

MULTIMODALITY IMAGING OF PITUITARY, THYROID, PARATHYROID, ADRENAL, AND PANCREATIC ENDOCRINE DISORDERS IN PEDIATRIC AND ADULT PATIENTS: A COMPREHENSIVE REVIEW WITH CLINICAL CORRELATION AND MEDICAL MANAGEMENT

Muhammad Bilal¹, Mohsin Khan², Sahar Fahim³, Muhammad Danyal⁴, Muhammad Nauman Akram⁵, Hina Azeez⁶

¹Department of Medicine, Lady Reading Hospital MTI, Peshawar, Pakistan

²Department of Radiology, Bacha Khan Medical Complex-MTI, Swabi, Pakistan

³Department of Radiology, Pak International Medical College, Peshawar, Pakistan

⁴Consultant paediatrician, Akbar Medical Hospital, Dabgari garden, Peshawar, Pakistan

⁵Department of Radiology, Sahara Medical College, Narowal, Pakistan

⁶Department of General Medicine, Federal Government Polyclinic Hospital, Islamabad, Pakistan

*Corresponding Author: Dr. Sahar Fahim. Email: sahar.fahim8665@gmail.com

ABSTRACT

Objective: To evaluate the role of multimodality imaging in the diagnosis and characterization of pituitary thyroid parathyroid adrenal and pancreatic endocrine disorders in pediatric and adult patients and to determine its clinical correlation and impact on medical management.

Methods: This descriptive observational study was conducted at Lady Reading Hospital Peshawar from 23 January 2025 to 23 December 2025. A total of 120 patients with suspected or confirmed endocrine disorders were included using nonprobability consecutive sampling. Clinical data laboratory findings and imaging examinations including ultrasonography computed tomography magnetic resonance imaging and nuclear medicine studies were reviewed. Imaging findings were correlated with clinical presentation histopathological diagnosis and treatment strategies. Statistical analysis was performed using Statistical Package for Social Sciences version 26 and a p value of less than 0.05 was considered significant.

Results: The mean age of the patients was 41.2 ± 16.8 years and 68 patients were male. Thyroid disorders were the most frequent endocrine abnormalities followed by pituitary and adrenal lesions. Ultrasonography was the most commonly utilized imaging modality while magnetic resonance imaging was primarily used for pituitary diseases. Solid enhancing lesions represented the most common imaging pattern. Medical management was performed in most patients while surgical intervention was required in selected cases. Multimodality imaging demonstrated high diagnostic accuracy and significantly influenced therapeutic decision making.

Conclusion: Multimodality imaging provides accurate characterization of endocrine disorders and facilitates early diagnosis appropriate treatment selection and improved patient management in both pediatric and adult populations.

Keywords: Endocrine disorders. Pituitary gland. Thyroid diseases. Magnetic resonance imaging. Computed tomography. Pancreatic neuroendocrine tumors.

INTRODUCTION

Endocrine disorders represent a diverse group of diseases that affect multiple organ systems and produce substantial morbidity in both pediatric and adult populations. The endocrine glands regulate growth metabolism reproduction and homeostasis through the secretion of hormones that influence nearly every tissue of the human body. Structural and functional abnormalities involving the pituitary thyroid parathyroid adrenal and pancreatic endocrine organs may result in significant clinical manifestations that require timely diagnosis and appropriate management.¹ Advances in medical imaging have transformed the evaluation of endocrine diseases and have improved the understanding of their pathophysiology and clinical behavior.²

The pituitary gland is considered the master endocrine organ because it regulates several peripheral glands through trophic hormones. Pituitary adenomas inflammatory lesions congenital anomalies and neoplastic conditions can produce visual impairment hormonal imbalance and neurological deficits. Magnetic resonance imaging has become

the principal modality for the assessment of pituitary disorders because of its excellent soft tissue resolution and multiplanar capability.³ Dynamic contrast enhanced sequences allow the identification of microadenomas and facilitate preoperative planning in patients who require surgical intervention. Pediatric pituitary disorders are often associated with growth disturbances delayed puberty and congenital syndromes while adults commonly present with endocrine hyperfunction or compressive symptoms.

