



Diagnostic Accuracy of Rectal Suction Biopsy for Hirschsprung Disease in a Thai Pediatric Setting

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1. Introduction

Hirschsprung disease (HSCR), a congenital disorder characterized by the absence of ganglion cells in the distal colon, stands as a significant concern in pediatric surgery. Its incidence, estimated at approximately 1 in 5,000 live births, underscores its relevance in clinical practice. The absence of these vital nerve cells disrupts the coordinated peristaltic movements of the bowel, leading to functional obstruction and a cascade of associated complications. The clinical presentation of HSCR is diverse, ranging from delayed passage of meconium in neonates to chronic constipation and abdominal distension in older children. Failure to diagnose and manage HSCR promptly can have dire consequences,

ABSTRACT

Introduction: Hirschsprung disease (HSCR) necessitates early diagnosis to prevent complications. Rectal suction biopsy (RSB) offers a less invasive alternative to full-thickness biopsy. This study evaluates RSB's diagnostic accuracy in a Thai pediatric population. **Methods:** A retrospective review analyzed children suspected of HSCR who underwent RSB at a tertiary Thai hospital (2018-2024). RSB findings were compared to the gold standard (full-thickness biopsy or intraoperative findings). Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were calculated. **Results:** 120 children (median age 2 months, range 1 day - 12 years) were included. RSB yielded 45 positive and 75 negative results. Gold standard confirmed 40 true positives, 5 false positives, 70 true negatives, and 5 false negatives. RSB's sensitivity was 88.9%, specificity 93.3%, PPV 88.9%, NPV 93.3%, and accuracy 91.7%. **Conclusion:** RSB demonstrates high diagnostic accuracy for HSCR in Thai children. It can serve as a valuable initial diagnostic tool, potentially reducing the need for full-thickness biopsies.

including enterocolitis, sepsis, and even mortality. The gravity of these potential complications underscores the critical need for early and accurate diagnosis. Traditionally, the gold standard for diagnosing HSCR has been the full-thickness rectal biopsy. This procedure, while highly accurate, necessitates general anesthesia and carries inherent risks associated with invasive surgery. In recent years, there has been a growing interest in less invasive diagnostic modalities, particularly in the pediatric population where the risks of general anesthesia are heightened.¹⁻⁴

Rectal suction biopsy (RSB) has emerged as a promising alternative to full-thickness biopsy. Introduced in the 1980s, RSB involves the removal of a small sample of rectal mucosa using suction. The

procedure can be performed under sedation or local anesthesia, offering a less invasive and potentially safer approach, especially in young infants and children with comorbidities. The diagnostic accuracy of RSB has been investigated in various populations across the globe. Several studies have reported high sensitivity and specificity for RSB, suggesting its potential as a reliable screening tool for HSCR. However, the performance of RSB can be influenced by several factors, including the experience of the operator, the quality of the biopsy specimen, and the interpretation of histological findings.⁵⁻⁸ Despite the growing body of evidence supporting RSB's utility, data from specific populations, such as Thai children, remains limited. The unique genetic and environmental factors within a population can potentially influence the presentation and diagnosis of HSCR. Therefore, it is imperative to evaluate the diagnostic accuracy of RSB within the context of the Thai pediatric population.^{9,10} This study aims to address this knowledge gap by assessing the diagnostic accuracy of RSB for HSCR in a Thai pediatric setting.

2. Methods

This investigation employed a retrospective study design, meticulously examining the medical records of pediatric patients who underwent rectal suction biopsy (RSB) as part of their diagnostic evaluation for suspected Hirschsprung disease (HSCR). The study was conducted at a prominent tertiary pediatric hospital in Thailand, renowned for its comprehensive care and specialized expertise in pediatric surgery. The hospital's robust medical record-keeping system and commitment to evidence-based practice provided a fertile ground for this retrospective analysis. The study period spanned from January 2018 to August 2024, encompassing a substantial timeframe that allowed for the inclusion of a diverse cohort of patients. This extended duration facilitated the capture of a wide spectrum of clinical presentations and diagnostic outcomes, enhancing the generalizability of the study findings.

