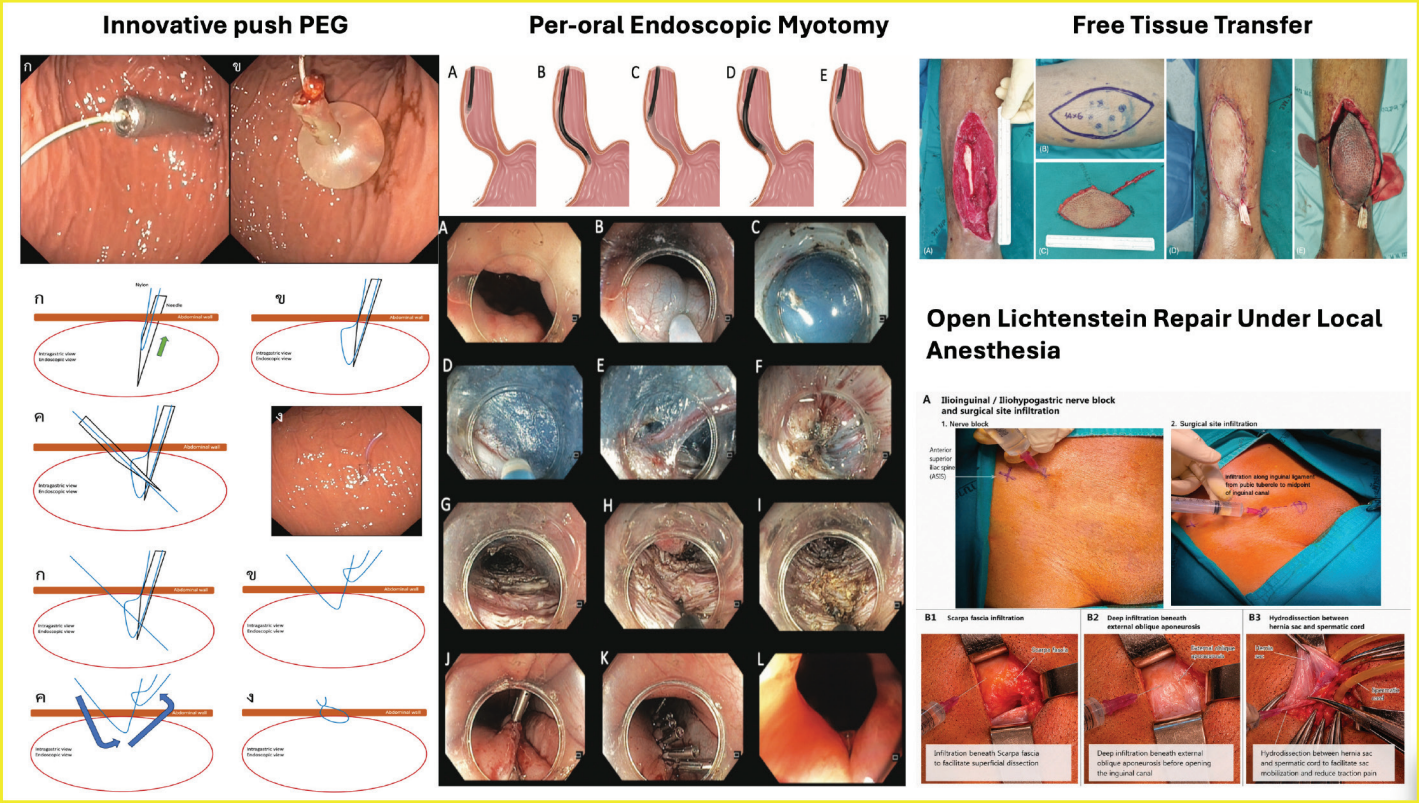
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สารบัญ CONTENT

สารจากนายกฯ

v **คำนำ วารสารฉบับที่ 1 ปี 2569**
พล.ต. ผศ.ดร.นพ.สุชัย สาทถาพร

vi **สารจากหัวหน้ากองบรรณาธิการ**
ศ.นพ.พรพรหม เมืองแมน

Case Series

1 **Lessons from a Low-Volume and Non-academic Hospital: Optimizing Outcomes in Free Tissue Transfer—A Case Series by a Novice Plastic Surgeon**
Sarinya Boonpoapichart, MD
Natthawoot Hongkarnjanakul, MD

Original Articles

14 **Clinical Success and Safety of Per-oral Endoscopic Myotomy (POEM) for Achalasia: A Real-World Retrospective Single-Center Case Series**
Chotirot Angkurawaranon, MD

27 **Case Report: Innovative Push Percutaneous Endoscopic Gastrostomy By Means Of Gastropexy And Foley Catheter In A Patient With Advanced Esophageal Cancer**
Prasit Mahawongkajit, MD
Kanokwan Bunprachoen, MD
Worapong Anuponganan, MD

37 **Transient Femoral Nerve Dysfunction During Open Lichtenstein Repair Under Local Anesthesia: A Retrospective Cohort Study**
Thawatchai Phoonkaew, MD

สมาคมศัลยแพทย์ทั่วไปแห่งประเทศไทย ในพระบรมราชูปถัมภ์อาคารเฉลิมพระบารมี ๕๐ ปี
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สารจากนายกสมาคมฯ

เรียน ท่านสมาชิกสมาคมศัลยแพทย์ทั่วไปแห่งประเทศไทย ในพระบรมราชูปถัมภ์

ในโอกาสที่ผมได้เข้ารับหน้าที่ นายกสมาคมศัลยแพทย์ทั่วไปแห่งประเทศไทย ในพระบรมราชูปถัมภ์ ประจำวาระปี พ.ศ. 2569-2570 นี้ ผมขอต้อนรับเพื่อนสมาชิกทุกท่านเข้าสู่ศักราชใหม่แห่งการขับเคลื่อนวิชาชีพร่วมกันอย่างเข้มแข็ง ศัลยกรรมทั่วไปถือเป็นรากฐานสำคัญยิ่งของระบบสาธารณสุขไทย ที่ต้องอาศัยทั้งทักษะฝีมืออันประณีตและการตัดสินใจที่เด็ดขาดบนพื้นฐานขององค์ความรู้ที่ทันสมัย เพื่อเป็นที่พึ่งพาสูงสุดให้แก่ผู้ป่วยในทุกระดับการรักษาทั่วประเทศ

ผมขอถือโอกาสนี้ ขอบพระคุณทุกท่านอย่างจริงใจที่ได้ให้การสนับสนุนกิจกรรมของสมาคมและวารสารฯ มาอย่างต่อเนื่องความร่วมมือและแรงผลักดันจากพวกเราส่งผลให้วารสารสมาคมศัลยแพทย์ทั่วไปแห่งประเทศไทยฯ ได้รับการรับรองคุณภาพและ จัดอยู่ในกลุ่มวารสารระดับ TCI Tier 2 สำหรับรอบการประเมินตั้งแต่วันที่ 1 มกราคม 2569 จนถึงเดือนธันวาคม 2572 ซึ่งถือเป็นก้าวย่างสำคัญที่ยืนยันถึงความเข้มแข็งทางวิชาการและมาตรฐานที่เป็นสากลยิ่งขึ้นของสมาคมเรา

ความสำเร็จของวารสารในระดับ Tier 2 จะมีความมั่นคงและยั่งยืนได้นั้น จำเป็นต้องอาศัยพลังทางวิชาการจากท่านสมาชิกทุกท่าน ผมจึงขอ เรียนเชิญชวนทุกท่านร่วมส่งบทความวิชาการหรืองานวิจัย ของท่านมาตีพิมพ์ในวารสารของเรา เพื่อร่วมกันแบ่งปันองค์ความรู้และสร้างมาตรฐานใหม่ให้กับวงการศัลยศาสตร์ไทยให้เจริญก้าวหน้าสืบไป

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สารจากหัวหน้ากองบรรณาธิการ

เรียน ท่านสมาชิกสมาคมศัลยแพทย์ทั่วไปแห่งประเทศไทย ในพระบรมราชูปถัมภ์

ในนามของกองบรรณาธิการ ผมขอ ขอบพระคุณทุกท่านที่ได้ให้การสนับสนุนวารสารและสมาคมฯ มาอย่างต่อเนื่อง และมีความยินดีอย่างยิ่งที่จะแจ้งข่าวดีว่า วารสารของเราได้รับการประเมินคุณภาพจากศูนย์ดัชนีการอ้างอิงวารสารไทย (TCI) และ ถูกจัดให้อยู่ในกลุ่มวารสารระดับ TCI Tier 2 ตั้งแต่วันที่ 1 มกราคม 2569 จนถึงเดือนธันวาคม 2572 ซึ่งถือเป็นก้าวย่างสำคัญในการยกระดับมาตรฐานทางวิชาการของเราให้เป็นที่ยอมรับในระดับสากลมากยิ่งขึ้น

สำหรับวารสารฉบับนี้ เรายังคงนำเสนอบทความที่มีคุณค่า 4 เรื่อง ที่สะท้อนถึงการพัฒนาคุณภาพการรักษาในทุกระดับโรงพยาบาล:

1. บทเรียนจากการผ่าตัด Free Tissue Transfer (FTT) ในโรงพยาบาลระดับจังหวัดที่มีปริมาณเคสน้อย ซึ่งเน้นย้ำความสำคัญของการฝึกอบรมทีมและการแก้ปัญหาเฉพาะหน้า

2. ผลสำเร็จและความปลอดภัยของการทำ POEM ในโรงพยาบาลนครพิงค์ เพื่อรักษาโรคหลอดอาหารไม่คลายตัว ซึ่งยืนยันว่าเทคนิคส่องกล้องขั้นสูงนี้สามารถทำได้อย่างมีประสิทธิภาพในศูนย์ภูมิภาค