Thyroid disorders are among the most prevalent endocrine diseases worldwide and encompass a broad spectrum of inflammatory benign and malignant conditions. Ultrasonography has been established as the first line imaging technique because it is noninvasive widely available and capable of characterizing thyroid nodules with high sensitivity.⁴ Cross sectional imaging with computed tomography and magnetic resonance imaging is also employed for the assessment of large goiters invasive malignancies and postoperative recurrence. In children thyroid nodules are relatively uncommon but carry a higher risk of malignancy than those identified in adults. Therefore accurate imaging evaluation and risk stratification are essential for guiding clinical management and preventing unnecessary interventions.

Parathyroid disorders frequently manifest through abnormalities in calcium metabolism and are often associated with hyperparathyroidism or hypoparathyroidism. The localization of abnormal parathyroid tissue has historically represented a diagnostic challenge because of the small size and variable anatomical position of these glands. Nuclear medicine techniques and high resolution ultrasonography have significantly improved the preoperative identification of parathyroid adenomas and hyperplastic glands.⁵ Advanced imaging modalities including four dimensional computed tomography and magnetic resonance imaging have further enhanced diagnostic confidence in complex cases and recurrent disease.

Adrenal gland disorders constitute another important category of endocrine abnormalities and include benign adenomas pheochromocytomas hyperplasia metastatic lesions and primary malignancies. The adrenal glands play a central role in the regulation of stress response blood pressure and electrolyte balance. Computed tomography and magnetic resonance imaging provide detailed characterization of adrenal masses and assist in differentiating benign from malignant lesions.⁶ Functional imaging has also emerged as an important adjunct in selected disorders particularly in the evaluation of neuroendocrine tumors and metastatic disease. Pediatric adrenal disorders differ considerably from adult conditions because congenital abnormalities and neuroblastic tumors are more frequently encountered during childhood.

Pancreatic endocrine disorders are relatively uncommon but possess significant clinical importance because of their association with hormone secreting neoplasms and hereditary syndromes. Insulinomas gastrinomas and other pancreatic neuroendocrine tumors may produce severe metabolic disturbances and are often difficult to localize.⁷ Multiphase computed tomography magnetic resonance imaging and nuclear medicine studies have improved the detection of these lesions and have enabled precise anatomical mapping before surgery. The integration of imaging findings with biochemical investigations has become essential for achieving accurate diagnosis and optimal therapeutic planning.

The concept of multimodality imaging has gained increasing importance because no single imaging technique can adequately evaluate all endocrine disorders. Each modality possesses distinct advantages and limitations and therefore a combined imaging approach is frequently necessary for comprehensive assessment.⁸ Correlation of radiological findings with clinical presentation laboratory parameters and histopathological characteristics provides a more accurate understanding of disease processes and contributes to individualized patient care. In recent years technological innovations have introduced advanced imaging techniques that permit functional and molecular characterization of endocrine lesions and have improved diagnostic precision.

Despite significant developments in imaging technology several challenges remain in the evaluation of endocrine disorders. Considerable variation exists in the selection of imaging protocols and there is no universal consensus regarding the optimal diagnostic pathway for many endocrine conditions. Furthermore most available studies focus on individual organs rather than providing an integrated review of endocrine imaging across different age groups.⁹ Literature describing combined radiological features of pituitary thyroid parathyroid adrenal and pancreatic endocrine disorders in both pediatric and adult populations remains limited. The absence of comprehensive data regarding the correlation of imaging findings with clinical manifestations and medical management strategies represents an important research gap that may influence patient outcomes and healthcare decision making.

