



EVALUATION OF ADRENAL INCIDENTALOMAS ON ABDOMINAL CT IN A TERTIARY CARE SETTING

Dr. Nitin Bhutada

MD, Department of Radiodiagnosis, Government Medical College, Nagpur

Dr. Nikhil Kumar Singh*

Junior Resident, Department of Radiodiagnosis, Government Medical College, Nagpur *Corresponding Author

ABSTRACT

Background: The widespread use of abdominal computed tomography (CT) has led to a rise in incidental detection of adrenal masses—adrenal incidentalomas (AIs). These lesions may be benign, functional, or malignant, requiring a structured evaluation. **Objective:** To determine the prevalence, radiological features, hormonal activity, management outcomes, and cost implications of adrenal incidentalomas detected on abdominal CT at Government Medical College, Nagpur. **Methods:** In this retrospective study, all abdominal CTs performed between January and December 2024 for non-adrenal indications were reviewed. CT acquisition parameters, lesion size, attenuation, washout characteristics, and biochemical data (overnight dexamethasone suppression test, plasma metanephrines, renin–aldosterone profile) were recorded. Direct costs were obtained from hospital billing. Management followed a tiered, resource-adapted protocol. **Results:** Among 5,000 CT scans, 150 (3%) AIs were identified; mean patient age was 58 ± 12 years; 55% were female. Lesions averaged 2.8 cm (range 1.2–6.8 cm); 85% demonstrated noncontrast attenuation ≤ 10 HU. Functional tumors comprised 10% (6 cortisol–secreting, 5 aldosterone–secreting, 4 pheochromocytomas). Indeterminate lesions were 5%. Twelve patients underwent adrenalectomy; 138 were monitored. Tiered evaluation reduced direct costs by $\sim 40\%$. **Conclusion:** Adrenal incidentalomas occur in 3% of abdominal CTs. A resource-adapted, tiered protocol integrating CT attenuation thresholds and selective hormonal assays safely identifies lesions requiring intervention while curbing costs. Multidisciplinary collaboration and locally tailored guidelines optimize patient care in tertiary centers.

KEYWORDS :

INTRODUCTION

Adrenal incidentalomas (AIs) are masses ≥ 1 cm identified serendipitously during imaging for unrelated clinical concerns. Advances in cross-sectional imaging have led to their more frequent detection, with reported prevalence of 1–5% in abdominal CT cohorts worldwide. These lesions span benign lipid-rich adenomas to hormonally active tumors (subclinical Cushing's, aldosteronoma, pheochromocytoma) and rare adrenal cortical carcinomas (ACC).

Accurate characterization relies on noncontrast CT Hounsfield units (HU), contrast washout kinetics, and focused biochemical testing. However, in resource-limited settings, comprehensive evaluation can impose significant financial burdens on patients and institutions alike. Government Medical College, Nagpur—a high-volume tertiary care center serving central India—faces this challenge daily. We, therefore, devised and tested a tiered diagnostic algorithm emphasizing cost-effectiveness without compromising diagnostic accuracy.

Our aims were to:

1. Assess AI prevalence on routine abdominal CT scans.
2. Describe imaging and hormonal characteristics.
3. Evaluate management outcomes under a locally adapted protocol.
4. Analyze direct costs of workup.
5. Propose practical guidelines for similar resource settings.

MATERIALS AND METHODS

Study Design and Setting

This retrospective observational study included all abdominal CT scans performed at Government Medical College, Nagpur, from January 1 to December 31, 2024, for indications unrelated to adrenal disease.

CT Acquisition Protocol

- **Scanner:** 128-slice multidetector CT (MDCT).
- **Noncontrast Phase:** 120 kVp, 120–200 mAs, slice thickness 3 mm.
- **Contrast Phase:** 100 mL iodinated contrast at 4 mL/s; arterial (25–30 s), venous (60–70 s), and delayed (10 min)

phases for washout studies in selected cases.

- **Image Reconstruction:** Soft tissue and adrenal windows, 1 mm overlap.

Inclusion and Exclusion Criteria

- **Included:** Adults (≥ 18 years) undergoing CT for non-adrenal indications with incidental adrenal masses ≥ 1 cm.
- **Excluded:** Known adrenal disease or prior surgery; CT for adrenal evaluation; incomplete imaging or missing biochemical data.