3. นวัตกรรม 5TAMeD เทคนิคการทำรูเปิดกระเพาะ (Push-PEG) รูปแบบใหม่ที่ปลอดภัยและช่วยประหยัดค่าอุปกรณ์ได้มากกว่าร้อยละ 90 เหมาะสำหรับผู้ป่วยมะเร็งหลอดอาหารระยะลุกลาม

4. การศึกษาภาวะ TFND หลังการผ่าตัดไส้เลื่อนขาหนีบภายใต้ยาชาเฉพาะที่ ซึ่งเป็นข้อมูลสำคัญในการเพิ่มความปลอดภัยและประสิทธิภาพให้กับระบบการผ่าตัดแบบวันเดียวกลับ (One Day Surgery)

ในโอกาสนี้ ผมขอเชิญชวนศัลยแพทย์และนักวิชาการทุกท่าน ร่วมส่งบทความวิชาการหรืองานวิจัย ของท่านมาตีพิมพ์ในวารสารของเรา เพื่อแบ่งปันความรู้และร่วมกันสร้างสรรค์วงการศัลยศาสตร์ไทยให้แข็งแกร่งสืบไป

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Case Series

Lessons from a Low-Volume and Non-academic Hospital: Optimizing Outcomes in Free Tissue Transfer—A Case Series by a Novice Plastic Surgeon

Sarinya Boonpoapichart, MD[1,*]
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ABSTRACT

Background: Free tissue transfer (FTT) has become the preferred method in modern reconstructive surgery, offering excellent functional and aesthetic outcomes, particularly for complex oncologic, traumatic, and post-infectious defects. This study describes the early experience and key lessons learned from a series of FTT procedures performed by a novice plastic surgeon at Nakhon Phanom Hospital, a standard-level (S-level) hospitals in Thailand.

Methods: Medical records of all patients who underwent FTT performed by a single surgeon were reviewed. Data collected included demographics, operative details, pathology results, and postoperative complications.

Results: Nineteen FTT procedures were identified, performed for reconstruction of the head and neck (n = 15) and lower extremities (n = 4). Five cases experienced postoperative complications resulting in flap compromise. Three of eight threatened flaps were successfully salvaged. The primary causes of flap loss were vascular complications, including venous congestion (26.3%) and arterial thrombosis (15.7%). The overall flap success rate was 73.7%.

Conclusions: Performing free tissue transfer as a young plastic surgeon embarking on reconstructive surgery in a non-academic hospital with no prior experience in this procedure posed significant challenges. Limited early postoperative monitoring capacity, insufficiently trained nursing staff, and the surgeon's learning curve contributed to delays in critical decision-making. Ultimately, improving outcomes in such settings requires recognizing systemic limitations, implementing continuous team training, and maintaining perseverance throughout the demanding early learning phase.

Keywords: Free tissue transfer (FTT), Novice Plastic Surgeon, Postoperative Complications, Non-Academic Hospital, Flap survival

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Introduction

Free tissue transfer (FTT) has revolutionized reconstructive surgery by providing reliable options for the restoration of complex composite defects following oncologic resection, trauma, or infection. The success rate is influenced by various factors such as venous anastomosis number, vascular crisis, and hematomas.[1] the number of cases. The overall success rate of free flap transfer was 95–99.2%.[2] These outcomes are usually reported in the high-volume center. The treating center was classified as large where there were more than 50 cases per year of free tissue transfer with double team consultants according to the British Association of Head and Neck Oncologists recommendations.[3] Many high-volume training centers have reported decreasing complication and failure rates while minimizing hospital stays. These improvements are likely multifactorial, resulting from improved team familiarity, streamlined perioperative processes, and increased surgeon experience.[4,5]

In contrast, the introduction of microsurgery in low-volume hospitals poses distinct challenges. All procedures, including neck dissection, tumor resection, and free-flap reconstruction, were performed by a single surgeon using a single-team approach.[6] Limited infrastructure, lack of trained nursing staff, and the absence of multidisciplinary microsurgical support can hinder both operative performance and postoperative monitoring.[7,8] Moreover, for young plastic surgeons embarking on their first independent microsurgical cases, these institutional and experiential constraints compound the inherent technical difficulty of free tissue transfer. Despite these challenges, the demand for reconstructive microsurgery continues to grow across all levels of healthcare systems,[9,10] particularly in regional or provincial hospitals where access to tertiary centers may be limited.

The present study reports a case series of free tissue transfers performed by one primary plastic surgeon through the entire procedures at Nakhon Phanom Hospital, a standard-level (S) hospital in northeastern Thailand, where no previous free flap surgery existed. This study aims to analyze early outcomes, flap success or failure rate, and share practical lessons learned from establishing microsurgery in a low-volume setting.

Materials and Methods

Study design

This is a retrospective case series of consecutive free tissue transfer (FTT) procedures performed by a single plastic surgeon (Sarinya Boonpoapichart) between [1st June 2023 – 1st June 2025] at Nakhon Phanom Hospital, a standard-level (S) provincial hospital in Thailand. Institutional review board approval was obtained. [NP-EC11-No.54/2568



Data collection

The electronic medical record (EMR) of all patients who underwent free tissue transfer for reconstructive purposes during the study period were included. Indications for reconstruction included oncologic resection defects, post-traumatic defects, and post-infectious soft-tissue loss. Patients who underwent local or regional flap reconstruction without microvascular anastomosis were excluded.

General demographic, clinical, and operative data were collected from the hospital EMRs. The patient demographics including age, sex, comorbidities, and ASA classification were recorded. Reviewing operative data to get the information of the defect site, type of free flap and use of vein graft, ischemic time, total operating time was done. The need for intensive care, postoperative complications, re-exploration, flap survival, duration of ICU and hospital stay were identified.

Surgical techniques

All procedures were performed under an operating microscope using standard microvascular techniques. Flap selection was based on defect size, location, and tissue requirements. Recipient vessels were chosen based on availability and vessel quality, with end-to-end or end-to-side anastomoses using 9-0 or 10-0 nylon sutures. Vein grafts were used when the recipient vessel length was inadequate.

Outcome Measures and Statistical Analysis

The primary outcome was flap survival, defined as complete viability of the transferred tissue at discharge. Secondary outcomes included flap complications, re-exploration, salvage success, and donor site morbidity. The successful salvage was defined as any flap that did not result in total loss. Descriptive statistics were calculated for continuous variables as mean ± standard deviation and for categorical variables as frequencies and percentages.

Results

A total of 19 patients underwent free tissue transfer during the study period (Table 1), with a mean age of 55.1 years. There were 12 males (63.1%) and 7 females (36.8%). Comorbidities were present in the patients, including hypertension (47.3%), diabetes mellitus (31.5%), and chronic kidney disease (21.0%). Most patients were classified as ASA III (73.6%), reflecting significant systemic comorbidities. The majority of reconstructions were performed for head and neck defects (15 cases, 78%), followed by lower extremity reconstructions (4 cases, 21%). The free flaps were distributed as follows: anterolateral thigh (ALT) flap: 7 cases (36.8%), free



fibula osteocutaneous flap: 6 cases (31.5%), radial forearm flap: 5 cases (26.3%), and other flaps: 1 case (5.2%). Defect locations included the tongue (31.5%), maxilla (15.7%), mandible (15.7%), lower extremity (15.7%), intraoral mucosa (10.5%), and scalp (0.5%). Vein grafts were required in 2 cases of maxillary reconstruction (10.5%).

The mean ischemic time was 97.2 ± 33.3 minutes, and the mean total operative time was 11.75 ± 4.0 hours. The mean ICU stay was 6.4 ± 5.7 days, and the mean total hospital stay was 20.3 ± 7.7 days. The overall flap survival rate was 73.7% (14 of 19). Prolonged ICU stays were most commonly observed in head and neck reconstruction cases, primarily due to the need for continued intubation while awaiting resolution of flap edema which typically required 7–10 days. In addition, cases requiring revision surgery with a second flap or complicated by failed extubation were associated with prolonged ICU stays. Postoperative monitoring included serial assessments of flap color, turgor, and capillary refill. Patient positioning and flap assessment were performed immediately after the patients arrived at the ward by the surgeon. The flap monitoring was performed every 4-6 hours by nursing staff, and it was always confirmed with the surgeon during the first 12-24 hours postoperatively.

A total of 8 patients (42.1%) underwent re-exploration for suspected vascular compromise, of which 3 flaps (24%) were successfully salvaged. Flap loss occurred in 5 patients (26.3%). Complications at the recipient site included: venous congestion/thrombosis: 5 cases (26.3%), arterial thrombosis: 3 cases (15.7%) and hematoma: 1 case (0.05%). Three arterial thrombosis were found in cases with underlying disease of Systemic lupus nephritis, previous history of chemotherapy from breast cancer treatment, and the Gustilo class IIIB patients. All three maxillary reconstructions with fibular flap had venous congestion due to the increased distance from the pedicle to the recipient vessels compared to the mandibular defect. Only one flap was successfully salvaged with the use of a vein graft during reoperation. One venous congestion of the radial forearm flap in tongue reconstruction occurred from the compression of the post-operative hematoma. This case was resolved with the revision surgery of the venous anastomosis. Another venous congestion was found in a gunshot wound case of lower extremity reconstruction with ALT flap as a result of the pedicled kinking during flap positioning. No cases of infection or fistula were observed. Donor site complications were minimal, limited to 1 case (0.05%) of delayed wound healing; no infections, hematomas, or seromas occurred (Table 2).