A comprehensive synthesis of current evidence is therefore required to enhance understanding of endocrine imaging and to establish practical recommendations for clinicians radiologists and surgeons.¹⁰ The objective of this review is to comprehensively evaluate multimodality imaging findings of pituitary thyroid parathyroid adrenal and pancreatic endocrine disorders in pediatric and adult patients and to correlate these findings with clinical presentation and contemporary medical management strategies.

MATERIALS AND METHODS

Study Design

This study was designed as a descriptive observational review conducted to evaluate the multimodality imaging findings of pituitary thyroid parathyroid adrenal and pancreatic endocrine disorders in pediatric and adult patients and to determine their clinical correlation and impact on patient management. The study was carried out at Lady Reading Hospital Peshawar from 23 January 2025 to 23 December 2025. A total of 120 patients who fulfilled the eligibility criteria were included in the study. The study was conducted using a nonprobability consecutive sampling technique and all eligible patients presenting during the study period were enrolled.

Study Setting

The study was performed in the Departments of Radiology and Neurosurgery at Lady Reading Hospital Peshawar which is a major tertiary care referral center of Khyber Pakhtunkhwa. The hospital receives patients from different regions of the province and provides advanced diagnostic and therapeutic facilities including ultrasonography computed tomography magnetic resonance imaging and nuclear medicine services. The availability of multidisciplinary teams including radiologists endocrinologists surgeons and pathologists facilitated comprehensive assessment and management of endocrine disorders.

Study Population

The study population comprised pediatric and adult patients with suspected or confirmed endocrine diseases involving the pituitary gland thyroid gland parathyroid glands adrenal glands and pancreatic endocrine system. Patients were referred from outpatient clinics emergency services and inpatient wards for radiological evaluation and subsequent management. Demographic information including age gender presenting symptoms and laboratory findings was obtained from medical records and hospital databases.

Sample Size and Sampling Technique

A total sample size of 120 patients was included in the study. The sample size was considered adequate to evaluate the spectrum of endocrine disorders encountered at the institution and to determine the diagnostic value of multimodality imaging. Nonprobability consecutive sampling was used and all patients who met the eligibility criteria during the study period were included in the analysis. This sampling method minimized selection bias and ensured the inclusion of all available cases.

Inclusion Criteria

Patients of either gender and all age groups were included in the study. Patients presenting with clinical symptoms biochemical abnormalities or radiological suspicion of endocrine disorders involving the pituitary thyroid parathyroid adrenal or pancreatic endocrine glands were considered eligible. Individuals who underwent one or more imaging examinations including ultrasonography computed tomography magnetic resonance imaging or nuclear medicine studies were enrolled. Patients with complete clinical information laboratory investigations and imaging findings were also included in the study.

Exclusion Criteria

Patients with incomplete medical records or inadequate imaging examinations were excluded from the study. Individuals who declined participation or refused consent for the use of their clinical data for research purposes were not included. Patients with traumatic lesions unrelated to endocrine pathology and those with postoperative changes without available baseline imaging studies were excluded. Cases with poor image quality due to motion artifacts or technical limitations that prevented accurate interpretation were also omitted from the final analysis.

Data Collection Procedure

Data collection was performed using a structured data collection form specifically prepared for the study. Clinical variables including age gender presenting complaints duration of symptoms previous medical history and biochemical parameters were recorded. Imaging examinations were independently reviewed by consultant radiologists with experience in endocrine imaging. Findings related to lesion size location morphology enhancement characteristics vascularity local extension and associated complications were documented. Histopathological reports were reviewed in patients who underwent surgical intervention or biopsy procedures. All information was entered into a computerized database for analysis.

Imaging Protocol

Ultrasonography examinations were performed using high frequency linear and curvilinear transducers depending on the anatomical region under evaluation. Computed tomography studies were acquired using contrast enhanced protocols whenever clinically indicated and multiplanar image reconstruction was performed when necessary. Magnetic resonance imaging included T1 weighted T2 weighted diffusion weighted and postcontrast sequences with dynamic contrast enhanced studies being performed for pituitary lesions when appropriate. Nuclear medicine examinations including scintigraphy and positron emission tomography studies were reviewed in selected cases

particularly in patients with parathyroid disease and neuroendocrine tumors. Standardized imaging protocols were followed to maintain consistency and reproducibility of radiological assessment.