The selection of study participants adhered to stringent inclusion and exclusion criteria, ensuring

the homogeneity of the study population and minimizing the potential for confounding variables. Children aged 0 to 18 years who presented with clinical manifestations suggestive of HSCR were considered eligible for inclusion. These manifestations encompassed a constellation of symptoms, including delayed passage of meconium, chronic constipation, abdominal distension, and vomiting. The presence of these symptoms, in conjunction with a clinical suspicion of HSCR, warranted further diagnostic evaluation, often culminating in the performance of RSB. However, certain exclusion criteria were implemented to maintain the integrity of the study. Children who had previously undergone a full-thickness rectal biopsy were excluded, as this procedure could potentially alter the histological findings of the RSB. Furthermore, individuals with incomplete medical records were also excluded to ensure the accuracy and completeness of data collection.

The meticulous collection of data constituted a cornerstone of this study. Trained research personnel, well-versed in medical record abstraction and data management, meticulously reviewed the electronic and paper-based medical records of eligible patients. A standardized data collection form was employed to ensure consistency and accuracy in data capture. The following data elements were extracted from the medical records; Demographics: Age and sex of the patient were recorded to characterize the study population and explore potential associations between demographic factors and diagnostic outcomes; Clinical Presentation: The presenting symptoms and signs that prompted the suspicion of HSCR were documented. This information shed light on the clinical manifestations of HSCR in the Thai pediatric population and facilitated the identification of potential predictors of the disease; RSB Findings: The results of the RSB, specifically the presence or absence of ganglion cells in the biopsy specimen, were meticulously recorded. The histological interpretation of the RSB served as the primary outcome measure for assessing the diagnostic accuracy of the procedure; Gold Standard Diagnosis: The definitive diagnosis of HSCR, established through either a full-thickness

rectal biopsy or intraoperative findings, was documented. This gold standard served as the reference point against which the diagnostic performance of RSB was evaluated. The data collection process was conducted with utmost care and attention to detail. Any discrepancies or ambiguities in the medical records were resolved through consultation with the attending physicians or pathologists. The data were then securely stored and de-identified to protect patient confidentiality.

The collected data underwent rigorous statistical analysis to quantify the diagnostic accuracy of RSB for HSCR in the Thai pediatric population. The RSB results were compared to the gold standard diagnosis, allowing for the calculation of key performance metrics; Sensitivity: This metric represented the proportion of patients with HSCR who were correctly identified by RSB. It reflected the ability of the procedure to detect the presence of the disease; Specificity: This metric represented the proportion of patients without HSCR who were correctly identified by RSB. It reflected the ability of the procedure to exclude the disease in healthy individuals; Positive Predictive Value (PPV): This metric represented the probability of a patient having HSCR given a positive RSB result. It indicated the likelihood that a positive test result truly reflected the presence of the disease; Negative Predictive Value (NPV): This metric represented the probability of a patient not having HSCR given a negative RSB result. It indicated the likelihood that a negative test result truly reflected the absence of the disease; Accuracy: This metric represented the overall proportion of correct diagnoses made by RSB, encompassing both positive and negative results. It provided a comprehensive assessment of the procedure's diagnostic performance. The statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) software, version 26. Confidence intervals (CIs) were calculated to estimate the precision of the performance metrics. Appropriate statistical tests were employed to assess the significance of any observed differences or associations.

The conduct of this study adhered to the highest ethical standards, prioritizing the protection of patient rights and welfare. The study protocol was reviewed and approved by the Institutional Review Board (IRB) of the participating hospital. The IRB meticulously evaluated the study design, data collection procedures, and informed consent process to ensure compliance with ethical guidelines and regulations. Patient confidentiality was maintained throughout the study. All data were de-identified and securely stored to prevent any unauthorized access or disclosure. The study findings were reported in aggregate form, ensuring the anonymity of individual patients.

3. Results and Discussion

Table 1 provides a snapshot of the demographic and clinical features of the 120 children included in the study evaluating the diagnostic accuracy of rectal suction biopsy (RSB) for Hirschsprung disease (HSCR). The study included a total of 120 children, which is a reasonably large sample size for a retrospective study in this context. This sample size strengthens the statistical power of the analysis and enhances the generalizability of the findings. The median age of the patients was 2 months, with a wide range from 1 day to 12 years. This indicates that the study encompassed both neonates and older children, reflecting the spectrum of ages at which HSCR can present clinically. The inclusion of patients across a broad age range allows for the assessment of RSB's diagnostic accuracy in different age groups. The study population was slightly skewed towards males, with 65 males (54.2%) and 55 females (45.8%). The most common presenting symptoms were delayed meconium passage (80%), constipation (60%), and abdominal distension (50%). These symptoms are cardinal manifestations of HSCR and reflect the underlying functional obstruction caused by the absence of ganglion cells in the distal colon. The high prevalence of these symptoms in the study population underscores the clinical suspicion of HSCR that prompted further diagnostic evaluation, including RSB.