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Table 1 Case summary

Case No.	Age, y	Sex	Location	Incident Details	Diagnosis	Recipient Site	Chronic medical conditions	Free flap performed	Flap survival
1	52	M	H&N	Neoplasm	SCC	Tongue	HT	ALT	Yes
2	81	F	H&N	Neoplasm	SCC	Mandible	DM	Radial forearm	Yes
3	32	M	Lower limb	Trauma	Gun shot wound	Lower leg	none	ALT	Yes
4	42	M	H&N	Neoplasm	SCC	Tongue	none	ALT	Yes
5	57	F	H&N	Neoplasm	SCC	Tongue	Thalassemia	Radial forearm	Yes
6	54	M	Lower limb	Neoplasm	Marjolin ulcer	Plantar foot	none	ALT	Yes
7	68	M	H&N	Neoplasm	SCC	Mandible	DM, HT, CKD	Fibula	Yes
8	69	F	H&N	Neoplasm	SCC	Maxilla	DM, HT, Goiter	Fibula	No
9	76	F	H&N	Neoplasm	SCC	Mandible	DM, HT, DLD	Fibula	Yes
10	49	M	H&N	Neoplasm	SCC	Cheek	HT	ALT	Yes
11	26	M	H&N	Neoplasm	SCC	Scalp	SLE	Latissimus dorsi	No
12	76	M	H&N	Neoplasm	SCC	Tongue	none	Radial forearm	Yes
13	12	M	Lower limb	Trauma	Internal hardware expose	Lower leg	none	ALT	No
14	59	M	H&N	Neoplasm	SCC	Maxilla	HT	Fibula	Yes
15	52	M	H&N	Neoplasm	SCC	FOM	none	Radial forearm	Yes
16	60	F	Lower limb	Trauma	Achilles rupture with soft tissue defect	Heel	DM, HT	ALT	Yes
17	67	F	H&N	Neoplasm	SCC	Tongue	DM, HT	Radial forearm	No
18	72	M	H&N	Neoplasm	SCC	Maxilla	none	Fibula	No
19	44	F	H&N	Neoplasm	SCC	Tongue	HT	Radial forearm	Yes

Table 2 Overall complications

Total patients	19 (%)
Recipient sites	
Flap loss	5 (26.3)
Arterial thrombosis	3 (15.7)
Venous congestion/Thrombosis	5 (26.3)
Hematoma	1 (0.05)
Infection	0
Partial flap loss	0
Fistula	0

The comparison of flap success rates between the first and second years of practice was illustrated in Figure 1. The reduction in flap success observed in the second year was attributed to an increased proportion of more complex cases. Contributing patient-related factors included a prior history of chemotherapy, severe lower-extremity trauma (Gustilo type IIIB fractures), and active vasculitis in patients with systemic lupus erythematosus. In addition, maxillary reconstruction posed greater technical challenges due to the increased distance between the flap pedicle and recipient vessels, necessitating the use of interposition vein grafts, which are associated with a higher risk of vascular anastomotic thrombosis.

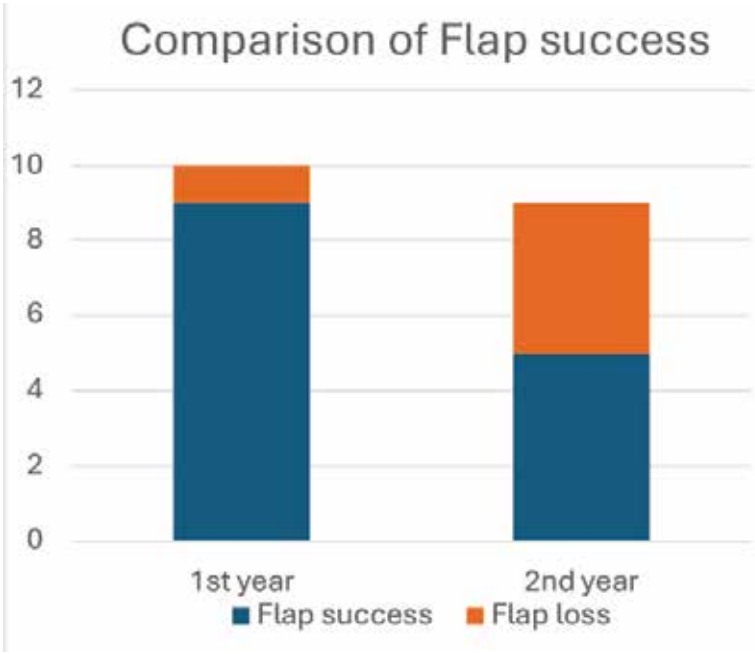


Figure 1 The bar chart demonstrates differences in flap success rates between the first and second years of surgical practice.visible cervical scar, illustrating cosmetic advantage.

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Case reports

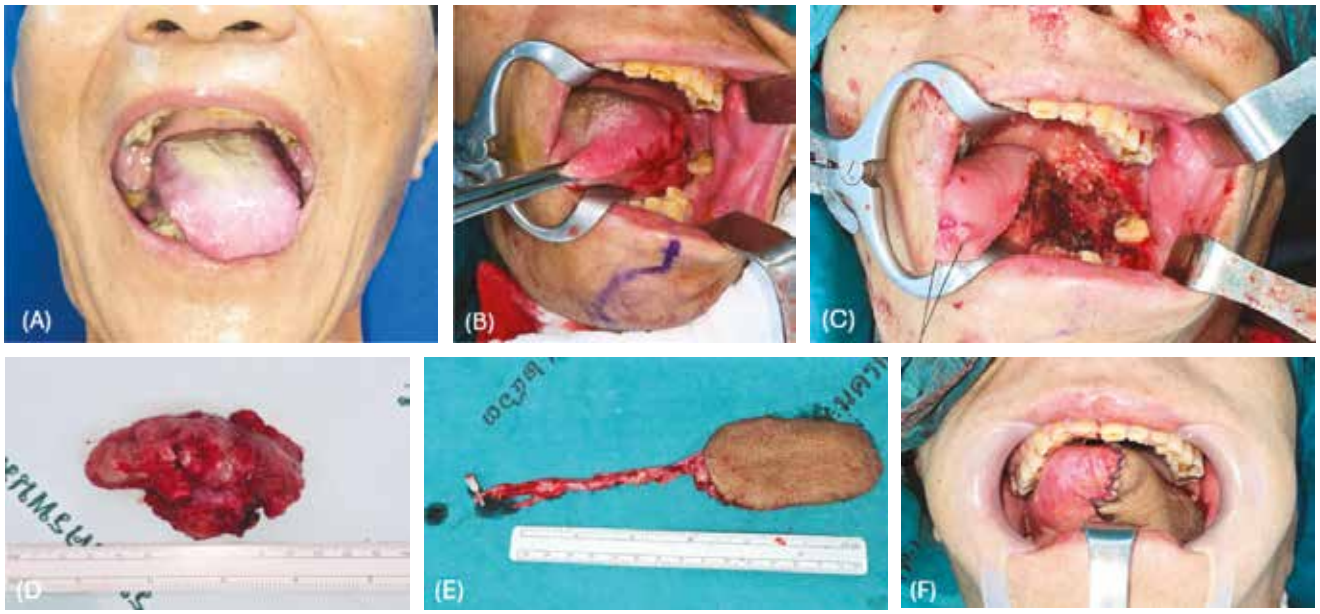


Figure 2 A 56-year-old man with thalassemia was diagnosed with squamous cell carcinoma of the left tongue. (A) Preoperative examination showed deviation of the tongue to the left. (B) An ulcerative mass was noted on the left lateral tongue. (C) Tumor ablation was performed with left hemiglossectomy. (D) Resected specimen of the left hemi-tongue. (E) Harvesting of the radial forearm free flap. (F) Immediate postoperative appearance following tongue reconstruction with a radial forearm free flap

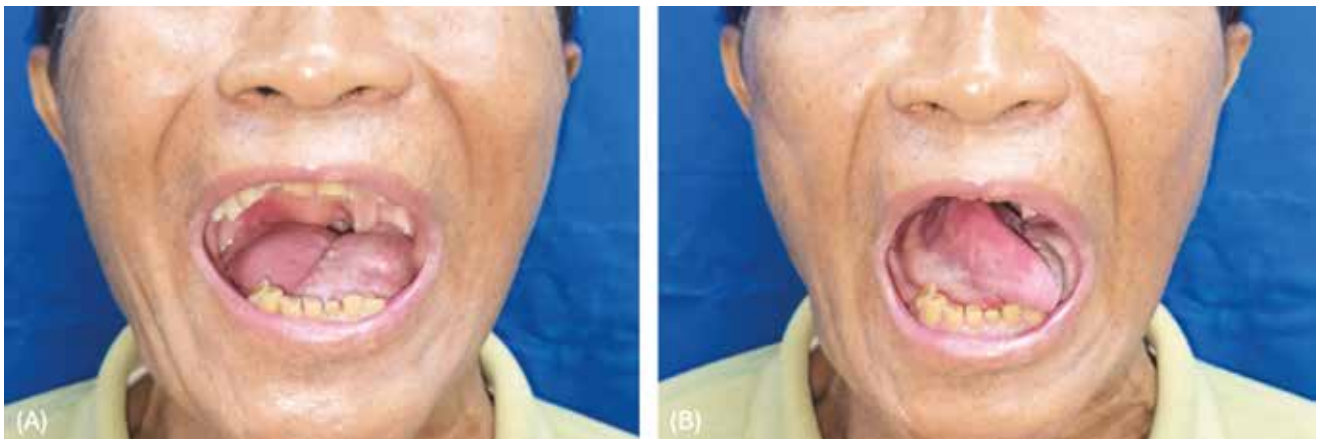


Figure 3 Outcome of radial forearm free flap reconstruction for the tongue. Photographs obtained 14 months postoperatively, following completion of adjuvant radiotherapy. (A, B) The patient demonstrates good tongue contour and mobility

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Figure 4 (A) A 32-year-old man presented with a gunshot wound of the distal third of the right lower leg with exposed tibia. (B) Design of a 6 × 14 cm anterolateral thigh (ALT) flap (width × length). (C) Harvesting of the ALT flap. (D) Immediate postoperative appearance following flap inset. (E) Venous congestion noted on postoperative day 1; partial suture release was performed prior to revision surgery.

