The Specimen Handling of GI Mucosal Biopsy: A Simple and Effective Quality Improvement Initiative

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Objective: *Histologic diagnostic foci on GI mucosal biopsy may be patchy. Therefore, slides with good orientation of mucosal tissue in a perpendicular plane and demonstrating an entire layer of mucosa will increase the diagnostic yield. Department of Pathology Faculty of Medicine Siriraj Hospital has launched the two steps quality improvement program and a parallel research aiming to demonstrate the importance of tissue orientation of GI biopsy.*

Material and Method: *Step 1: quality improvement was introduced at the pathology laboratory. Embedding technicians were trained to embed tissue in perpendicular plane. Step 2: quality improvement at endoscopy unit, endoscopic nurses were trained to spread the biopsy tissues on a mesh with upward mucosal surface before fixing them into formalin. Three sets of 50 consecutive cases of GI mucosal biopsy were retrieved from before, after step 1, and after step 2. The number of high quality slides, diagnostic discrepancy, and diagnostic confidence of the pathologists were compared between the three sets.*

Results: *High quality slides were significantly increased from 23 (46%) before quality improvement to 30 (60%) after step 1, and 37 (74%) after step 2 (p-value = 0.017). Diagnostic discrepancy was decreased while diagnostic confidence was increased after quality improvement.*

Conclusion: *The quality of GI mucosal biopsy slides were significantly improved after a simple and feasible program indicating that both educating and training of medical personnel for tissue procurement and tissue processing are crucial. Higher quality of slide can lead to more accurate diagnosis and fewer laboratory resources used.*

Keywords: *GI mucosal biopsy, Quality improvement, Specimen handling*

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Gastrointestinal (GI) mucosal biopsy plays important roles in several clinical situations. Many specific diagnoses can be reached from biopsy of patients with or without endoscopic abnormality. Both endoscopic and histologic diagnostic foci may be patchy or discontinuous in distribution. In order to adequately evaluate various inflammatory disorders, multiple samples with an optimal number of biopsies were recommended[1]. Moreover, histologic diagnostic foci in some inflammatory disorders may exclusively locate in certain areas of mucosa, e.g. on the surface of the mucous layer, tip of the villi or deep within the crypt epithelium. Thus, slides providing good orientation of mucosal tissue in a perpendicular plane and demonstrate an entire layer of mucosa from the mucosal surface to the muscularis mucosae would increase the diagnostic yield. In polypoid lesions, larger pieces of biopsy[2] and additional step-sections[3-6] could increase detection rates of dysplasia or diagnostic abnormality since the diagnostic foci may present deeper in the tissue. Thus, slides containing multiple levels of tissue sections may increase the diagnostic yield in these cases.

Siriraj Hospital, a 2,200-bed referral university hospital, has a large GI endoscopy unit with a high volume of GI mucosal biopsy service. Previously the importance of appropriate handling and processing procedures for histopathology tissue sections has not been well-emphasized on the quality. A certain number of slides contained only one or two sections of tissue in a distorted and unorientated plane, which may compromise diagnostic decision in some situations. In this study, we aimed to compare the quality of slide after introducing a 2-step quality improvement program and to demonstrate

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an importance of tissue orientation in GI mucosal biopsy.

Material and Method

Step 1 quality improvement was introduced at Siriraj pathology laboratory in November 2010. Specimens of GI mucosal biopsy were identified and submitted, not to exceed five tissue pieces in each cassette. Embedding technicians were trained to recognize GI mucosal biopsy and to embed tissue in perpendicular plane. At least four tissue sections per slide were performed from each paraffin block. This step focused on techniques in pathology laboratory that aimed to place tissue in perpendicular plane and to produce adequate tissue sections per slide. Step 2 quality improvement was introduced at Siriraj endoscopy unit. Endoscopic nurses were trained to recognize mucosal surface and to spread the biopsy tissues on a mesh, with an upward mucosal surface, before fixing them in formalin. This technique aimed to stretch the tissue from a curling irregular shape into a straight shape that could facilitate the embedding technicians to place the tissue in perpendicular plane. While implementing step 2 quality improvement, step 1 quality improvement was simultaneously maintained (Table 1).

Three sets of 50 consecutive cases of GI mucosal biopsy were retrieved from the Pathology Department database. The first set was collected before implementation of the improvement program. The second and third sets were collected after step 1 and step 2 quality improvements. Each case included one H&E original slide and one H&E step section. If the step-sectioned slide was not readily available, it was produced for the study. Quality of all slides was evaluated by a third year pathology resident and a general pathologist. Total number of tissues and the number of tissues in perpendicular plane of each slide were assessed. Slides that contained perpendicular tissue pieces more than 50% were considered as "high quality" slides. Any conflict in reporting was resolved by consensus. In order to demonstrate the importance of tissue orientation of GI mucosal biopsy, comparison of diagnosis between the original slide and the step section slide was performed by a third year pathology resident, a general pathologist, and another GI pathologist. Diagnostic discrepancies between these two slides in each case were recorded as (1) marked difference (missing any diagnostic foci e.g. *H. pylori* infection, metaplastic foci, dysplastic foci or malignancy), (2) moderate (differences in degree of disease severity), (3) minor/none (differences only in diagnostic terminology or no difference). The confidence of diagnosis was also recorded among three observers.

