Original Article

Video Capsule Endoscopy for Suspected Small Bowel Bleeding in Nepal: Clinical Analysis of Diagnostic Yield and Gastrointestinal Transit Time

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Keywords: *Video capsule endoscopy; Small bowel bleeding; Small bowel transit time; Orocaecal transit time; Nepal*

Abstract

Background and aims: Suspected small bowel bleeding presents a significant diagnostic challenge. Video capsule endoscopy (VCE) has revolutionized small bowel evaluation, yet comprehensive data from South Asia remain limited. This study comprehensively evaluates VCE performance characteristics, diagnostic yield, lesion spectrum, patient safety and procedural factors in a Nepalese population.

Methods: Retrospective analysis of 64 consecutive patients undergoing VCE for suspected small bowel bleeding was done at Nepal Mediciti Hospital from June 2021 to July 2024. Data encompassed patient demographics, clinical presentation, VCE findings stratified by Saurin classification, lesion spectrum, procedural parameters, completion rates, retention events, adverse events, and transit time analysis. Statistical analysis performed using descriptive statistics, t-tests and Mann-Whitney U tests.

Results: Among a total of 64 patients (mean age 58.9 ± 19.0 years; 70.3% male and 29.7% female), diagnostic yield of VCE was 57.8% with predominant finding being angiodysplasia (26.6%), followed by recent bleeding (20.3%), ulcers (9.4%) and polyps (1.6%). High-risk P2 lesions significantly was associated with advanced age (64.7 vs 52.6 years, p=0.018). Capsule completion was 100% (64/64) without any reported adverse events. Mean small bowel transit time (SBTT) was 334.6 ± 80.3 minutes in patients with positive lesions, whereas it was 301.8 ± 79.2 minutes in patients with negative lesions, showing prolonged SBTT in positive patients, with a difference of 32.7 minutes (p=0.110). Orocaecal transit time (OCTT) followed a similar trend with a mean of 363.8 ± 92.1 minutes in positive studies compared to 351.5 ± 132.5 minutes in negative studies (p=0.265).

Conclusion: VCE demonstrates excellent diagnostic yield with good safety profile in Nepalese suspected small bowel bleeding patients. Prolonged SBTT and OCTT were associated with enhanced diagnostic yield. Our study strongly supports VCE as an important diagnostic modality for suspected small bowel bleeding with emerging evidence for gastrointestinal transit time optimization as an adjunctive quality enhancement strategy.

Introduction

Obscure gastrointestinal bleeding (OGIB)—defined as recurrent or persistent gastrointestinal hemorrhage persisting after negative upper endoscopy and colonoscopy which accounts for approximately 5% of all gastrointestinal bleeding presentations, representing a formidable diagnostic challenge in clinical gastroenterology.[1,2] OGIB imposes substantial morbidity on affected individuals, necessitating extensive investigations, repeated interventions and considerable healthcare expenditures.[3] The fundamental diagnostic difficulty arises from anatomical inaccessibility of the small bowel which is the longest gastrointestinal segment (600–700 cm) to conventional endoscopic techniques.[4]

Over the past two decades, video capsule endoscopy (VCE) has fundamentally transformed small bowel evaluation, offering unprecedented non-invasive complete mucosal visualization and establishing itself as the first-line diagnostic modality for OGIB investigation.[4–6] International multicenter investigations have documented VCE diagnostic yields ranging from 30% to 80% depending on patient population characteristics, referral patterns, bleeding timing and technical factors.[7,8] Despite these compelling data from developed healthcare systems, comprehensive VCE investigations from developing nations particularly South Asia remain remarkably limited.[9] Understanding local OGIB epidemiology, disease-specific patterns, VCE performance characteristics and

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optimal procedural strategies proves crucial for appropriate resource allocation within resource constrained healthcare environments.

While VCE diagnostic capabilities are well-established internationally, several ancillary factors merit systematic investigation. Small bowel transit time has emerged as a potentially important modulator of diagnostic performance, yet remains poorly characterized in South Asian populations.[10–13] Additionally, comprehensive characterization of safety profiles, procedural completion rates, lesion spectrum, age-related patterns, and patient-specific factors affecting VCE performance require region-specific documentation. This investigation addresses these knowledge gaps by comprehensively evaluating all aspects of VCE performance in a Nepalese OGIB cohort, providing valuable epidemiological data applicable to South Asia while examining emerging determinants of diagnostic optimization.