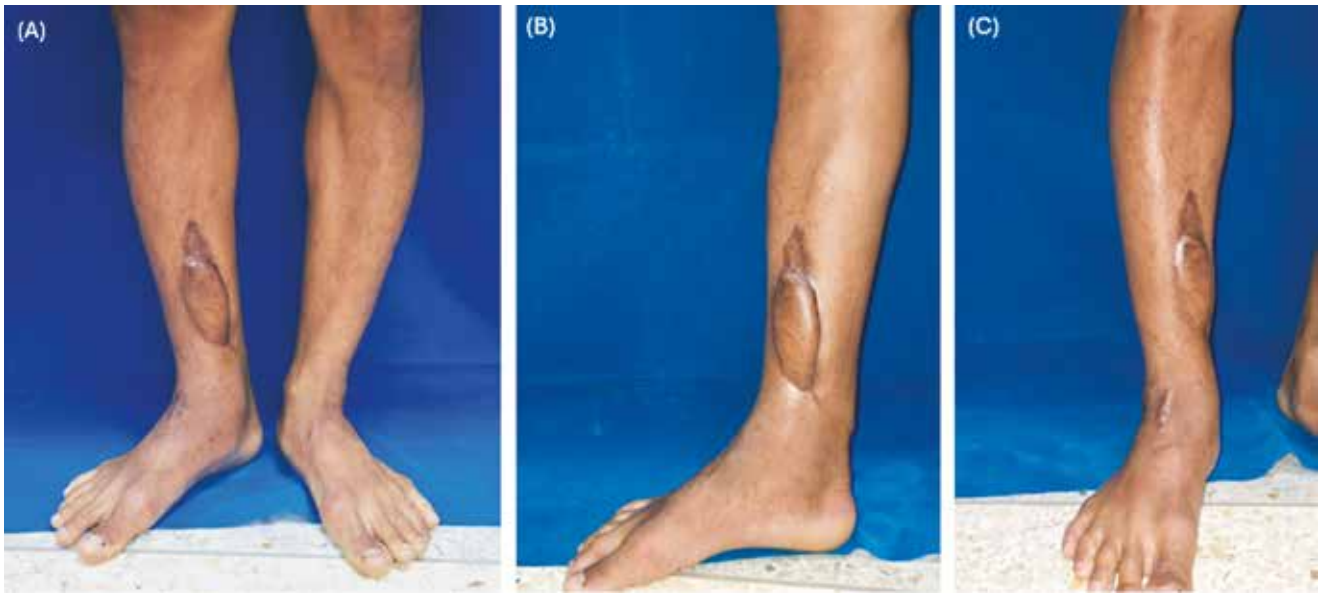


Figure 5 (A–C) Postoperative photographs obtained five months after surgery, shown in anteroposterior and lateral views of the lower leg following an anterolateral thigh (ALT) free flap reconstruction.

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Figure 6 A 76-year-old woman was diagnosed with squamous cell carcinoma of the left lower gingiva with mandibular invasion (A). Tumor ablation was performed with segmental mandibulectomy and left modified radical neck dissection (B, C). Reconstruction was achieved using a fibular osteocutaneous flap harvested from the right lower extremity (D). Final flap inset and bony fixation with miniplates and screws are demonstrated in panels E and F.



Figure 7 (A–C) Postoperative photographs obtained one year after surgery, shown in anteroposterior and oblique views, demonstrating a well-contoured mandible. (D, E) Following completion of postoperative radiotherapy, resolution of flap bulk is observed



Discussion

Free tissue transfer (FTT) has become the cornerstone of modern reconstructive surgery, offering superior functional and aesthetic outcomes in the treatment of complex defects. It allows the plastic surgeon to perform wide excisions for tumor ablative surgery, especially in the most complex defects of the head and neck areas. However, surgical outcomes of FTT are typically reported from higher-volume centers with superior flap survival and salvaged flaps. In 2024, the systematic review reported an overall success rate of 95–99.2% for free flap transfer.[2] Siriraj Hospital, the high-level academic P-plus hospital in Thailand, reported a 92.8% flap success rate and 67.0% salvaged success rate during 2007-2011. There were 153 microvascular flaps during the five years of study, an average of 30 flaps per year.[11] Another study from Rajavithi Hospital, an A-plus level hospital of Thailand, has an 89.7% success rate of free flap reconstruction.[12] In contrast, performing microsurgery in a low-volume, resource-limited environment poses unique challenges. This case series presents the early experience of a young plastic surgeon establishing a free flap program at a standard-level (S) hospital in Thailand, with an overall flap success rate of 73.7% and only 24.0% salvaged flap success.

Challenges in a Low-Volume and Non-Academic Setting

Low-volume centers often face constraints in both technical and logistical aspects of microsurgery. The absence of a dedicated microsurgical team, long operating time, and inexperienced nursing staff can affect outcomes, particularly during the critical early postoperative period. The flap success rate of this study had an inferior result due to several reasons. A two-team surgical approach, in which ablative and reconstructive procedures are performed simultaneously, is not available at our institution. Only two scrubs and one circulating nurse were available for each operation due to the limited number of staff. Long operation usually occurs in the case of tumor ablation with immediate reconstruction. The average of operative time in this study was 11.75 (± 4.0) hours. The most common causes of flap loss were vascular compromise, including venous congestion (26.3%) and arterial thrombosis (15.7%). Early identification of vascular issues in this study was hindered by inconsistent postoperative monitoring, especially within the first 24 hours after surgery. The study by Zoccali et al emphasizes the compulsory monitoring of free flap hourly during the first 48 hours.[13] Shen et al present a high success rate



of flap salvage during the early 24-48 hours in a systematic review. In the first 24 hours, the flap was successfully 93.8% salvaged. The success decreased to 83.33% by day 2. Then, it declined remarkably to 12.1% by day 3, and none survived on day 4.[14]

Clinical bedside assessment remains the standard method for flap monitoring. Vigilant assessment within the first 48 hours is critical, as it allows early identification of vascular compromise, facilitating prompt salvage and enhancing flap survival.[15] Flap-monitoring protocols vary significantly among plastic surgery units. A commonly used schedule includes checks every 30 minutes for the first 3 hours, hourly for the next 48 hours, and every 2 hours until 72 hours postoperatively. Monitoring is then reduced to every 4–8 hours until discharge.[16] However, given our hospital's circumstances, the single plastic surgeon who introduced free tissue transfer is responsible for all aspects of care, including performing the surgery, conducting flap monitoring, and managing ward rounds. The reduced frequency of flap monitoring (every 4–6 hours during the first 48 postoperative hours) is performed in our setting, which delays the detection of flap compromise and increases the risk of unsuccessful salvage. These emphasize the importance of early detection and timely re-exploration in improving salvage rates.

Strategies for Optimizing Outcomes

Several strategies contributed to improved outcomes over time. First, the implementation of a structured flap monitoring protocol—combining frequent clinical assessment with standardized documentation—enhanced early recognition of vascular compromise. Nowadays, clinical assessment remains the most valuable tool for flap monitoring. A review study of flap monitoring presents that the free flap outcomes were not influenced by the extent of resident or physician involvement in postoperative monitoring. Further findings support that a high-volume, well-trained nursing-led flap monitoring system can reliably and efficiently identify flap compromise.[17] Training sessions for nursing staff on flap observation and escalation criteria are essential in bridging the knowledge gap. In the past few decades, the application of Indocyanine Green (ICG) fluorescence imaging for intraoperative flap perfusion assessment was useful in identifying the best perforator during operations and reducing the incidence of postoperative complications, such as flap necrosis and congestion.[18] However, the cost of using ICG was not included in the Medical Expense Reimbursement from the Thai National Health Security Office, causing limited usage in the public hospital.

Comparison with Reported Outcomes

The overall flap success rate of 73.7% in this study is lower than the >95% rates (2). However,



similar success rates have been documented in early experiences of surgeons initiating microsurgical programs in low-volume settings. Reported by Andrey Karpenko et al in 2021, the study had a total of 58 flaps over the period of 6 years, equal to 9.6 flaps per year on average. During the first 2 years, the success rate was 72.2% of the total 18 flaps. The success rate increases remarkably to 95% of the total 40 cases in the last 3 years.[19] Similarly, our study had the same ratio of 9.5 flaps per year in 2 years. The flap success rate was 73.7% which is a comparable result. Therefore, the outcomes in this series reflect a realistic trajectory of a developing microsurgical service rather than poor performance.

Center-specific strategies to improve the outcomes

Several strategies were implemented to improve free flap outcomes. These included the establishment of a structured multidisciplinary microsurgical team and the implementation of standardized perioperative care and flap monitoring pathways. In addition, collaboration with regional academic centers provided valuable guidance in case selection and intraoperative troubleshooting. Ongoing development of close cooperation among surgeons, anesthesiologists, scrub nurses, and ICU nurses further enhanced perioperative coordination and postoperative care.