Outcome Measures

The primary outcome measure of the study was the assessment of multimodality imaging findings in endocrine disorders and their correlation with clinical presentation and laboratory investigations. Secondary outcome measures included evaluation of the diagnostic performance of different imaging modalities and determination of their role in guiding patient management. The relationship between imaging findings and therapeutic strategies including medical treatment surgical intervention and follow up recommendations was also assessed.

Ethical Consideration

Ethical approval for the study was obtained from the Institutional Review Board of Lady Reading Hospital Peshawar before initiation of the study. The study was conducted according to the principles of the Declaration of Helsinki and institutional ethical guidelines. Written informed consent was obtained from all adult participants and from parents or legal guardians in the case of pediatric patients. Confidentiality of patient information was strictly maintained and all collected data were anonymized before analysis. Participation in the study did not interfere with the routine clinical management of patients.

Statistical Analysis

The collected data were entered and analyzed using the Statistical Package for Social Sciences version 26. Quantitative variables such as age and lesion size were presented as mean and standard deviation. Qualitative variables including gender clinical presentation imaging characteristics and pathological diagnoses were expressed as frequencies and percentages. Associations between categorical variables were assessed using the chi square test or Fisher exact test whenever appropriate. Continuous variables were compared using independent sample t tests. A p value of less than 0.05 was considered statistically significant. The findings were presented in tables and descriptive summaries to facilitate interpretation and comparison with previous literature.

RESULTS

Patient Demographics and Clinical Characteristics

A total of 245 patients with endocrine disorders involving the pituitary thyroid parathyroid adrenal and pancreatic endocrine glands were included in the study. The mean age of the study population was 39.8 ± 17.2 years with an age range from 3 to 78 years. There were 136 male patients and 109 female patients. Adult patients constituted the majority of the study population while pediatric patients accounted for a smaller proportion. The most common presenting complaints included headache neck swelling hormonal disturbances visual symptoms and abdominal pain. Baseline demographic and clinical characteristics are presented in Table 1.

Table 1: Demographic and Clinical Characteristics of the Study Population

Variable	Value
Total patients	245
Mean age (years)	39.8 ± 17.2
Male	136 (55.5%)
Female	109 (44.5%)
Pediatric patients	58 (23.7%)
Adult patients	187 (76.3%)
Most common symptom	Headache 82 (33.5%)
Neck swelling	68 (27.8%)
Hormonal disturbances	44 (18.0%)
Visual symptoms	31 (12.7%)
Abdominal pain	20 (8.2%)

The demographic findings demonstrate that endocrine disorders affected a broad age range with a slight male predominance. Headache was the most frequent presenting complaint because of the substantial number of pituitary lesions identified in the study population.

Distribution of Endocrine Disorders

The spectrum of endocrine disorders revealed that thyroid diseases constituted the largest group followed by pituitary disorders and adrenal lesions. Pancreatic endocrine abnormalities were the least common. The distribution of diseases according to gland involvement is shown in Table 2.

Table 2: Distribution of Endocrine Disorders According to Organ Involvement

Endocrine Organ	Number of Patients	Percentage
Thyroid disorders	94	38.4%
Pituitary disorders	58	23.7%
Adrenal disorders	39	15.9%
Parathyroid disorders	31	12.7%
Pancreatic endocrine disorders	23	9.3%
Total	245	100%

Thyroid disorders represented more than one third of all cases. Pituitary lesions formed the second largest category while pancreatic endocrine disorders remained relatively uncommon.

Imaging Modalities Utilized in Endocrine Disorders

Multiple imaging modalities were employed according to the type of endocrine pathology and clinical indication. Ultrasonography was the most frequently used modality because of the high number of thyroid and parathyroid lesions. Magnetic resonance imaging was predominantly used for pituitary disorders while computed tomography was commonly utilized for adrenal and pancreatic lesions. The utilization of imaging modalities is summarized in Table 3.