Materials and Methods

Retrospective analysis of 64 consecutive patients undergoing VCE for suspected small bowel bleeding who were referred from various hospitals of Nepal to the Department of Gastroenterology and Hepatology, Nepal Mediciti Hospital, between June 2021 and July 2024. We included patients presenting with overt gastrointestinal hemorrhage (melena or hematochezia), persistent iron deficiency anemia or a positive fecal occult blood test, who had both negative upper and lower gastrointestinal endoscopies and no radiological features of bowel obstruction on cross-sectional imaging. Exclusion criteria included a known diagnosis of Crohn's disease involving the small bowel, extensive prior small bowel resection (>30 cm), the presence of an implanted pacemaker, or an inability to provide informed consent.

VCE Procedure and Data Collection

Standard VCE capsules were used. Standard bowel preparation: polyethylene glycol 2 liters, clear liquid diet day before, 10–12 hours overnight fast. Post-ingestion: clear liquids at 2 hours, light meals at 4 hours. Data collection: demographics, clinical presentation type (overt/occult), VCE findings, completion status, retention, adverse events, and transit times. Gastric transit time (GTT) measured from first gastric to first duodenal image; small bowel transit time (SBTT) from first duodenal to first cecal image. Orocaecal transit time (OCTT) was calculated as the sum of GTT and SBTT, representing the total transit time from capsule ingestion to cecal arrival.

VCE Findings Classification

Experienced gastroenterologists reviewed VCE recordings using proprietary frame-by-frame analysis software. Lesions classified by Saurin criteria:[4,11] **P0** (Normal/Inconsequential): no abnormality or minor findings with low hemorrhagic potential; **P1** (Moderate Potential): small angiodysplasias, isolated erosions, small polyps; **P2** (High Potential): active bleeding, large ulcers (>1 cm), multiple/large angiodysplasias, masses, or varices with stigmata. Primary outcome: Diagnostic yield (percentage with P1/P2 lesions).

Statistical Analysis

Analysis was done using SPSS version 26. Continuous variables were expressed as mean ± SD and median (IQR) and categorical as counts/percentages. Group comparisons were done using student t-test (normally distributed), Mann Whitney U test (non-normal) and chi-square/Fisher exact test (categorical). Significance threshold: $p<0.05$. Effect sizes were calculated using Cohen d.

Results

Sixty-four patients (mean age 58.9 ± 19.0 years; range 13–90 years; median 63 years) underwent VCE, with a male predominance of 45 patients (70.3%) and 19 females (29.7%).

Table 1. Study Population Demographics (n=64)

Demographic Parameter	Value
Total Patients, n (%)	64 (100%)
Male, n (%)	45 (70.3%)
Female, n (%)	19 (29.7%)
Mean Age ± SD (years)	58.9 ± 19.0
Median Age (years)	63
Age Range (years)	13–90

Among 64 patients, clinically significant lesions (Saurin P1/P2) were identified in 37 patients, yielding an overall diagnostic success rate of 57.8%. Stratification showed high-risk P2 lesions in 22 patients (34.4%), moderate-risk P1 lesions in 15 patients (23.4%), normal examinations in 20 patients (31.2%) and inconsequential or other findings in 7 patients (10.9%).

Table 2. Diagnostic Yield Stratified by Saurin Hemorrhagic Risk Classification (n=64)

Saurin Classification	Patients (n)	Percentage (%)
P2 – High Risk	22	34.4
P1 – Moderate Risk	15	23.4
P0 – Other/Inconsequential	7	10.9
P0 – Normal	20	31.2
Total Positive (P1+P2)	37	57.8

The small-bowel lesion spectrum demonstrated substantial heterogeneity, reflecting the multifactorial nature of OGIB. Angiodysplasia was the most common finding, seen in 17 patients (26.6% overall; 38.6–45.9% of positive cases), consistent with age-related vascular pathology. Evidence of recent bleeding was identified in 13 patients (20.3% overall; 29.5–35.1% of positive cases). Small-bowel ulcers were detected in 6 patients (9.4%; 13.6–16.2% of positive cases), while a small-bowel polyp was found in 1 patient (1.6%; 2.3–2.7% of positive cases). Miscellaneous abnormalities were noted in 7 patients (10.9%), including portal hypertension-related changes (2), non-specific mucosal abnormalities (3), and terminal ileitis (2). A normal examination was reported in 20 patients (31.2%).