Limitations

This study is limited by its retrospective nature, small sample size, and the absence of long-term functional outcome assessment. A comparative analysis was not feasible due to the small sample size of the study. Nevertheless, the study provides valuable insight into the challenges faced during the establishment of a microsurgical program in a resource-constrained setting.

Conclusions

Establishing free tissue transfer in a low-volume, non-academic hospital is challenging but achievable. The Initial success rates for free flap surgery during the early stages were significantly lower than current rates >95%.[2] Flap survival was only 73.7% in this study. The disparity in success rates underscores the significant role of surgeon experience. Finally, the flap success depends on recognizing system limitations, engaging in continuous team training, and maintaining perseverance through the steep learning curve. The lessons from this early experience may help young plastic surgeons aiming to initiate microsurgical programs in similar environments.

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Original Article

Clinical Success and Safety of Per-oral Endoscopic Myotomy (POEM) for Achalasia: A Real-World Retrospective Single-Center Case Series

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ABSTRACT

Background: Achalasia is a rare esophageal motility disorder that significantly impairs quality of life. Per oral endoscopic myotomy (POEM) has emerged as an effective minimally invasive treatment; however, data from Thai institutions remain limited.

Objective: This study aimed to evaluate the technical success, clinical outcomes, and perioperative safety of POEM at one year follow up in a single tertiary care hospital.

Materials and Methods: A retrospective observational study was conducted including all patients diagnosed with achalasia who underwent POEM between August 2018 and March 2025. Demographic data, procedural details, complications, Eckardt score, timed barium esophagography (TBE), and body mass index (BMI) were analyzed. Clinical success was defined as an Eckardt score ≤ 3.

Results: Fourteen patients were included. Technical success was achieved in 92.8% (13/14), with one conversion to endoscopic dilatation due to intraoperative bleeding. The median operative time was 162.5 minutes. Overall morbidity was 28.5%, including one esophageal perforation, one bleeding event, and two cases of aspiration pneumonia. Median length of hospital stay was four days. At one year follow up, clinical success was achieved in all patients, with significant improvement in Eckardt score, TBE parameters, and BMI.

Conclusion: POEM is a safe and effective treatment for achalasia and can be successfully implemented in a low volume or early experience center. Larger studies with long term follow up and objective reflux assessment are recommended.

Keywords: Per-oral endoscopic myotomy (POEM), Achalasia, Eckardt score

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Introduction

Achalasia is a rare primary esophageal motility disorder characterized by impaired relaxation of the lower esophageal sphincter and absence of normal esophageal peristalsis. Patients typically present with progressive dysphagia, regurgitation, and weight loss.[1-3] High resolution esophageal manometry (HREM) is the gold standard investigation for achalasia and enables classification into three subtypes according to the Chicago Classification.[4] HREM categorizes achalasia into type I (classic achalasia with absent peristalsis), type II (absent peristalsis with panesophageal pressurization), and type III (spastic achalasia with premature distal contractions). This subclassification has prognostic value and guides treatment selection and expected response. Even though HREM remains the diagnostic gold-standard, access to this investigation is limited in many regions of Thailand.[4-6]

Laparoscopic Heller myotomy has traditionally been the standard surgical treatment for achalasia.[7] Since its introduction by Inoue in 2008,[7-10] per oral endoscopic myotomy (POEM) has gained widespread acceptance as a minimally invasive alternative.

POEM utilizes a submucosal tunnel to perform a selective myotomy without external incisions of the abdomen.[8] Extensive data validate POEM's efficacy as comparable to LHM and superior to pneumatic dilation.[10-13] POEM is highly effective across all subtypes, particularly advantages in Achalasia Type III, and recent meta-analyses demonstrate its safety in specific populations, including the elderly and pediatric patients.[14,15] Long-term follow-up data now confirm that POEM provides durable symptom relief exceeding 90%.[16] However, POEM is associated with a higher incidence of iatrogenic gastroesophageal reflux disease (GERD) compared to LHM with fundoplication.[17] Recent literature highlights the importance of post-POEM reflux management, which is typically responsive to proton pump inhibitors (PPIs).[18-20] Despite this, the procedure's minimally invasive nature and rapid recovery profile have solidified its status as a preferred treatment.[20]

Given the rising global adoption of POEM, continuous evaluation of real-world outcomes is essential.[21-22] Due to limited availability of esophageal manometry in many hospitals in Thailand, especially in the Northern region, and the favorable outcome of POEM in all achalasia subtypes, the justification for applying POEM in these patients without prior classification is perhaps valid. Our center, Nakornping Hospital, initiated the POEM procedure in August 2018, becoming one of the early adopters of this innovative technique in the Northern region of Thailand. This retrospective observational study aims to present and critically analyze the outcomes of our seven-year experience with POEM in a single tertiary



care institution. We focus on technical success rates, clinical success rates, perioperative adverse events, and long-term complications. Through this study, we seek to contribute to the growing body of evidence supporting POEM as a first-line treatment for achalasia, while highlighting lessons learned and areas for ongoing improvement in technique and patient care.[23]

Materials and Methods

This retrospective single center observational study included all consecutive patients who underwent POEM for achalasia between August 2018 and March 2025. The study was approved by the Institutional Review Board (IRB code: 07768). The first two cases were performed under direct proctorship by an experienced POEM endoscopist from Siriraj Hospital to ensure procedural safety during the early phase of implementation. Subsequent procedures were performed by a single advanced endoscopist, certified in minimally invasive surgery.

The primary objective is to evaluate the technical and clinical success of POEM at 1-year follow-up study. The secondary objective is to assess the perioperative morbidity and complications. Also, to evaluate postoperative nutritional recovery as reflected by change in the body mass index (BMI). The technical success is defined as successful POEM operation. The clinical success was defined as a postoperative Eckardt score less than 3. Sigmoid type achalasia was defined as marked esophageal dilatation with a tortuous S shaped configuration and maximal diameter greater than 8 cm.

Statistical analysis was performed using Stata software (StataCorp LLC, College Station, TX, USA). Continuous variables are presented as median and range. Preoperative and postoperative outcomes, including Eckardt score, timed barium esophagography parameters, and body mass index (BMI), were compared using the paired t test, as measurements were obtained from the same patients before and after the intervention. A p-value < 0.05 was considered statistically significant.

Techniques of POEM

All POEM procedures were performed under general anesthesia with endotracheal intubation, in a supine position, left arm tucked, and the patient's abdomen exposed to observe signs of pneumoperitoneum. The patient position and endoscopic suite set up according to Figure 1. Prophylactic intravenous antibiotics were administered 30 minutes prior to the procedure. Copious irrigation was performed to remove remaining esophageal content.