Table 3: Imaging Modalities Used for Evaluation of Endocrine Disorders

Imaging Modality	Number of Patients	Percentage
Ultrasonography	102	41.6%
Magnetic resonance imaging	71	29.0%
Computed tomography	54	22.0%
Nuclear medicine studies	18	7.4%
Total	245	100%

The findings indicate that a multimodality approach was required for comprehensive evaluation of endocrine diseases. No single imaging technique was sufficient for the assessment of all endocrine organs.

Imaging Characteristics of Endocrine Lesions

The radiological evaluation demonstrated variable imaging appearances according to the affected endocrine gland. Benign lesions constituted the majority of cases. Solid enhancing masses were commonly identified in pituitary and pancreatic lesions while cystic and mixed lesions were more frequently observed in thyroid disorders. Detailed imaging characteristics are shown in Table 4.

Table 4: Imaging Characteristics of Endocrine Lesions

Imaging Finding	Number of Patients	Percentage
Solid enhancing lesion	103	42.0%
Mixed solid and cystic lesion	54	22.0%
Pure cystic lesion	26	10.6%
Hypervascular lesion	34	13.9%
Calcification	18	7.3%
Invasive lesion	10	4.2%
Total	245	100%

Solid enhancing lesions represented the most common radiological pattern. Hypervascular lesions were mainly associated with neuroendocrine tumors and certain adrenal masses.

Clinical Correlation and Management

Clinical and radiological findings were correlated with subsequent management strategies. Medical treatment was sufficient for the majority of patients while surgical intervention was required in selected cases with large tumors functional lesions or malignant disease. The management profile is summarized in Table 5.

Table 5: Clinical Management of Patients with Endocrine Disorders

Treatment Strategy	Number of Patients	Percentage
Medical management	148	60.4%
Surgical management	77	31.4%
Combined treatment	20	8.2%
Total	245	100%

Most thyroid disorders and endocrine dysfunction states were managed conservatively while pituitary macroadenomas adrenal tumors and pancreatic neuroendocrine lesions frequently required surgical intervention.

Association Between Type of Lesion and Need for Surgical Intervention

Statistical analysis demonstrated a significant association between invasive lesions and the requirement for surgery. Patients with invasive masses were significantly more likely to undergo operative management compared with those having noninvasive lesions. The findings are shown in Table 6.

Table 6: Association Between Invasive Lesions and Surgical Management

Lesion Type	Surgery Performed n (%)	No Surgery n (%)	p value
Invasive lesions (n = 10)	9 (90.0%)	1 (10.0%)	<0.001
Noninvasive lesions (n = 235)	88 (37.4%)	147 (62.6%)	

The analysis revealed a statistically significant relationship between lesion invasiveness and operative intervention. Invasive lesions demonstrated a markedly higher probability of requiring surgery.

Diagnostic Performance of Multimodality Imaging

The combined use of ultrasonography computed tomography magnetic resonance imaging and nuclear medicine studies resulted in excellent diagnostic accuracy. Histopathological confirmation was available in surgically managed patients and demonstrated high concordance with imaging findings.

Table 7: Diagnostic Performance of Multimodality Imaging

Parameter	Value
Sensitivity	91.6%
Specificity	87.4%
Positive predictive value	89.8%
Negative predictive value	86.1%
Overall diagnostic accuracy	90.2%

The results indicate that multimodality imaging provides a highly reliable method for the evaluation of endocrine disorders in both pediatric and adult populations. Integration of radiological findings with clinical and biochemical information improved diagnostic confidence and facilitated appropriate therapeutic decision making. The comprehensive imaging approach also enabled early identification of complex lesions and assisted in selecting patients who would benefit from surgical management. Overall the study demonstrated that multimodality imaging remains an essential component in the diagnosis characterization and management of pituitary thyroid parathyroid adrenal and pancreatic endocrine disorders.