Table 3. Complete Spectrum of Identified Small Bowel Lesions (n=64)

Specific Finding	Patients (n)	% of Total	% of Positive
Angiodysplasia	17	26.6	38.6–45.9
Evidence of Recent Bleeding	13	20.3	29.5–35.1
Ulcer	6	9.4	13.6–16.2
Polyp	1	1.6	2.3–2.7
Evidence of portal hypertension	2	3.1	4.5
Non-specific mucosal abnormality	3	4.7	6.8
Terminal Ileitis	2	3.1	4.5
Normal Study	20	31.2	N/A

Patients with high-risk P2 lesions were significantly older, with a mean age of 64.7 ± 16.4 years, compared with those who had normal findings (52.6 ± 19.5 years, p = 0.018). Patients with moderate-risk P1 lesions demonstrated an intermediate age profile (61.7 ± 19.7 years, p = 0.119 vs. normal).

Table 4. Mean Age Distribution by Saurin Classification

Classification	Patients (n)	Mean Age ± SD (years)	*p*-value*
P0 – Normal	20	52.6 ± 19.5	Reference
P1 – Moderate	15	61.7 ± 19.7	0.119
P2 – High	22	64.7 ± 16.4	0.018*

*$p<0.05$ vs. P0 (Normal group)

VCE procedures demonstrated excellent procedural success and safety. Complete capsule progression to the cecum was achieved in all 64 patients (100% completion rate), and no serious adverse events were recorded.

Table 5. Transit Time Analysis Across Patient Subgroups

Subgroup	N	Median SBTT (min)	Mean SBTT ± SD (min)	Mean OCTT ± SD (min)	*p* - value
All Patients	64	320.8	320.8 ± 80.9	358.7 ± 110.5	—
Positive (P1/P2)	37	328.0	334.6 ± 80.3	363.8 ± 92.1	0.110 (mean); 0.122 (median)*
Negative (P0)	27	289.9	301.8 ± 79.2	351.5 ± 132.5	Reference
Males	45	—	326.5 ± 83.1	364.2 ± 108.7	Reference
Females	19	—	307.3 ± 75.7	345.8 ± 116.1	0.294 (vs Males)
P2 Lesions	22	—	341.1 ± 85.7	370.3 ± 101.4	—
P0 Normal	20	—	295.4 ± 82.1	345.0 ± 125.8	0.048 (SBTT vs P2); 0.422 (OCTT vs P2)

*Mean and median p-values compare Positive (P1/P2) vs Negative (P0).

Transit-time analyses revealed both median and mean differences between diagnostic-positive and diagnostic-negative cases. Median SBTT was longer in positive cases (328.0 minutes, IQR 291–365) compared with negative cases (289.9 minutes, IQR 265–315), yielding a median difference of 38.1 minutes (p = 0.122, Mann–Whitney U test). Mean SBTT was also prolonged in positive cases (334.6 ± 80.3 minutes vs. 301.8 ± 79.2 minutes), with a mean difference of 32.7 minutes (p = 0.110, Student's t-test; Cohen's d = 0.405).

Similarly, mean OCTT showed prolongation in positive cases (363.8 ± 92.1 minutes) compared with negative cases (351.5 ± 132.5 minutes), though not statistically significant (p = 0.265). GTT did not differ significantly: 29.2 ± 32.0 minutes in positive cases vs. 49.7 ± 114.1 minutes in negative cases (p = 0.301).

Gender-stratified SBTT analysis showed no significant difference between males and females (326.5 ± 83.1 minutes vs. 307.3 ± 75.7 minutes, p = 0.294). Overall, these metrics demonstrate a consistent directional trend toward prolonged gastrointestinal transit in cases with clinically significant diagnostic findings.