Table 1. Patient characteristics.

Characteristic	Value
Total	120
Median age (range)	2 months (1 day - 12 years)
Male	65 (54.2%)
Female	55 (45.8%)
Delayed meconium passage	80%
Constipation	60%
Abdominal distension	50%

Table 2 presents the key metrics evaluating the performance of rectal suction biopsy (RSB) in diagnosing Hirschsprung disease (HSCR) within the context of this study. High Sensitivity (88.9%) indicates that RSB is adept at correctly identifying children with HSCR. In other words, nearly 9 out of 10 children who truly had the disease were accurately diagnosed by RSB. This high sensitivity suggests that RSB is a valuable tool for ruling out HSCR when the result is negative, providing clinicians with a degree of confidence in excluding the diagnosis in those cases. High Specificity (93.3%) signifies that RSB is also proficient at correctly identifying children who do not have HSCR. This means that the test rarely produces false positive results, minimizing the likelihood of unnecessary further investigations or interventions in healthy children. A high PPV (88.9%) positive predictive value suggests that a positive RSB result is

highly indicative of the presence of HSCR. In this study, almost 9 out of 10 children with a positive RSB result were confirmed to have the disease. This high PPV reinforces the clinical utility of RSB in guiding further diagnostic and therapeutic decisions. High NPV (93.3%) negative predictive value underscores the reliability of a negative RSB result in excluding HSCR. A child with a negative RSB result has a very high probability (93.3%) of not having the disease. This information can be particularly reassuring for clinicians and families, potentially obviating the need for more invasive diagnostic procedures. High Accuracy (91.7%) signifies that RSB is a highly accurate diagnostic test for HSCR in this study population. This metric encompasses the ability of the test to correctly identify those with and without the disease, highlighting its overall effectiveness.

Table 2. Diagnostic accuracy of rectal suction biopsy (RSB) for Hirschsprung disease.

Metric	Value	95% confidence interval
Sensitivity	88.90%	78.2% - 95.6%
Specificity	93.30%	86.1% - 97.5%
PPV (Precision)	88.90%	78.2% - 95.6%
NPV	93.30%	86.1% - 97.5%
Accuracy	91.70%	85.4% - 95.9%

The cornerstone of our study's findings rests upon the impressive sensitivity of 88.9% demonstrated by rectal suction biopsy (RSB) in diagnosing Hirschsprung disease (HSCR). This remarkable figure signifies that RSB accurately identifies nearly nine out of every ten children who truly have the condition. The implications of such high sensitivity are far-reaching,

particularly in the realm of ruling out HSCR and optimizing patient care. In the intricate landscape of pediatric diagnostics, the ability to confidently exclude a diagnosis is as valuable as the ability to confirm one. In the context of HSCR, a condition that can lead to severe complications if left untreated, the ability to rule out the disease with a high degree of certainty is

paramount. This is where the high sensitivity of RSB shines. When a child presents with symptoms that raise the suspicion of HSCR, such as delayed passage of meconium, chronic constipation, or abdominal distension, the clinician faces a critical decision point. The next step in the diagnostic pathway often involves choosing between a less invasive RSB or a more invasive full-thickness rectal biopsy. The high sensitivity of RSB provides a compelling argument in favor of the former, especially when the clinical suspicion of HSCR is low to moderate. A negative RSB result, armed with its high sensitivity, can be interpreted with a substantial degree of confidence. It essentially tells the clinician that the child is highly unlikely to have HSCR. This newfound certainty can have a profound impact on the subsequent management of the child. It empowers clinicians to potentially avoid subjecting the child to the more invasive full-thickness rectal biopsy, which necessitates general anesthesia and carries inherent risks. The avoidance of general anesthesia is particularly crucial in vulnerable populations, such as young infants and children with comorbidities. Infants, especially those born prematurely, have immature respiratory and cardiovascular systems, making them more susceptible to complications from anesthesia. Similarly, children with underlying medical conditions, such as heart disease or respiratory problems, might face heightened risks during anesthesia. By offering a reliable means of ruling out HSCR without the need for general anesthesia, RSB acts as a protective shield for these vulnerable children. It allows clinicians to make informed decisions that prioritize the safety and well-being of their patients. This aligns with the core principles of pediatric care, which emphasize minimizing harm and optimizing outcomes for every child. Beyond its role in ruling out HSCR, the high sensitivity of RSB can also expedite the diagnostic process. In cases where the clinical suspicion of HSCR is low, a negative RSB result can provide early reassurance and allow clinicians to shift their focus towards exploring alternative diagnoses. This can prevent unnecessary delays in identifying the true cause of the child's symptoms and initiating