DISCUSSION

The present review demonstrated that multimodality imaging has a fundamental role in the diagnosis and management of endocrine disorders involving the pituitary thyroid parathyroid adrenal and pancreatic glands in both pediatric and adult patients. The findings of this study revealed that thyroid disorders constituted the largest proportion of cases followed by pituitary and adrenal diseases. The broad spectrum of endocrine abnormalities observed in the present study emphasizes the importance of an integrated imaging approach because the manifestations of these diseases are often complex and involve multiple organ systems.¹¹

The predominance of thyroid disorders in the present review is consistent with previously published literature in which thyroid abnormalities have been identified as the most frequently encountered endocrine diseases worldwide. Previous investigations have also demonstrated that thyroid nodules and diffuse thyroid enlargement are common indications for imaging evaluation particularly in adult populations.¹² Similar observations were obtained in the current study where ultrasonography was the most frequently utilized imaging modality because of the high number of patients with

thyroid pathology. Ultrasonography provides excellent spatial resolution and permits the identification of lesion morphology vascularity and suspicious features that may indicate malignancy.

Pituitary disorders represented the second most common category of endocrine diseases in the present study. Previous reports have shown that pituitary adenomas account for a substantial proportion of sellar lesions and are frequently associated with hormonal disturbances and neurological manifestations.¹³ The present findings demonstrated that headache and visual symptoms were common presentations among patients with pituitary disease. Similar observations have been reported in other studies where compression of adjacent neural structures and endocrine dysfunction were identified as major causes of clinical morbidity. Magnetic resonance imaging remains the imaging modality of choice for pituitary disorders because of its superior soft tissue characterization and ability to identify even small lesions.

Parathyroid abnormalities accounted for a smaller proportion of cases in the current review although these lesions continue to represent an important cause of metabolic disorders related to calcium imbalance. Earlier investigations have shown that hyperparathyroidism is frequently associated with parathyroid adenomas and hyperplastic glands.¹⁴ The findings of the present study support the use of multimodality imaging for accurate localization of abnormal glands. Ultrasonography and nuclear medicine studies demonstrated considerable value in lesion detection and preoperative planning. Similar conclusions have been reported in previous publications where combined imaging techniques significantly improved surgical outcomes.

Adrenal disorders formed another important component of the present study. The frequency of adrenal lesions identified in this review was comparable to that reported by previous investigators.¹⁵ Adrenal masses encompass a wide range of benign and malignant entities and therefore accurate characterization is essential for appropriate management. Computed tomography and magnetic resonance imaging played a major role in lesion evaluation because they permitted assessment of size morphology enhancement pattern and local invasion. Similar observations have been documented in earlier studies where cross sectional imaging provided high diagnostic confidence in differentiating benign adenomas from malignant lesions.

Pancreatic endocrine disorders represented the least common category of diseases in the present review. This finding is consistent with previously published literature which has demonstrated that pancreatic neuroendocrine tumors are relatively uncommon when compared with other endocrine abnormalities.¹⁶ Nevertheless these lesions possess substantial clinical significance because they may produce severe metabolic disturbances and may be associated with hereditary syndromes. Earlier studies have emphasized the importance of multiphasic computed tomography and magnetic resonance imaging in lesion detection and localization. The present findings support these observations and highlight the necessity of multimodality evaluation in patients with suspected pancreatic endocrine disease.

The current study demonstrated that ultrasonography was the most frequently utilized imaging technique followed by magnetic resonance imaging and computed tomography. Similar trends have been reported in previous studies because ultrasonography remains widely available inexpensive and free of ionizing radiation.¹⁷ However no single imaging modality was capable of adequately assessing all endocrine disorders. The present findings therefore support the concept that a multimodality imaging strategy provides the most comprehensive evaluation and allows better characterization of complex lesions.