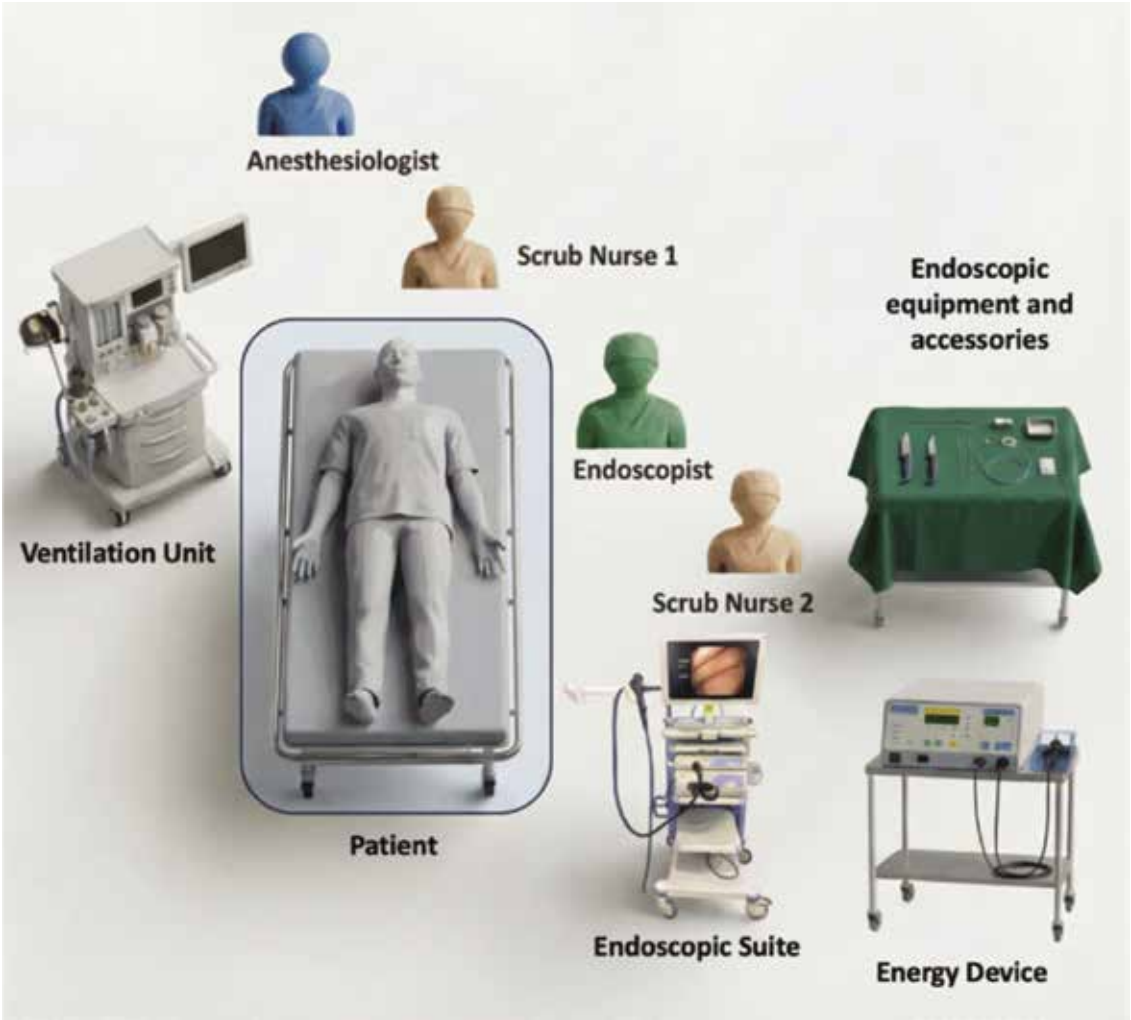


Figure 1 Operating Room Set Up

A high-definition gastroscope (GIF-HQ170, Olympus) with low flow carbon dioxide insufflation was used. A transparent distal cap (11.6–13.9 mm) was fitted to facilitate dissection and visualization. Electrosurgical dissection was performed using a 4.5 mm TriangularTipKnife (TT) knife (Olympus, Japan) or a 2.0 mm Dualknife (Olympus, Japan) connected to a high-frequency generator ERBE VIO 3 electrosurgical unit (ERBE, Germany). The setting used during incision/myotomy, submucosal dissection, hemostasis is shown as Table 1.

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Table 1 Electrosurgical setting for Per-Oral Endoscopic Myotomy.

POEM step	VIO 200 D	VIO 300	VIO 3
Incision/Myotomy	ENDOCUT Q, Effect 2 *(Cutting duration 3, Cutting interval 3)* DRYCUT, Effect 2-3, 30-80 W	ENDOCUT I, Effect 2-4 *(Cutting duration 1-3, Cutting interval 1-3)* DRYCUT Effect 2-3, 30W	DRYCUT, Effect 3-5, ENDOCUT Q, Effect 1-2 PreciseSECT, Effect 3,4-5
Submucosal Dissection	ENDOCUT Q, Effect 2 *(Cutting duration 3, Cutting interval 3)* DRYCUT Effect 2, 30-80W	FORCED COAG, Effect 2-3, 35-100 W SWIFT COAG, Effect 2-3, 35-100 W DRYCUT, Effect 2-3, 35-100 W	SWIFT COAG, Effect 3-4 DRYCUT, Effect 3-4 ENDOCUT Q, Effect 1-2 PreciseSECT, Effect 3,4-5
Hemostasis	FORCED COAG, Effect 2, 60 W	SOFT COAG, Effect 5, 60-100 W	SOFT COAG, Effect 5 SPRAY COAG, Effect 1-4, PreciseSECT, Effect 3,4-5

Esophagogastroduodenoscopy was done to examine the esophagus, stomach, and duodenum as shown in Figure 2. Irrigation and removal the remaining esophageal content was done. If there are thickened content, an overtube may be placed for copious irrigation and clearance of the esophageal content. Documentation of the esophagogastric junction (EGJ) distance and decision for mucosal entry site was selected at least 8-12 centimeters proximal to the EGJ. All patients were performed by posterior approach.

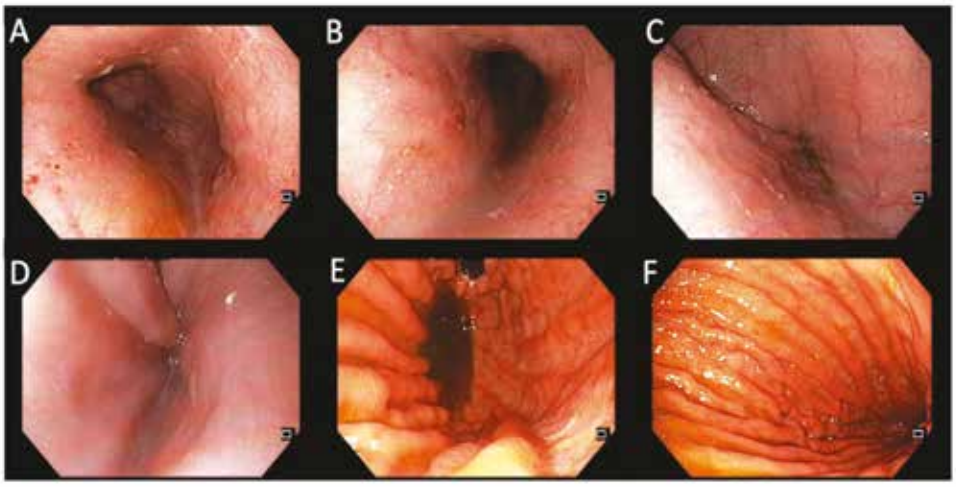


Figure 2 Esophagogastroduodenoscopy findings (EGD) in achalasia. Upper thoracic esophagus (A), Middle thoracic esophagus (B), Lower thoracic esophagus (C), Tight lower esophageal sphincter (D), Tight cardia in J-turn endoscopic view (E), Stomach (F)



Steps for POEM

1. Mucosal Entry

A submucosal injection is made at least 10–12 cm proximal to the esophagogastric junction (EGJ), using a lifting solution, usually with glycerol 200 ml tinted with 0.4% indigo carmine mixture to achieve a deep skyblue color and one ampule of epinephrine 1mg/ml was infused. Submucosal injection via a 23-gauge needle injection (Olympus, Japan) of at least 10 ml to separate the mucosal layer and submucosal layer to reduce the penetration of the muscularis propria. A longitudinal posterior mucosal incision approximately 1.5–2 cm is performed using a TT knife in Endocut I mode setting 2-3-3. Care is taken to avoid the 6 o'clock position (posterior) in sigmoid-type achalasia; consider the 2 or 5 o'clock position for better tunnel orientation and gravity-assisted exposure.

2. Submucosal Tunneling

A submucosal tunnel is created from the mucosal entry site down to 2–3 cm distal the EGJ into the proximal stomach. Switch setting to Endocut Q 2-3-3 and swift coagulation or spray coagulation mode 2-50 depending on the tissue resistance, a PreciseSECT mode is also an option. Maintain adequate submucosal lifting with repeated injections of the lifting solutions and normal saline irrigation to separate the submucosal plane. Any large vessels or bleeding are controlled via coagulation graspers and switch to hemostatic mode to minimize thermal damage.

3. Myotomy

A selective myotomy of the circular muscle layer is performed, starting 2–3 cm below the mucosal incision and usually 6-8 cm above the esophagogastric junction (EGJ), then extending 2–3 cm below the EGJ into the gastric cardia. Usually a posterior approach is performed due to feasibility of the patient position.

4. Closure of Mucosal Entry

After the passing the endoscopic through the esophageal lumen into the stomach, The mucosal entry is closed using standard endoscopic clips in a "zipper" fashion. The steps of per-oral endoscopic myotomy (POEM) is summarized in Figure 3 and the endoscopic view of the POEM is demonstrated in Figure 4.

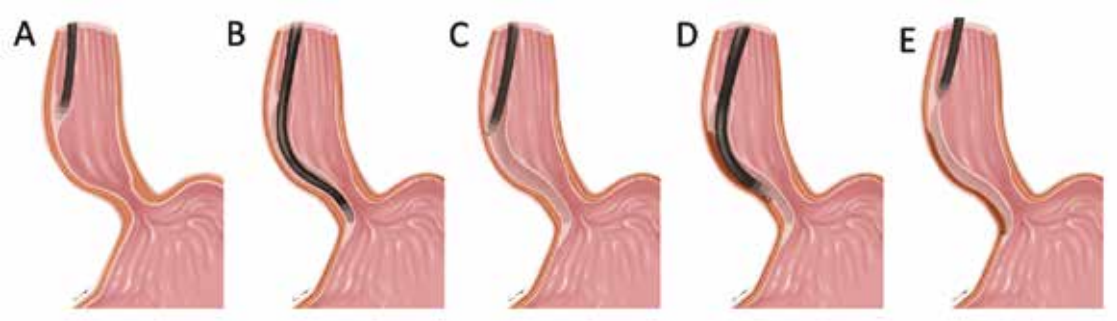


Figure 3 Per-oral endoscopic myotomy (POEM) technique. Lifting submucosal injection at 8-10 cm above EGJ. Mucosostomy performed to enter submucosal space (A), Dissection of submucosal tunneling caudally to 2 cm below esophagogastric junction (EGJ) (B), Endoscopic myotomy of the 6-8 cms above EGJ (C), Endoscopic myotomy 2-3 cm below EGJ (D), Closure of mucosal defects at entry site (E).