appropriate treatment. In the fast-paced world of pediatric healthcare, time is of the essence. Delays in diagnosis can lead to disease progression, complications, and increased morbidity. The ability of RSB to rapidly and reliably exclude HSCR in a significant proportion of children can translate to improved patient outcomes and more efficient utilization of healthcare resources. The high sensitivity of RSB observed in our study is not an isolated finding. It resonates with a growing body of evidence from various populations across the globe, highlighting the consistent performance of RSB as a diagnostic tool for HSCR. This convergence of findings from diverse settings strengthens the generalizability of our results and reinforces the confidence in RSB's ability to accurately identify children with HSCR. Furthermore, the high sensitivity of RSB complements its other favorable attributes, such as its minimally invasive nature, rapid turnaround time, and cost-effectiveness.^{11,12}

In the realm of medical diagnostics, the pursuit of accuracy is paramount. However, accuracy alone does not tell the whole story. A test's ability to correctly identify those *without* a disease, its specificity, is equally crucial, particularly when the consequences of a false-positive result can be significant. In our study evaluating rectal suction biopsy (RSB) for Hirschsprung disease (HSCR), the observed specificity of 93.3% stands as a testament to the test's ability to guard against false alarms, offering clinicians and patients a sense of security and guiding judicious clinical decision-making. A false-positive result, in essence, is a diagnostic misfire. It incorrectly labels a healthy individual as having a disease, setting in motion a cascade of events that can have profound implications for the patient and the healthcare system. In the context of HSCR, a false-positive RSB result could lead to a chain reaction of unnecessary anxiety, further investigations, and potential delays in the diagnosis and management of the child's actual underlying condition. The anxiety triggered by a false-positive diagnosis can be immense. Parents, already grappling with the stress of their child's symptoms, are suddenly confronted with the specter of a serious condition, often accompanied by the prospect of

invasive procedures and potential long-term consequences. This emotional toll can reverberate through the entire family, impacting their well-being and quality of life. Moreover, a false-positive result can lead to a cascade of unnecessary investigations. In the pursuit of confirming or refuting the diagnosis, the child might be subjected to a battery of tests, some of which could be invasive or uncomfortable. This not only adds to the emotional burden but also exposes the child to potential risks and complications associated with these procedures. Furthermore, the pursuit of a false-positive diagnosis can divert attention and resources away from the child's actual underlying condition. This can lead to delays in diagnosis and treatment, potentially compromising the child's health and well-being. In some cases, these delays can have irreversible consequences, underscoring the critical importance of minimizing false-positive results. The high specificity of 93.3% observed in our study positions RSB as a reliable safeguard against the perils of false positives. It signifies that only a small fraction of children without HSCR will receive a positive RSB result. This translates to a reduced risk of unnecessary anxiety, investigations, and delays in management for these children. In the specific context of HSCR, the high specificity of RSB is particularly reassuring. A false-positive result could lead to unwarranted surgical intervention, a major procedure that carries inherent risks and complications. The potential harm associated with unnecessary surgery in a child is immense, encompassing not only the physical risks of the procedure but also the psychological trauma and potential long-term sequelae. The high specificity of RSB acts as a protective barrier against such scenarios. It ensures that children without HSCR are not misidentified and subjected to undue harm. This attribute of RSB aligns with the fundamental principle of "first, do no harm," which lies at the heart of medical ethics. Beyond its role in minimizing false positives, the high specificity of RSB also reinforces its clinical utility as a screening tool. Clinicians can confidently use RSB to triage patients, prioritizing those with positive results for further evaluation with more definitive diagnostic modalities, such as full-thickness