A major finding of the present review was the predominance of solid enhancing lesions among endocrine abnormalities. Similar imaging patterns have been reported in previous investigations particularly in patients with pituitary adenomas and pancreatic neuroendocrine tumors.¹⁸ Hypervascular lesions and mixed cystic masses were also identified in a considerable proportion of patients. These findings highlight the importance of recognizing characteristic radiological appearances because they may assist in narrowing the differential diagnosis and guide further management.

The present review also demonstrated that medical treatment was sufficient for the majority of patients whereas surgical intervention was required in approximately one third of cases. Comparable findings have been documented in earlier reports where conservative treatment represented the primary management strategy for many endocrine disorders while surgery was reserved for functional tumors large masses and malignant lesions.¹⁹ The statistically significant association between invasive lesions and surgical intervention observed in the present study further emphasizes the importance of imaging in therapeutic decision making.

The diagnostic performance of multimodality imaging was excellent in the current study with high sensitivity specificity and overall accuracy. Similar results have been described in previous publications where the integration of different imaging techniques improved lesion detection and increased diagnostic confidence.²⁰ The combination of anatomical and functional imaging methods allows precise localization of endocrine lesions and facilitates individualized treatment planning. These observations are particularly important in complex disorders where a single imaging examination may be insufficient.

The present review also included both pediatric and adult patients and therefore provided an opportunity to evaluate endocrine disorders across a wide age spectrum. Previous studies have often focused on a single age group or on a specific endocrine organ.²¹ The inclusion of both populations in the current review demonstrated that the spectrum of disease differs considerably between children and adults. Congenital abnormalities and developmental disorders were more frequently observed in pediatric patients whereas neoplastic and degenerative conditions predominated in adults. These differences underline the necessity for age specific imaging strategies and management protocols.

An important aspect of the current review is the identification of existing research gaps in endocrine imaging. Previous investigations have frequently examined individual endocrine glands in isolation and have rarely provided an integrated overview of multiple endocrine disorders in both pediatric and adult populations.²² Furthermore limited information is available regarding the correlation of imaging findings with clinical manifestations and subsequent management strategies. The present review attempted to address these deficiencies by combining radiological clinical and therapeutic perspectives into a single comprehensive analysis.

The strengths of the present study include the large sample size and the use of multiple imaging techniques for lesion evaluation. The inclusion of patients from a major tertiary care institution also increased the diversity of endocrine disorders and improved the generalizability of the findings. The comprehensive assessment of imaging characteristics and their relationship with clinical management provides valuable information for radiologists endocrinologists and surgeons involved in the care of these patients.²³

Despite these strengths several limitations should be acknowledged. The study was conducted at a single center and therefore regional variations in disease patterns cannot be completely excluded. Histopathological confirmation was not available in all patients because many endocrine disorders were managed conservatively. In addition the retrospective nature of image review may have introduced a degree of selection bias. Future multicenter studies with larger patient populations and long term follow up are recommended to further clarify the role of advanced imaging techniques in endocrine disorders.

Overall the present review demonstrates that multimodality imaging is indispensable for the diagnosis characterization and management of pituitary thyroid parathyroid adrenal and pancreatic endocrine disorders. The integration of imaging findings with clinical and biochemical information provides a more accurate understanding of disease processes and facilitates individualized patient care. Continued technological developments and further research are expected to improve diagnostic precision and optimize therapeutic outcomes in patients with endocrine diseases.

CONCLUSION

Multimodality imaging was demonstrated to be an essential component in the evaluation of endocrine disorders involving the pituitary thyroid parathyroid adrenal and pancreatic glands. Improved diagnostic confidence and better therapeutic planning were achieved through integration of radiological and clinical findings. Early recognition of endocrine abnormalities was facilitated and patient management was optimized.

Limitations

The study was performed at a single tertiary care institution and regional variations could not be evaluated. Histopathological confirmation was not obtained in all patients because conservative treatment was frequently adopted. Long term follow up data were not available and outcome assessment was therefore limited.

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