SPSS version 18 was used for statistical analysis. Pearson's Chi-square test was applied to compare the proportion of high quality slides among the steps of quality improvement. $P<0.05$ was considered statistical significance. Other data were collected and descriptively presented. This study was approved by the Siriraj Institution Review Board.

Results

Distribution of biopsy location and disease process are shown in Table 2. The most frequent location was the stomach, followed by the colon.

Number of high quality slide was progressively increased from 23 (46%) to 30 (60%) after step 1 improvement and reached 37 (74%) after step 2 improvement (Fig. 1-3). The improvement among three sets reached statistical significance ($p = 0.017$) with the highest difference between the group before quality improvement and the group after step 2 improvement ($p = 0.004$).

Table 1. Process at pathology laboratory and endoscopy unit

	Endoscopy unit	Pathology laboratory
Before quality improvement	Fix tissue in formalin	Grossing: put all tissue pieces in one cassette Embedding: embed all tissue pieces randomly (no orientation) Cutting: cut 1-2 sections per slide
Step 1 improvement	Fix tissue in formalin	Grossing: put 4 or less tissue pieces in one cassette Embedding: orientate tissue plane before embed in perpendicular plane Cutting: cut 4 or more sections per slide
Step 2 improvement	Spread tissue on mesh before fix in formalin	Same as step 1

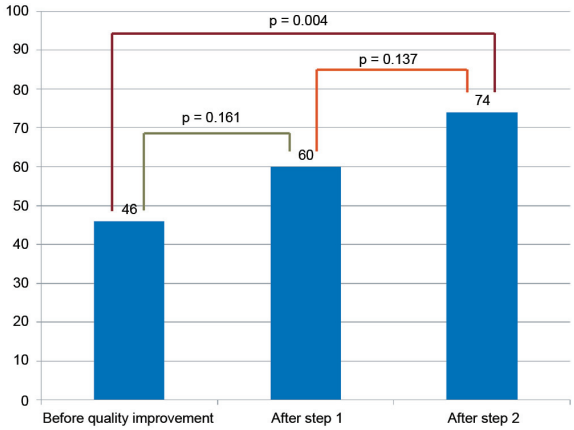

Fig. 1 Percentage of high quality slides.

Diagnostic discrepancy seemed to be decreased after the quality improvement. Minor or no diagnostic discrepancy increased from 101 (67.3%) before quality improvement to 110 (73.3%) after step 1 improvement, and 110 (73.3%) after step 2 improvement out of total 150 examinations from all observers (Table 3). Especially, the diagnosis from GI pathologist, minor/none diagnostic discrepancy increased from 34 (68%) to 38 (76%), and 40 (80%), respectively.

In the present study, confidence in rendering diagnosis from providing slides after quality improvement also tended to increase. Both resident and general pathologist reported more confidence with the slides prepared after quality improvement. Diagnosis made with least confidence by the resident decreased from 15 (30%) before quality improvement to six (12%) after step 1 improvement and eight (16%) after step 2 improvement, and by the general pathologist from three (6%) before quality improvement to 0 (0%) after quality improvement (Table 4).

Discussion

The present study demonstrated that additional proper handling of GI mucosal biopsy could significantly improve quality of slides. By comparing before and after step 2 quality improvement, a dramatic increase in number of high quality slides was observed. The improvement program was very simple and feasible. The step 1 improvement program (Table 1) at pathology laboratory required only minimal training of technicians. The key success of this step required an identification of GI mucosal biopsy before embedding the biopsy tissue and a consistent performance of such techniques. It is important to note that not every type of tissue biopsy needs specific attention; for instance, liver needle core biopsy or bone marrow biopsy do not require any tissue orientation for microscopic examination. Identification of all GI mucosal biopsy by only eye inspection is not practically possible especially in a very high volume load pathology center. This problem could easily be solved by applying an additional simple label in the cassette blocks together with the properly arrangement of tissue in perpendicular plane while embedding before the paraffin set, the number of tissue pieces should not exceed 5 tissues per block. Step 2, improvement program at endoscopy unit (Table 1), required more training and greater experience since endoscopic nurses usually were unfamiliar with orienting and stretching mucosal biopsy techniques. Acquiring and retaining these skills needed constant practice. However, with the observed benefits from this study, there is still some concern that step 2 improvement might be too much time consuming in the endoscopic theater, the authors highly encourage every endoscopy unit to implement this practice as we had observed the skillful nurses could stretch a piece of tissue within less than 30 seconds and could carry the scope while endoscopists further apply scope simultaneously.

