	0 0.00%	1
Sepsis	0 0.00%	0 0.00%	0 0.00%	1
Shock	0 0.00%	0 0.00%	0 0.00%	1
Bleeding transfusion	0 0.00%	0 0.00%	0 0.00%	1
Renal complications	0 0.00%	0 0.00%	0 0.00%	1

**Table 6: Type of Lesion.**

	<b>Total 399</b>	<b>Superficial Excision 147 36.84%</b>	<b>Deep Excision 252 63.16%</b>	<b>p Value</b>
Branchial cleft cyst, sinus, fistula	333 83.46%	112 76.19%	221 87.70%	0.0028
Preauricular sinus or cyst	45 11.28%	27 18.37%	18 7.14%	0.0006
Other	21 5.26%	8 5.44%	12 4.76%	0.7639

Superficial excisions were more likely to be performed on pre-auricular cysts or sinuses. In contrast, deep excisions were more likely to be performed on branchial cleft cysts, sinuses, or fistulas (Table 6).

## Discussion

This analysis shows that adult patients undergoing surgical excision of branchial cleft malformations at ACS NSQIP

participating hospitals may have similar short-term outcomes regardless of superficial or deep excision. While the length of operation may be longer in those undergoing deep excision, the clinical impact of this may be negligible. This analysis provides information for surgeons looking for national perioperative demographics and outcomes data of patients undergoing these procedures. This data also adds to the growing body of literature on pathologies, classically associated with children, which reach adulthood undetected.

This study may represent the largest cohort of patients undergoing branchial cleft excision as adults. The results support our hypothesis that patients undergoing deep excision of branchial cleft abnormalities may experience longer operative times, without apparent significant differences in clinical outcomes. Not captured in this data are outcomes relevant to the procedure and pathology, such as exact depth of involvement, preoperative episodes of infection, prior operations, or associated abnormalities. Postoperative pain and patient satisfaction are also not captured in this group. Finally, long term outcomes of recurrence or reoperation are not captured.

The strength of this study is the use of a national cohort of patients abstracted from the patient chart and not insurance claims, capturing procedures, surgeon specialty, and granular perioperative data and outcomes. We found little data on a national level, in the adult population, of patients undergoing such procedures for this pathology. Studies of the pediatric population involving national datasets are also scarce.

The study's limitations lie in its retrospective nature, the limitations inherent to the database, and the inherent differences surgical techniques among specialties. The ACS NSQIP database acknowledges several limitations inherent to their database [12]. Generic variables are collected, patients are only followed for 30 days, data is only from participating hospitals, and some variables are not present for each case. Further detail about case complexity, such as prior operations, is not available. Without a longer period of time tracking the patients, it is not possible to describe long term outcomes or disease recurrence and disease-free survival with this database. Data is only from participating hospitals, and neither surgical nor hospital volume are included as variables. Thus we are unable to control for these. Having these variables in such a database would allow for analysis and control of specialty volume and hospital volume. ACS NSQIP has worked to eliminate sampling error, but complete removal of bias is not possible without random assignment of cases by a computer-generated algorithm or similar mechanism. Although our study has several limitations, the database allows for analysis of trends on a more granular level than the National Inpatient Sample and avoids some of the biases that may be inherent in other databases as described by LaPar and colleagues [13].

Surgical treatment of branchial clefts in adults, while rare, appears to have low associated morbidity and little difference between superficial or deep excision. Operative time may be longer in the deep excision group, but the clinical impact of this may be small. This study equips surgeons with perioperative data of patients undergoing repair of these pathologies. Further research is necessary to study the pediatric to adult

continuum of surgical pathology, including branchial cleft anomalies.

## Conclusion

Little data exists about branchial cleft excision in the adult population regarding the demographics or perioperative outcomes. Furthermore, given the low rate of complications associated with branchial cleft excision, differences between surgical specialty, pathology, or procedural type can be difficult to distinguish. Based on analysis of the ACS NSQIP database from 2015 to 2018, branchial cleft excision is a safe procedure with little clinical difference between excision of superficial or deep lesions.

## Authors contribution

**Joseph G Brungardt:** Conception and design of the work, collecting data, analysis, writing, reviewing and editing, final approval of manuscript.

**Adam C Kahle:** Writing, reviewing and editing, final approval of manuscript.

**Kurt P Schropp:** Final approval of manuscript, supervision.

All co-authors take full responsibility for all aspects of the study and the final manuscript.

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## Declaration of Competing Interest

The authors report no competing interests.

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## Competing Interest

The authors have no disclosures or competing interest.

## Classifications

Branchial cleft, sinus, excision, cyst, neoplasm.

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