Imaging Analysis

Radiologists independently reviewed images for:

- Lesion size (maximum axial diameter).
- Noncontrast attenuation (HU).
- Contrast washout: absolute (%) and relative (%) when delayed-phase images available.
- Morphology: heterogeneity, calcification, hemorrhage.
- Bilaterality.

Discrepancies resolved by consensus.

Biochemical Evaluation

- **Cortisol Secretion:** 1 mg overnight dexamethasone suppression test (DST); post-DST cortisol $> 1.8 \mu\text{g/dL}$ flagged.
- **Aldosterone $\rightarrow$ Renin Ratio (ARR):** Screened in hypertensive patients; ARR > 20 plus aldosterone $> 15 \text{ ng/dL}$ considered positive.
- **Catecholamine Secretion:** Plasma free metanephrines; $> 65 \text{ pg/mL}$ (normetanephrine) or $> 45 \text{ pg/mL}$ (metanephrine) positive.

Classification and Management

Lesions were classified as:

- **Benign Non-functional Adenomas:** HU ≤ 10 , DST suppression, normal ARR and metanephrines.
- **Functional Tumors:** Biochemically confirmed hypersecretion.
- **Indeterminate:** Atypical imaging (HU > 10 , heterogeneous enhancement, washout $< 60\%$ absolute) or discordant biochemistry.

Our Tiered Protocol:

1. All patients with AIs underwent noncontrast CT HU measurement and DST.
2. If DST abnormal or clinical suspicion (hypertension, hypokalemia, episodic headaches): proceed to ARR or metanephrines.
3. If HU > 10 or DST abnormal: contrast washout study or MRI.
4. Surgical referral: functional tumors, indeterminate lesions > 4 cm, growth > 1 cm on serial imaging.
5. Conservative monitoring: benign non-functional adenomas ≤ 4 cm; follow-up noncontrast CT at 6 and 12 months.

Cost Analysis

Direct costs (INR) for CT, DST, ARR, metanephrines, contrast phases were extracted from hospital billing. Costs compared between full workup (all tests) and tiered workup approaches.

RESULTS**Prevalence and Demographics**

- **Total CT Scans:** 5,000
- **AIs Detected:** 150 (3%)
- **Mean Age:** 58 ± 12 years (range 19–85)
- **Sex:** 55% female (n = 83), 45% male (n = 67)

Imaging Findings

- **Size:** Mean 2.8 cm (range 1.2–6.8 cm)
- **Laterality:** Right 60% (n = 90), left 35% (n = 52), bilateral 5% (n = 8)
- **Noncontrast Attenuation ≤ 10 HU:** 85% (n = 128)
- **Calcification:** 10% (n = 15)
- **Hemorrhagic Component:** 5% (n = 7)
- **Delayed Washout Available:** 40% (n = 60); benign adenomas showed mean absolute washout of 72%.

Biochemical Results

- **Non-functional Adenomas:** 128 (85%)
- **Functional Tumors:** 15 (10%)
- **Cortisol-secreting:** 6
- **Aldosterone-producing:** 5
- **Pheochromocytoma:** 4
- **Indeterminate:** 7 (5%)

Management and Follow-up

- **Adrenalectomy:** 12 patients (8 functional; 4 indeterminate > 4 cm or growth > 1 cm).
- **Histopathology:** All resected tumors benign; no ACC.
- **Conservative Monitoring:** 138 patients. No lesion grew > 1 cm or became functional over 12 months.
- **Patient Adherence:** 85% completed both 6- and 12-month follow-ups.

Cost Analysis

- **Full Workup Median Cost:** INR 8,500 (~USD 100)
- **Tiered Workup Median Cost:** INR 5,100 (~USD 60)
- **Savings:** ~40% per patient without missed functional diagnoses.

DISCUSSION**Pathophysiology**

Most adrenal incidentalomas are cortical adenomas with cytoplasmic lipid droplets, accounting for low HU values. Autonomous hormone secretion arises from clonal expansion of steroidogenic cells. Pheochromocytomas originate from adrenal medullary chromaffin cells, releasing catecholamines episodically, hence requiring sensitive metanephrine assays.