rectal biopsy or anorectal manometry. This targeted approach to diagnosis can optimize resource utilization. By focusing resources on children with a high likelihood of HSCR, as indicated by a positive RSB result, clinicians can avoid wasting valuable time and resources on extensive investigations in children who are unlikely to have the disease. Furthermore, the high specificity of RSB can streamline the diagnostic pathway for children with suspected HSCR. By providing a reliable means of excluding the diagnosis in a significant proportion of children, RSB can expedite the identification of alternative diagnoses and facilitate timely initiation of appropriate treatment. This efficiency in diagnosis can translate to improved patient outcomes and a more streamlined healthcare system. The high specificity of RSB observed in our study echoes findings from other populations and clinical settings. Multiple studies have consistently reported high specificity for RSB, ranging from 90% to 98%. This convergence of evidence from diverse contexts strengthens the confidence in RSB's ability to accurately identify children without HSCR. Moreover, the high specificity of RSB complements its other favorable attributes, such as its high sensitivity, minimally invasive nature, rapid turnaround time, and cost-effectiveness. These features collectively position RSB as an attractive and reliable tool in the diagnostic armamentarium for HSCR.^{13,14}

In the realm of medical diagnostics, the ability to predict the presence or absence of a disease with a high degree of certainty is a coveted goal. Positive predictive value (PPV) and negative predictive value (NPV) are two key metrics that quantify this predictive power. In our study evaluating rectal suction biopsy (RSB) for Hirschsprung disease (HSCR), the observed PPV of 88.9% and NPV of 93.3% underscore the reliability of RSB in guiding clinical decision-making and providing reassurance to patients and their families. The high PPV of 88.9% observed in our study signifies that a positive RSB result carries substantial weight in predicting the presence of HSCR. In essence, when a child receives a positive RSB result, there is a very high probability, nearly nine out of ten, that they indeed have the disease. This predictive power is invaluable in guiding subsequent clinical decisions

and shaping the trajectory of care. A positive RSB result serves as a powerful signal, prompting clinicians to take decisive action. It can trigger further confirmatory testing, such as a full-thickness rectal biopsy, to definitively establish the diagnosis. It can also initiate crucial conversations with the family regarding the nature of HSCR, its potential implications, and the available treatment options, including surgical intervention. The high PPV of RSB empowers clinicians to initiate these discussions early in the diagnostic process. This early engagement can alleviate anxiety and uncertainty for the family, allowing them to actively participate in the decision-making process and prepare for the potential challenges ahead. It fosters a sense of shared responsibility and empowers the family to become active partners in their child's care. Furthermore, the high PPV of RSB allows for early planning and preparation for potential surgical intervention. By identifying children with a high likelihood of HSCR, clinicians can initiate the necessary preoperative evaluations, optimize the child's medical condition, and ensure the availability of specialized surgical teams and resources. This proactive approach can potentially lead to improved surgical outcomes and a smoother postoperative course. While a positive RSB result illuminates the path forward, a negative result, armed with a high NPV, can be equally powerful in dispelling doubts and fears. The high NPV of 93.3% observed in our study signifies that a negative RSB result is highly reliable in excluding HSCR. A child with a negative RSB result can be reassured that the likelihood of having HSCR is very low, offering a sense of relief and closure. This reassurance can have a profound impact on the child and their family. It can alleviate the anxiety and uncertainty associated with the diagnostic process, allowing them to move forward with a sense of peace and confidence. It can also prevent unnecessary further investigations and interventions, sparing the child from potential harm and discomfort. Moreover, a negative RSB result can redirect the diagnostic focus towards exploring alternative explanations for the child's presenting symptoms. This can lead to the timely identification and management of other underlying conditions,

ensuring that the child receives appropriate care and avoids potential complications from delayed diagnosis. The combination of high PPV and NPV observed in our study underscores the predictive power of RSB in both confirming and excluding the diagnosis of HSCR. This dynamic duo empowers clinicians to make informed decisions based on the likelihood of disease presence or absence, facilitating a more targeted and efficient approach to diagnosis and management. The high PPV ensures that children with a positive RSB result are promptly evaluated and managed, potentially leading to improved outcomes. The high NPV provides reassurance to children and families with negative results, sparing them from unnecessary anxiety and interventions. While the PPV and NPV are valuable metrics, their interpretation should always be contextualized within the clinical scenario. The pretest probability of HSCR, based on the child's clinical presentation and other diagnostic findings, can influence the post-test probability, even in the presence of a high PPV or NPV. For instance, in a child with a strong clinical suspicion of HSCR, a negative RSB result, despite its high NPV, might warrant further investigation with a full-thickness biopsy to definitively rule out the diagnosis. Conversely, in a child with a low pretest probability of HSCR, a positive RSB result, despite its high PPV, might necessitate further confirmatory testing before proceeding with surgical intervention.^{15,16}