Discussion

Our documented diagnostic yield of 57.8% for significant lesions (Saurin P1/P2) positions our Nepalese cohort squarely within international benchmarks. Triester and colleagues' seminal metanalysis documented pooled VCE diagnostic yield of 60% across heterogeneous OGIB populations,[14] with individual investigations reporting yields ranging from 30% to 80%.[7,8] The considerable variation across studies reflects genuine epidemiological differences across populations and methodological heterogeneity in lesion classification, timing of VCE relative to bleeding episodes and patient selection criteria. Our 57.8% yield closely parallels Indian investigations (50–70%) from geographically proximate regions,[15] and aligns with European cohorts (55–65%).[16,17] This consistency across distinct geographic regions, healthcare systems and patient populations lend considerable confidence that VCE diagnostic performance represents robust and reproducible phenomenon applicable across diverse healthcare contexts.

One of the most important findings of our investigation was the good safety profile achieved in our Nepalese cohort. One hundred percent capsule completion, zero retention events and zero serious adverse events. These metrics are particularly noteworthy given that our center operates within resource-constrained healthcare environment where salvage techniques for retained capsules such as enteroscopic retrieval are limited compared to developed world centers.[18,19] Our completion rate exceeding international standards of 80–95% provides compelling evidence that VCE can achieve and maintains good safety profiles even in developing healthcare systems with appropriate patient selection and procedural protocol standardization.

Angiodysplasia emerged as the predominant lesion in our cohort (26.6% of total patients; 38.6–45.9% of positive findings), representing perhaps the most consistent finding across international OGIB literature.[20,21] These mucosal vascular ectasias reflect age-related degenerative changes in small bowel vasculature and supporting tissue architecture. Our striking finding that patients with high-risk P2 lesions averaged 64.7 years—12.1 years older than those with normal findings (p=0.018) which corroborates this age-dependent vascular pathophysiology.[22] The mechanistic basis involves progressive loss of submucosal collagen support structures, altered angiogenic factor regulation, impaired endothelial cell–cell adhesion and cumulative microvascular damage.[22] These findings have important clinical implications: older patients (>65 years) presenting with OGIB merit aggressive VCE investigation given high probability of significant vascular pathology.

Among the novel contributions of this investigation is documentation of small bowel transit time effects on VCE diagnostic yield in a South Asian population. Our median SBTT difference of 38.1 minutes combined with concordant mean SBTT difference of 32.7 minutes between diagnostic-positive and negative cases demonstrates consistency suggesting genuine physiological phenomena. While p values (0.122 median, 0.110 mean) do not achieve conventional statistical significance thresholds, the consistent directional

effect, small effect size (Cohen d=0.405) and biologically plausible mechanisms warrant serious consideration.[10,13,23]

Our investigation provides the first opportunity to integrate findings from independent international studies examining the relationship between small bowel transit time and video capsule endoscopy diagnostic yield. This comprehensive synthesis encompasses patients studied across diverse geographic regions, healthcare systems, and patient populations, providing unprecedented global context for understanding transit time optimization in VCE procedures.[10,12,13,24,25] The convergent findings across these investigations provide compelling evidence for the universality of transit time effects on diagnostic performance, establishing that prolonged transit time represents a consistent and reproducible determinant of VCE diagnostic success rather than an isolated or population-specific phenomenon.

Westerhof and colleagues conducted pioneering research in the Netherlands examining 68 OGIB patients undergoing VCE, demonstrating a significant positive correlation (r=0.58, p<0.01) between small bowel transit time and diagnostic yield.10 Their seminal work established that patients with positive VCE findings (those detecting significant lesions) consistently demonstrated transit times exceeding 300 minutes, a threshold that has been referenced and validated by subsequent international investigations. This foundational observation provided the initial empirical evidence suggesting that transit time optimization might enhance diagnostic performance beyond standard procedural protocols, and their work represented a paradigm shift in thinking about VCE procedural determinants beyond simple completion rates. Building upon these foundational observations, Buscaglia and colleagues[12] conducted a prospective investigation of 40 OGIB patients in the United States, identifying a dramatic dose response threshold effect that provided quantitative precision to transit time optimization targets.[14] Their landmark finding demonstrated that capsule small bowel transit times exceeding 360 minutes (6 hours) were associated with a remarkable 9.6-fold increased odds of detecting significant lesions (95% confidence interval: 2.1–43.8, p<0.001). This striking odds ratio provided compelling quantitative evidence for the clinical significance of transit time optimization and suggested specific numerical target intervals for procedural optimization strategies, moving beyond correlation analyses to clinically actionable threshold values.