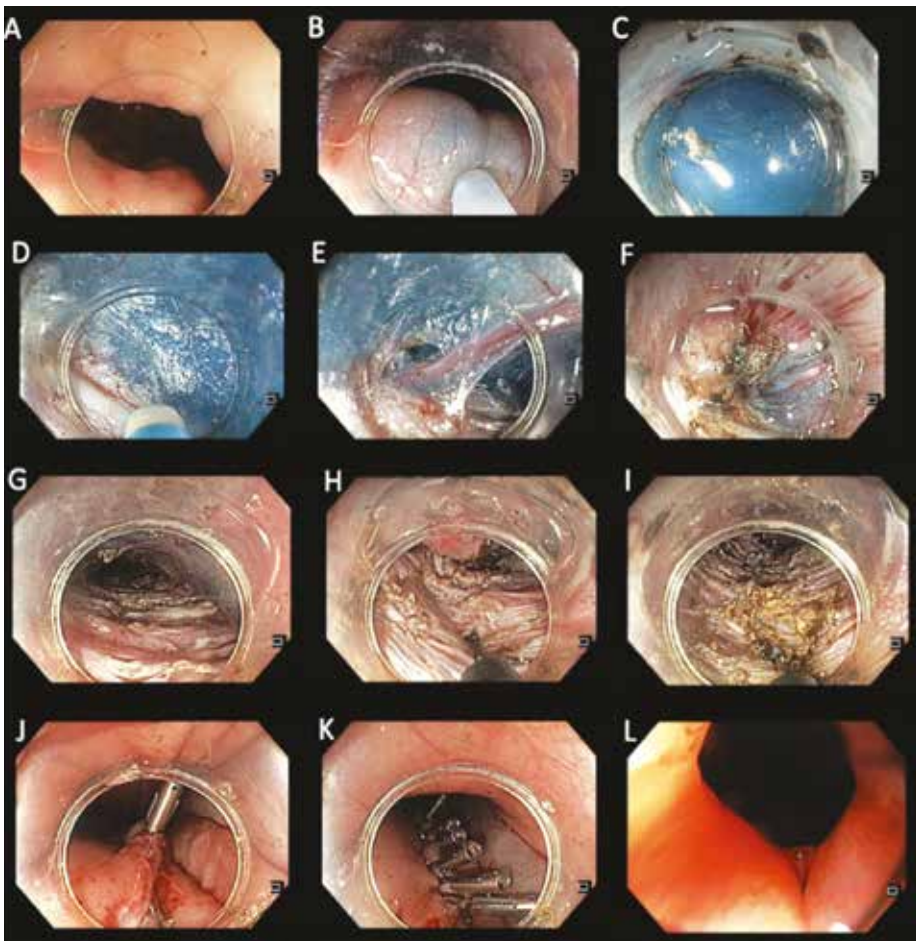


Figure 4 Per-oral endoscopic myotomy (POEM) endoscopic view. Esophagus location at 8-10 cm above the EGJ (A), Submucosal injection (B), Submucosal incision 1.5-2 cm allowing entry into the submucosal space (C), Submucosal tunneling (D), Submucosal esophageal vessels (E), Tight EGJ (F), Complete submucosal tunneling at esophageal and gastric site (G), Posterior myotomy of the esophageal circular and/or longitudinal muscle fibers via (H), Split circular muscles of the esophagus using a Triangular TipKnife (I), Closure of the submucosal entry site from caudal to cephalad (J), Complete closure of the mucosa of esophagus (K), Endoscopic view revealing relaxed lower esophageal sphincter at EGJ (L).



Postoperative Protocol

1. Initiate sipping water immediately within the first 24 hours after POEM. Then a stepwise dietary advancement to liquids and soft diet over the next 24-48 hours after POEM.

2. All patients received high-dose proton-pump inhibitor medication to reduce gastro-esophageal reflux symptoms.

3. Discharge within 72 hours once a soft, low residual, puree diet is tolerable.

4. Postoperative patients who develop subcutaneous emphysema are closely monitored, as this condition typically resolves spontaneously without the need for additional therapeutic intervention

5. Routine follow up with clinical symptoms, monitoring Eckardt score and reflux symptoms. A timed-barium esophagography at 1 and 12 months is done due to a high-resolution esophageal manometry is unavailable at our institution.

Results

A total of 14 patients (N=14) were included in this study. The patient demographic data is shown in Table 2. The median age was 52 years, with a wide range (18–81 years), including 8 males (57%) and 6 females (43%). The median preoperative Body Mass Index (BMI) was 19.6 (14-24) kg/m^2. The median duration of symptoms prior to per-oral endoscopic myotomy (POEM) was 8 months (range: 2–120 months). All patients (100%) had no history of previous treatment for achalasia. Achalasia subtype distribution showed that 5 patients (35.7%) had the sigmoid type, while 9 patients (64.3%) had the non-sigmoid type. Preoperatively, the median Eckardt score was 7 (range: 4–11), and the median timed-barium esophagography (TBE) measurements at 5 minutes were 184 mm (range: 37–314 mm) for barium height and 53 mm (range: 31–138 mm) for barium width.

The POEM procedure outcomes and follow-up is demonstrated in Table 2. The technical success rate was 92.8% (n = 13), with one patient (7.2%) requiring conversion to endoscopic dilatation due to equipment technical issues, improper setting of energy device causing frequent bleeding upon mucosal tunneling. The median operative time was 162.5 (range: 95–225 minutes), and the median myotomy length was 8 cm (range: 8–11 cm). Estimated blood loss was minimal, with a median of 5 ml. Overall 30-day morbidity was 28.5% (n = 4). Intraoperative complications included one perforation (7.1%) and one bleeding event (7.1%). The perforation was at the esophagus and was controlled by endoscopic clips. The bleeding was encountered and controlled via endocoagulation graspers and endoscopic clips successfully. This patient was converted to endoscopic dilatation due to friable mucosa and contact bleeding during submucosal tunneling. Two patients (14.3%) developed postoperative aspiration pneumonia. The first patient needed mechanical



ventilation support and had difficulty in weaning ventilation, requiring the length of hospital stay for 22 days before being discharged home. The cause of pneumonia was due to elderly fragile patient not associated with severity of achalasia. The second patient that had pneumonia was clinically minor, not requiring advanced airway management or intubation. This patient was observed post operative for 2 days and switched to oral antibiotics and discharged home. The median length of hospital stay was 4 (2-22) days. Table 4 demonstrates comparison of outcomes after POEM. The most clinically significant finding is the profound reduction in the Eckardt score. The cohort shifted from a preoperative mean of 7 (moderate-to-severe symptoms) to a median of 1 (range: 0–3) at 1-year follow-up ($p < 0.001$). There also was statistically significant reduction in the TBE column height from 184 mm to 117 mm ($p = 0.018$). This 36.4% decrease suggests a marked reduction in stasis and improved bolus transit across the lower esophageal sphincter. The nutritional status, measured by BMI, showed a positive trajectory from 19.6 to 21.4 kg/m^2 ($p = 0.062$). The median postoperative follow-up time was 12 months.

Table 2 Patient demographic data.

Patient demographic data	Total (N = 14) N (%)
Age, median (range); years	52 (18-81)
Gender	
Male	8 (57%)
Female	6 (43%)
Comorbid disease	
No	11 (78%)
Yes	3 (22%)
BMI, median (range); kg/m^2	19.6 (14-24.2)
Duration of symptoms, median (range); months	8 (2-120)
Preoperative Eckardt score, median (range)	7 (4-11)
Achalasia	
Sigmoid type	5 (35.7%)
Non-sigmoid type	9 (64.3%)
Previous treatment	
No	14 (100%)
Yes	0
Pre-operative TBE at 5 minutes, median (range); mm	
Barium height	184 (37-314)
Barium width	53 (31-138)



Table 3 Per-oral endoscopic myotomy results.

Results	Total (N = 14) N (%)
Technical success	
Yes	13 (92.8%)
No (conversion to endoscopic dilatation)	1 (7.2%)
Operative time, median (range); min	162.5 (95-225)
Per-oral endoscopic myotomy length, median (range); cm	8 (8-11)
Estimated blood loss, median (range); ml	5 (4-20)
Complications	
Overall 30 day morbidity	4 (28.5%)
Intraoperative	
Perforation	1 (7.1%)
Bleeding	1 (7.1%)
Post operative	
Pneumonia	2 (14.3%)
Length of post-operative hospital stay, median (range); days	4 (2-22)
Clinical success	14 (100%)
1-year post operative Eckardt score	1 (0-3)
Post operative BMI, median (range); kg/m^2	21.4 (18-34)
Post operative TBE at 5 minutes, median (range); mm	
Barium height	117 (28-235)
Barium width	42 (31.6-86)
Post operative follow-up time (month)	12 (6-48)

Table 4 Comparison of postoperative results after POEM.

Parameters	Preoperative	Post operative	Difference	*p*-value
TBE Height (mm)	184 (37-314)	117 (28-235)	67 (9-79)	0.018
TBE Width (mm)	53 (31-138)	42 (31.6-86)	11 (-0.6-52)	0.121
Eckardt score	7 (4-11)	1 (0-3)	6 (4-8)	< 0.001
BMI (kg/m^2)	19.6 (14-24.2)	21.4 (18-34)	1.8 (1.4-9.8)	0.062

BMI, body mass index; TBE, timed-barium esophagography.



Discussion

Achalasia is a rare primary esophageal motility disorder due to impaired relaxation of the lower esophageal sphincter (LES) and absent peristalsis, leading to progressive dysphagia, regurgitation, and weight loss. Although treatment modalities have been developed to alleviate symptoms, including pneumatic dilation, botulinum toxin injections, and Heller myotomy. However, each of these treatments has limitations in terms of long-term efficacy and invasiveness.

Due to limited resources of high-resolution esophageal manometry in many hospitals in Thailand, the omission of this investigation, leading to unidentified types of Achalasia, may be a challenge in the counselling and decision of treatment of the patient. The advanced endoscopic era, peroral endoscopic myotomy (POEM) has gained widespread acceptance due to its effectiveness, shorter recovery time, and has the advantage for the ability to address different subtypes of achalasia. Therefore, the author, due to limitations of no esophageal manometry available, has justified that POEM is also suitable for all Achalasia subtypes. The limitations of this study for the clinical success, is monitored by Eckardt score < 3, rather than the integrated resting pressure (IRP). This study fails to objectively assess post operative gastroesophageal reflux disease (GERD), due to no available 24-hr pH monitoring data. The post operative GERD is only obtained clinically along with Eckardt score at follow-up. This procedure is technically challenging for a low volume center, and may need high experience in advanced endoscopy. This case series aims to contribute to the growing body of literature by analyzing the outcomes, complications, and long-term efficacy of POEM in a series of patients diagnosed with achalasia at our institution.