In the complex landscape of medical diagnostics, the pursuit of accuracy is an unwavering goal. Accuracy, in its essence, represents the proportion of correct diagnoses made by a test, encompassing both its ability to identify those with the disease (true positives) and those without it (true negatives). In our study evaluating rectal suction biopsy (RSB) for Hirschsprung disease (HSCR), the observed accuracy of 91.7% serves as a powerful testament to the effectiveness of RSB as a diagnostic tool. This remarkable figure, backed by rigorous statistical analysis, reflects a holistic assessment of RSB's diagnostic performance, highlighting its ability to discriminate between children with and without HSCR with a high degree of precision. Accuracy, while a seemingly simple concept, encapsulates the

multifaceted nature of diagnostic testing. It represents the harmony between a test's sensitivity and specificity, its ability to correctly identify both the presence and absence of a disease. A high accuracy signifies that the test is reliable and trustworthy, minimizing the risk of both false-positive and false-negative results. In the context of our study, the accuracy of 91.7% signifies that RSB correctly classified nearly 92 out of every 100 children, accurately distinguishing between those with and without HSCR. This impressive figure underscores the clinical utility of RSB, suggesting that it can be a valuable asset in the diagnostic workup of children with suspected HSCR. The high accuracy of RSB observed in our study has several far-reaching clinical implications. First and foremost, it reinforces the confidence in RSB as a diagnostic tool. Clinicians can rely on RSB results to guide their decision-making, knowing that the test is highly likely to provide an accurate assessment of the child's condition. This confidence in RSB can lead to more efficient and streamlined diagnostic pathways. By accurately identifying children with HSCR, RSB can expedite the initiation of appropriate management, including further confirmatory testing and potential surgical intervention. This early intervention can potentially improve outcomes and reduce the risk of complications associated with delayed diagnosis. Moreover, the high accuracy of RSB can minimize the need for more invasive diagnostic procedures, such as full-thickness rectal biopsy. This is particularly beneficial for young infants and children with comorbidities, who might be more susceptible to the risks associated with general anesthesia and invasive surgery. By offering a reliable and less invasive alternative, RSB can contribute to a more patient-centered approach to diagnosis, prioritizing the safety and well-being of the child. Furthermore, the high accuracy of RSB can optimize resource allocation within the healthcare system. By accurately identifying children with HSCR, RSB can help prioritize those who require further evaluation and specialized care, ensuring that resources are utilized efficiently and effectively. While accuracy is a valuable metric, it is essential to interpret it in conjunction with

other diagnostic performance measures, such as sensitivity, specificity, PPV, and NPV. A high accuracy alone does not guarantee the absence of false-positive or false-negative results. In our study, the high accuracy of RSB is complemented by its high sensitivity and specificity, indicating that it performs well in both identifying children with HSCR and excluding those without it. This balanced performance further reinforces the clinical utility of RSB as a diagnostic tool. Moreover, the high PPV and NPV observed in our study provide additional insights into the predictive power of RSB. These metrics quantify the likelihood of a positive or negative RSB result accurately reflecting the presence or absence of HSCR, respectively. This information is crucial in guiding clinical decision-making and communicating the implications of RSB results to patients and their families. The high accuracy of RSB observed in our study aligns with findings from other populations and clinical settings. Multiple studies have consistently reported high accuracy rates for RSB, ranging from 85% to 95%. This convergence of evidence from diverse contexts strengthens the confidence in the generalizability of our results and reinforces the reliability of RSB as a diagnostic tool for HSCR. Furthermore, the minimally invasive nature of RSB, coupled with its high accuracy, positions it as an attractive option in the diagnostic algorithm for HSCR. It offers a balance between diagnostic accuracy and patient comfort, making it a valuable tool for clinicians seeking to optimize the care of children with suspected HSCR.^{17,18}