Table 2. Distribution of biopsy location and disease process

	Before quality improvement n = 50 (%)	After step 1 n = 50 (%)	After step 2 n = 50 (%)	Total n = 150 (%)
Site of biopsy				
Esophagus	7 (14.0)	4 (8.0)	1 (2.0)	12 (8.0)
Stomach	24 (48.0)	23 (46.0)	17 (34.0)	64 (42.7)
Small bowel	2 (4.0)	4 (8.0)	5 (10.0)	11 (7.3)
Colon	17 (34.0)	19 (38.0)	27 (56.0)	63 (42.0)
Disease process				
Inflammatory	27 (54.0)	22 (44.0)	21 (42.0)	70 (46.7)
Neoplastic	23 (46.0)	28 (56.0)	29 (58.0)	80 (53.3)

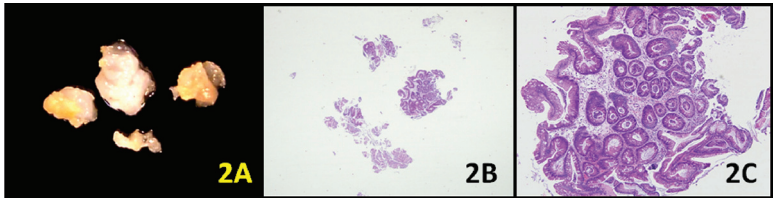

Fig. 2 Before quality improvement, the tissues were submitted in curling irregular shape (2A) leading to poor tissue orientation on the slide (2B, 2C).

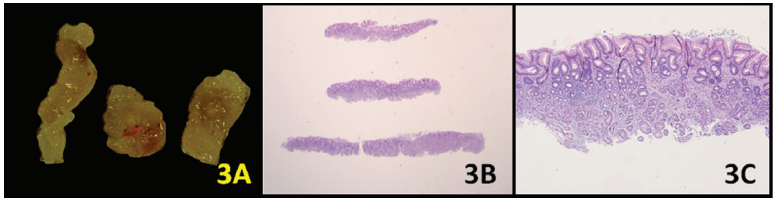

Fig. 3 After quality improvement, the tissues were stretched (3A) leading to good tissue orientation on the slide (3B, 3C).

Table 3. Diagnostic discrepancy between the original slide and the step section slide

Difference in diagnosis	Before quality improvement			After step 1			After step 2		
	Marked n (%)	Moderate n (%)	Minor/none n (%)	Marked n (%)	Moderate n (%)	Minor/none n (%)	Marked n (%)	Moderate n (%)	Minor/none n (%)
Resident	13 (26.0)	5 (10.0)	32 (64.0)	4 (8.0)	8 (16.0)	38 (76.0)	4 (8.0)	9 (18.0)	37 (74.0)
General pathologist	9 (18.0)	6 (12.0)	35 (70.0)	9 (18.0)	7 (14.0)	34 (68.0)	14 (28.0)	3 (6.0)	33 (66.0)
GI pathologist	10 (20.0)	6 (12.0)	34 (68.0)	6 (12.0)	6 (12.0)	38 (76.0)	3 (6.0)	7 (14.0)	40 (80.0)
Total	32 (21.3)	17 (11.3)	101 (67.3)	19 (12.7)	21 (14.0)	110 (73.3)	21 (14.0)	19 (12.7)	110 (73.3)

GI = gastrointestinal

Table 4. Confidence in rendering diagnosis among observers

Confidence	Before quality improvement			After step 1			After step 2		
	Most n (%)	Moderate n (%)	Least n (%)	Most n (%)	Moderate n (%)	Least n (%)	Most n (%)	Moderate n (%)	Least n (%)
Resident	31 (62.0)	4 (8.0)	15 (30.0)	31 (62.0)	13 (26.0)	6 (12.0)	30 (60.0)	12 (24.0)	8 (16.0)
General pathologist	32 (64.0)	15 (30.0)	3 (6.0)	42 (84.0)	8 (16.0)	0 (0)	41 (82.0)	9 (18.0)	0 (0)
GI pathologist	44 (88.0)	6 (12.0)	0 (0)	47 (94.0)	3 (6.0)	0 (0)	41 (82.0)	7 (14.0)	2 (4.0)
Total	107 (71.3)	25 (16.7)	18 (12.0)	120 (80.0)	24 (16.0)	6 (4.0)	112 (74.7)	28 (18.7)	10 (6.7)

Our study also demonstrated that the high quality slides could result in better accurate diagnosis. The GI pathologist, the most experienced in this field, reported progressively decreased in diagnostic discrepancy after step 1 and step 2 quality improvements. Feeling confidence in making diagnosis on the provided slides may have the effect on step sections request. After step 1 and step 2 quality improvements, the resident and general pathologist gained more confidence. This observation implies that in a routine practice situation, the step section slides would be less requested, thus the workload will be reduced which can lead to shorter turn-around time for the pathology laboratory.