Regional Guidelines and Resource Adaptation

Endocrine society guidelines recommend extensive hormonal panels and washout studies for all AIs. In central India, out-of-pocket expenses limit patient compliance. Our tiered

protocol—initial noncontrast CT plus DST for all, followed by targeted assays—balances diagnostic yield and cost. This approach can be generalized to similar healthcare settings.

Patient Case Vignettes

1. **Case A:** 62-year-old hypertensive female with 2.4 cm right AI; HU 8, DST suppressed. Managed conservatively; stable at 12 months.
2. **Case B:** 55-year-old male with incidental 5.2 cm left AI; HU 14, DST abnormal. Contrast washout 25%. Plasma metanephrines normal. Underwent laparoscopic adrenalectomy; pathology: benign adenoma.
3. **Case C:** 48-year-old hypertensive woman with 1.8 cm AI; HU 9, DST suppressed, but ARR elevated. Diagnosed aldosterone-secreting adenoma; managed with adrenalectomy; blood pressure normalized.

These vignettes illustrate decision points and outcomes.

Imaging Advances and AI Integration

MRI chemical-shift imaging and PET/CT provide complementary data but increase costs. Artificial intelligence-driven HU analysis and automated washout calculations are emerging, potentially streamlining workflows. Pilot integration of an AI algorithm in our radiology department demonstrated 95% concordance with expert readings, reducing review time by 30%.

Patient Perspectives and Quality of Life

AIs evoke significant anxiety ("tumor" label). Structured counseling—explaining benign nature of most lesions and the rationale for surveillance—improved follow-up adherence from 60% to 85%. Patient satisfaction surveys highlighted the value of clear communication and multidisciplinary support.

Limitations

Single-center, retrospective design limits generalizability. Follow-up beyond 12 months was incomplete for 15% of patients. Cost analysis excluded indirect costs (travel, lost wages). Long-term natural history beyond one year remains to be elucidated.

Future Research Directions

Prospective multicenter trials are needed to validate tiered protocols across diverse populations. Longitudinal studies extending follow-up to 5–10 years will clarify malignant transformation risk. Development of serum biomarkers (miRNAs, steroid metabolites) may reduce imaging reliance. Further validation of AI tools in lesion characterization is warranted.

CONCLUSION

At Government Medical College, Nagpur, adrenal incidentalomas were detected in 3% of abdominal CT scans. The majority were benign, non-functional adenomas safely managed with conservative follow-up. A tiered diagnostic approach, combining noncontrast CT attenuation thresholds, overnight dexamethasone suppression testing, and selective hormonal assays, achieved diagnostic accuracy while reducing direct costs by ~40%. Multidisciplinary collaboration, patient-centered counseling, and incorporation of emerging AI tools further optimize management. We recommend adoption of similar cost-effective protocols in resource-constrained tertiary care settings to ensure judicious use of healthcare resources and maintain high standards of patient care.

REFERENCES

1. Young WF Jr. Clinical practice. The incidentally discovered adrenal mass. *N Engl J Med*. 2007;356(6):601–10.
2. Zeiger MA, et al. American Association of Clinical Endocrinologists and American Association of Endocrine Surgeons guidelines for the management of adrenal incidentalomas. *Endocr Pract*. 2009;15(Suppl 1):1–20.
3. Song JH, Chaudhry FS, Mayo-Smith WW. The incidental adrenal mass on CT:

- prevalence of adrenal disease in 1,049 consecutive adrenal masses in patients with no known malignancy. *AJR Am J Roentgenol.* 2008;190(5):1163-70.
4. Cawood TJ, Hunt PJ, O'Shea D, Cole D, Soule S. Recommended evaluation of adrenal incidentalomas is costly, has high false-positive rates and confers a risk of fatal cancer similar to the risk of the adrenal lesion becoming malignant; time for a rethink? *Eur J Endocrinol.* 2009;161(4):513-27.
 5. Terzolo M, Stigliano A, Chiodini J, et al. AME position statement on adrenal incidentaloma. *Eur J Endocrinol.* 2011;164(6):851-70.
 6. Barzon L, Scaroni C, Sonino N, Fallo F, Paoletta A, Boscaro M. Incidentally discovered adrenal tumors: endocrine and scintigraphic correlates. *J Clin Endocrinol Metab.* 1998;83(1):55-62.