While the statistical metrics meticulously presented in our study, such as the impressive sensitivity, specificity, and accuracy of rectal suction biopsy (RSB) in diagnosing Hirschsprung disease (HSCR), undoubtedly hold scientific merit, their true value lies in their translation to tangible clinical benefits. Beyond the realm of numbers and percentages, these findings have the potential to revolutionize the diagnostic landscape for HSCR, ushering in an era of improved patient care, optimized resource utilization, and enhanced overall well-being for children and their families. One of the most profound clinical implications of RSB's high diagnostic

accuracy is its potential to reduce the need for invasive procedures, particularly full-thickness rectal biopsies. Traditionally, the gold standard for diagnosing HSCR has been the full-thickness biopsy, a procedure that necessitates general anesthesia and carries inherent risks. General anesthesia, while generally safe, is not without its complications. It can lead to adverse events such as respiratory depression, cardiovascular instability, and allergic reactions. These risks are particularly pronounced in vulnerable populations, such as young infants and children with comorbidities. Infants, especially those born prematurely, have immature respiratory and cardiovascular systems, making them more susceptible to the adverse effects of anesthesia. Similarly, children with underlying medical conditions, such as heart disease or respiratory problems, might face heightened risks during anesthesia. By offering a reliable and less invasive alternative, RSB has the potential to significantly reduce the number of children subjected to full-thickness biopsies. A negative RSB result, armed with its high negative predictive value, can effectively rule out HSCR in a vast majority of cases, obviating the need for further invasive testing. This translates to a reduced burden of anesthesia exposure, minimizing the associated risks and complications for countless children. Moreover, the avoidance of full-thickness biopsy can also lead to faster recovery times, reduced hospital stays, and decreased healthcare costs. This not only benefits the individual child but also has broader implications for the healthcare system, freeing up resources and allowing for more efficient allocation of care. In the realm of pediatric healthcare, time is often of the essence. Early diagnosis and prompt intervention are critical in mitigating the potential complications of many childhood diseases, and HSCR is no exception. Delayed diagnosis of HSCR can lead to a cascade of devastating consequences, including enterocolitis, sepsis, and even mortality. The ability of RSB to rapidly identify children with a high likelihood of HSCR, as evidenced by its high positive predictive value, can significantly expedite the diagnostic process. A positive RSB result serves as a red flag, prompting clinicians to initiate further confirmatory

testing and expedite the necessary surgical intervention. This acceleration of the diagnostic timeline can have a profound impact on patient outcomes. Early surgical intervention in HSCR has been shown to improve long-term bowel function, reduce the risk of complications, and enhance the overall quality of life for affected children. By enabling earlier diagnosis, RSB can potentially contribute to a brighter future for these children, allowing them to reach their full potential and live fulfilling lives. Beyond the tangible clinical benefits, RSB also offers a more patient-centered approach to diagnosis. Compared to the full-thickness biopsy, which requires general anesthesia and often involves a hospital stay, RSB is a minimally invasive procedure that can be performed under sedation or even local anesthesia in some cases. This less invasive nature of RSB translates to a more comfortable and less stressful experience for children and their families. It reduces the anxiety and apprehension associated with undergoing a major procedure and minimizes the disruption to the child's daily routine. Moreover, the quicker recovery time associated with RSB allows children to return to their normal activities sooner, promoting a sense of normalcy and well-being. The enhanced patient experience offered by RSB is not merely a matter of convenience. It reflects a shift towards a more compassionate and empathetic approach to healthcare, one that prioritizes the emotional and psychological well-being of children and their families alongside their physical health. In an era of increasing healthcare costs and resource constraints, the efficient allocation of resources is paramount. The high diagnostic accuracy of RSB can contribute to a more judicious utilization of healthcare resources. By accurately identifying children with a high likelihood of HSCR, RSB allows clinicians to prioritize those who require further evaluation and specialized care. This targeted approach prevents the unnecessary expenditure of resources on extensive investigations in children who are unlikely to have the disease. Furthermore, the ability of RSB to rule out HSCR in a significant proportion of children can reduce the burden on tertiary care centers, allowing them to focus on providing specialized care to those

with confirmed diagnoses. This can potentially lead to shorter wait times, improved access to care, and a more streamlined healthcare system.^{19,20}

4. Conclusion

This study establishes rectal suction biopsy (RSB) as a highly accurate diagnostic tool for Hirschsprung disease (HSCR) in Thai children, exhibiting impressive sensitivity, specificity, and overall accuracy. RSB's ability to effectively rule out HSCR, coupled with its minimally invasive nature, positions it as a valuable initial screening tool, potentially reducing the need for full-thickness biopsies and expediting the diagnostic process. These findings advocate for the wider adoption of RSB in the diagnostic algorithm for HSCR, ultimately contributing to improved patient care and optimized resource allocation in the Thai pediatric setting.

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