The importance of tissue orientation and proper technique in handling GI mucosal biopsy specimen were not overstated. The technique is simple and feasible. Pathology laboratory without direct communication with the endoscopy unit can still at least apply step 1 quality improvement and instantly realizes the benefit from it. In a larger academic institution, cooperation between pathology laboratory and endoscopic unit for installing these two steps for quality improvement would enhance the quality of slides and result in a better pathology report with faster turn-around time.

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Potential conflicts of interest

None.

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การพัฒนาคุณภาพการจัดการชิ้นเนื้อเยื่อบุทางเดินอาหาร

เทอดเกียรติ ตรงวงศา, จันทิมา แทนบุญ, อัครินทร์ นิมมานนิตย์, อนัญญา พงษ์ไพบูลย์

วัตถุประสงค์: การตรวจทางพยาธิวิทยาจากชิ้นเนื้อเยื่อบุทางเดินอาหารจำเป็นต้องมีการจัดวางชิ้นเนื้อให้อยู่ในแนวระนาบตั้งฉากกับชั้นผิวเยื่อบุ เพื่อให้เห็นส่วนประกอบของเยื่อบุได้ครบทุกชั้น เนื่องจากรอยโรคอาจมีการกระจายตัวไม่สม่ำเสมออยู่ในแต่ละชั้นของเนื้อเยื่อ การจัดการให้ชิ้นเนื้ออยู่ในระนาบที่เหมาะสมจะช่วยให้การตรวจวินิจฉัยโรคมีความแม่นยำมากขึ้น

วัสดุและวิธีการ: ภาควิชาพยาธิวิทยา คณะแพทยศาสตร์ศิริราชพยาบาล ได้ดำเนินการพัฒนาคุณภาพชิ้นเนื้อเยื่อบุทางเดินอาหารและทำการวิจัยเพื่อศึกษาความสำคัญของการตั้งระนาบชิ้นเนื้อ กระบวนการพัฒนาขั้นที่ 1 ดำเนินการที่ห้องปฏิบัติการพยาธิวิทยาโดยการแยกชิ้นเนื้อเยื่อบุทางเดินอาหารและฝึกอบรมให้บุคลากรจัดวางชิ้นเนื้อให้อยู่ในระนาบตั้งฉาก กระบวนการพัฒนาขั้นที่ 2 ดำเนินการที่ห้องส่องกล้องทางเดินอาหารโดยฝึกอบรมให้บุคลากรคลี่ชิ้นเนื้อวางลงบนแผ่นตาข่ายก่อนใส่ลงในฟอร์มาลินและชิ้นเนื้อดังกล่าวจะถูกส่งมายังภาควิชาพยาธิวิทยาโดยผ่านกระบวนการพัฒนาขั้นที่ 1 ดังกล่าวข้างต้นร่วมด้วย การศึกษาดำเนินการโดยตรวจสไลด์จากชิ้นเนื้อดังกล่าวจำนวน 50 ตัวอย่าง ในช่วงก่อนและหลังจากกระบวนการพัฒนาขั้นที่ 1 และขั้นที่ 2 ตามลำดับ บันทึกจำนวนสไลด์คุณภาพสูง ความแตกต่างของคำวินิจฉัย และความมั่นใจในการให้การวินิจฉัยของพยาธิแพทย์

ผลการศึกษา: พบว่าสไลด์คุณภาพสูงมีจำนวนมากขึ้นอย่างมีนัยสำคัญ ($p = 0.017$) จากร้อยละ 46 เป็นร้อยละ 60 และร้อยละ 74 ตามลำดับ ความแตกต่างระหว่างคำวินิจฉัยมีแนวโน้มลดลง และความมั่นใจในการให้คำวินิจฉัยของพยาธิแพทย์มีแนวโน้มเพิ่มขึ้นภายหลังมีกระบวนการพัฒนา

สรุป: การพัฒนาคุณภาพสไลด์ชิ้นเนื้อเยื่อบุทางเดินอาหารสามารถทำได้โดยการให้ความรู้และฝึกฝนทักษะแก่บุคลากรที่เกี่ยวข้อง สไลด์ที่มีคุณภาพช่วยให้พยาธิแพทย์วินิจฉัยโรคได้แม่นยำด้วยความมั่นใจมากขึ้น ทำให้ลดความจำเป็นในการสั่งตัดสไลด์เพิ่ม เป็นการลดการใช้ทรัพยากรของห้องปฏิบัติการลงได้