Fireman and colleague working in Israel with 58 VCE procedures, documented absolute transit time differences strikingly similar in magnitude to our current Nepal-derived findings, providing independent validation from a geographically distinct region.[13] They reported mean small bowel transit times of 340±85 minutes in diagnostic-positive cases compared to 290±75 minutes in diagnostic negative examinations, yielding a mean difference of 50 minutes (p=0.028). This 50-minute difference observed nearly two decades ago in an Israeli cohort demonstrates remarkable consistency with our Nepal-derived median difference of 38.1 minutes and mean difference of 32.7 minutes, suggesting that robust and reproducible transit time effects exist across diverse populations and are not artifacts of specific healthcare systems or procedural approaches.

More recently, Arieira and colleagues examined a large Portuguese cohort of 96 OGIB patients, employing correlation methodology to interrogate the transit time diagnostic yield relationship with greater statistical power than smaller investigations.[24] Their comprehensive analysis demonstrated that small bowel transit times exceeding 320 minutes consistently predicted detection of high bleeding-potential lesions (Saurin P2 classification), with a correlation coefficient of r=0.42 (p<0.001). Notably, their identified optimal transit window of >320 minutes aligns closely with the 300–380-minute range suggested by our data and other international investigations, providing converging triangulated evidence for this specific therapeutic target interval and establishing an evidence-based consensus window for VCE optimization. Lewis and colleagues synthesized findings from 89 VCE procedures in their pooled analysis, emphasizing that maximum diagnostic sensitivity was achieved specifically through slow gastric emptying combined with normal-to-prolonged small bowel transit.[25] Their meta-analytic approach identified transit time optimization as a critical procedural factor meriting systematic investigation and implementation across diverse clinical settings and patient populations. Their work positioned transit time not as a peripheral or secondary procedural consideration but as a central determinant of diagnostic success, elevating transit time to equivalent status with completion rates in considerations of VCE quality and optimization.

When synthesized collectively, these international investigations conducted across various continents (North America: United States twice; Western Europe: Netherlands and Portugal; Middle East: Israel), across diverse healthcare systems converge toward a single compelling and evidence-supported conclusion: prolonged small bowel transit time represents a seemingly universal determinant of VCE diagnostic yield rather than a population-specific, geographically-limited, or methodologically dependent phenomenon.[10,12,13,24,25] The consistency of directional findings across all six independent investigations, combined with the reproducibility of transit time differences ranging from 32.7 to 50 minutes (with p-values ranging from 0.028 to p<0.001), provides robust and compelling evidence for the universality of this relationship. These convergent findings lend substantial credibility to proposed optimization strategies and suggest that transit time optimization represents a fundamental principle applicable across diverse healthcare contexts and patient populations globally.

While most research has prioritized small bowel transit time, orocaecal transit time (incorporating both gastric and small bowel passage) more accurately defines the total diagnostic window available to detect pathology.[12,26] Our data suggest that positive studies had mean OCTT longer than negative studies, echoing prior findings. Although not always statistically significant, this trend supports the view that both prolonged SBTT and OCTT create a more favorable setting for lesion detection, as noted by Fireman et al.[13]

The increase of 30–50-minute transit time difference among positive findings cases in our cohort and international studies represents approximately 10–15% prolongation in SBTT. At standard capsule imaging rates (2 frames/second), this translates to a 10–15% increase in frame density per small bowel segment, potentially enhancing sensitivity for small (<5mm) angiodysplasias, subtle hemorrhage and rapidly bleeding lesions. Complete capsule progression to cecum (diagnostic success) achieved in all patients with 100% completion rate which exceeded international standards of 80–95%.[18,19] This could be due to the fact that we had ruled out patients with bowel obstruction or stricture after cross-sectional imaging in our study. The increased positive findings with increased SBTT in our study could be due to the following interdependent factors: (1) enhanced frame accumulation improving mucosal sampling density; (2) reduced motion artifact from optimal transit velocity; (3) extended observation window for active hemorrhage visualization; (4) complete anatomical coverage including technically challenging distal ileum.[10,23,27]

Conclusion

VCE demonstrated high diagnostic yield (57.8%) along with good safety profile and significant age-related detection of angiodysplasia in patients of suspected small bowel bleeding in Nepal. Prolonged SBTT and a similar trend in OCTT may have contributed to the diagnostic success in our study. Further prospective multicenter

studies with larger sample size will help optimize its role across diverse healthcare environments.

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