Larger cohorts are needed to improve statistical power and allow for more robust subgroup analyses, especially given the rarity of achalasia and the POEM procedure. Also a long-term follow-up is essential to assess the durability of symptom relief, late complications (such as gastroesophageal reflux disease), and quality of life outcomes.

Conclusion

The increasing utilization of POEM worldwide, the need for real-world data on its outcomes, particularly in diverse patient populations are necessary. Our institutional single-center case series has confirmed the feasibility of POEM with acceptable results. The initial experience can achieve good technical success, symptomatic improvement, and acceptable potential complications associated with POEM, contributing to the growing role as a primary treatment option. Long-term follow-up, larger sample size, manometry, and 24-hr pH monitoring is warranted for future studies.



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บทคัดย่อ

การให้อาหารเข้าทางเดินอาหารทางสายมีบทบาทสำคัญในการดูแลคุณภาพชีวิตของผู้ป่วยโรคมะเร็ง การผ่าตัดทำรูเปิดกระเพาะด้วยการส่องกล้องผ่านทางผิวหนังด้วยเทคนิควิธีแทงเป็นวิธีการรุกรานอย่างน้อยที่สุด ซึ่งใช้การส่องกล้องเพื่อช่วยในการสอดสายเข้าไปในกระเพาะอาหาร วิธีนี้มีข้อเด่นมากกว่าวิธีดึงเนื่องจากช่วยลดความเสี่ยงของการแพร่กระจายของมะเร็งไปยังเนื้อเยื่อรอบๆ สายให้อาหารทางผิวหนังโดยเฉพาะในผู้ป่วยมะเร็งศีรษะและคอหรือมะเร็งหลอดอาหาร แม้กระนั้นก็ยังพบข้อด้อย ได้แก่ ภาวะแทรกซ้อนจากเทคนิคนี้และราคาของวัสดุอุปกรณ์ เทคนิควิธีแทงสำหรับการผ่าตัดทำรูเปิดกระเพาะด้วยการส่องกล้องผ่านทางผิวหนังโดยใช้ไหมผ่านกับดักร่วมกับเครื่องถ่างโลหะอัลเคนได้รับการพัฒนาขึ้นโดยมีความปลอดภัย ประหยัด และทำได้ง่ายสำหรับดูแลโภชนาการในผู้ป่วยโรคมะเร็งกลุ่มนี้ กรณีศึกษาในรายงานนี้ ผู้ป่วยมะเร็งหลอดอาหารชายอายุ 59 ปี ได้รับการผ่าตัดด้วยเทคนิควิธีแทงสำหรับการผ่าตัดทำรูเปิดกระเพาะด้วยการส่องกล้องผ่านทางผิวหนังโดยใช้ไหมผ่านกับดักร่วมกับเครื่องถ่างโลหะอัลเคน ประสบผลสำเร็จและสามารถออกจากโรงพยาบาลได้ในวันที่สองหลังการผ่าตัดโดยไม่มีภาวะแทรกซ้อนใดๆ เมื่อติดตามต่อเนื่องที่ 4 สัปดาห์

Keywords: Push percutaneous endoscopic gastrostomy, Push PEG, Gastropexy, Esophageal cancer, Head and Neck cancer

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เทคนิควิธีแทงสำหรับการผ่าตัดทำรูเปิดกระเพาะด้วยการส่องกล้องผ่านทางผิวหนังโดยใช้ไหมผ่านกับดักร่วมกับเครื่องถ่างโลหะอัลเคนในผู้ป่วยมะเร็งหลอดอาหารระยะลุกลาม

วีดิทัศน์อิเล็กทรอนิกส์ทางศัลยศาสตร์คลินิก กดที่ภาพ:



For Video download please click link:
https://drive.google.com/file/d/1PqCiX1dM9c4GoKX70xaqY4XrWkrwyg_9/view?usp=sharing
วิดีโอ ขั้นตอนเทคนิควิธีแทงสำหรับการผ่าตัดทำรูเปิดกระเพาะด้วยการส่องกล้องผ่านทางผิวหนังโดยใช้ไหมผ่านกับดักร่วมกับเครื่องถ่างโลหะอัลเคนในผู้ป่วยมะเร็งหลอดอาหารระยะลุกลามผ่านมุมการส่องกล้องภายในกระเพาะอาหาร

JAGST 1/2026 Mahawongkajit

Journal of the Association of General Surgeons of Thailand under the Royal Patronage of HM the King
วารสารสมาคมศัลยแพทย์ทั่วไปแห่งประเทศไทยในพระบรมราชูปถัมภ์
Journal homepage : https://he02.tci-thaijo.org/index.php/agstjournal



Case Report: Innovative Push Percutaneous Endoscopic Gastrostomy By Means Of Gastropexy And Foley Catheter In A Patient With Advanced Esophageal Cancer

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ABSTRACT

Enteral tube feeding plays a vital role in maintaining the quality of life of patients with cancer. Percutaneous endoscopic gastrostomy (PEG) with the push technique is a minimally invasive method that uses endoscopy to assist in the insertion of a feeding tube into the stomach. This method is preferred over pull method as it minimizes the risk of cancer spreading to the surrounding tissue of stroma, especially in patients with head and neck or esophageal cancer. However, it has some drawbacks, such as the possibility of complications related to the feeding tube and economic concerns. A surgical technique called push-PEG using thread the thread through trap and Alken metal dilator (5TAMeD) has been developed to provide a safe and simple method for oncologic patients in need of nutritional support. In a case study, a 59-year-old man diagnosed with malignant esophageal cancer underwent the push-PEG with 5TAMeD procedure and experienced a successful outcome. The patient's condition remained stable after the surgery, he was discharged from the hospital on the second day, and had no complications during the 4-week follow-up period. This case demonstrates the effectiveness, safety, and cost-effectiveness of the push-PEG with 5TAMeD technique for providing enteral nutrition support to advanced esophageal cancer patients.

Keywords: Push percutaneous endoscopic gastrostomy, Push PEG, Gastropexy, Esophageal cancer, Head and Neck cancer

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Push method for percutaneous endoscopic gastrostomy using thread the thread though trap and alken metal dilator technique in advanced esophageal cancer patient:

For E-Videos click images below:



For Video download please click link:
https://drive.google.com/file/d/1PqCiX1dM9c4GoKX70xaqY4XrWkrwyg_9/view?usp=sharing
วิดีโอ ขั้นตอนเทคนิควิธีแทงสำหรับการผ่าตัดทำรูเปิดกระเพาะด้วยการส่องกล้องผ่านทางผิวหนังโดยใช้ไหมผ่านกับดักร่วมกับเครื่องถ่างโลหะอัลเคนในผู้ป่วยมะเร็งหลอดอาหารระยะลุกลามผ่านมุมการส่องกล้องภายในกระเพาะอาหาร

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บทนำ

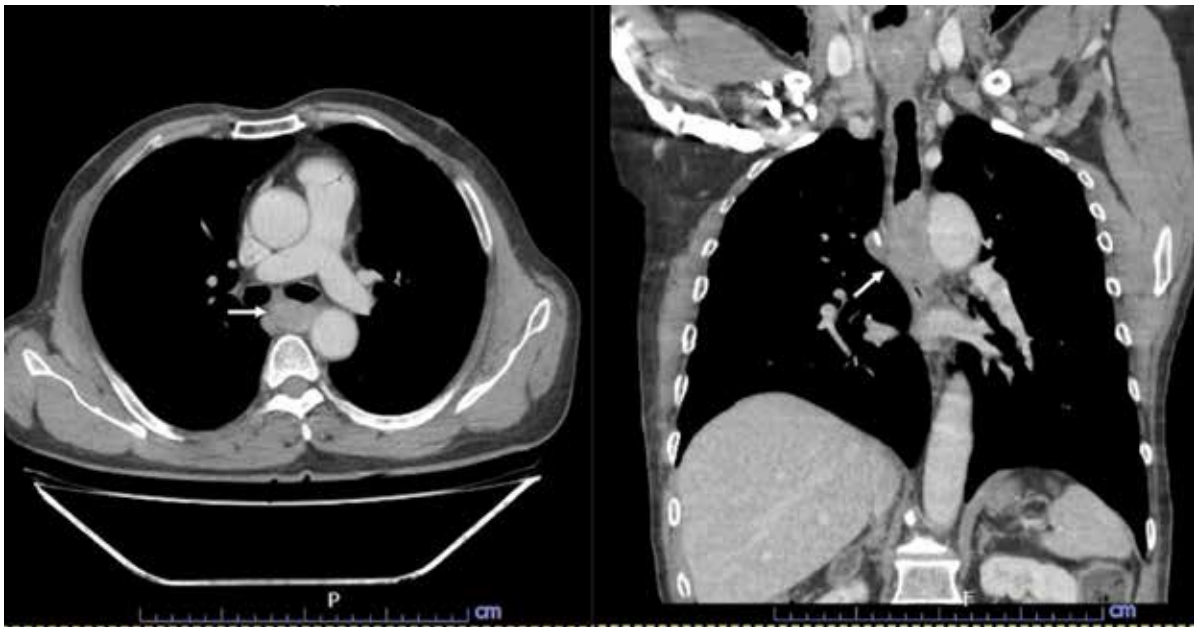
ภาวะทุพโภชนาการ (malnutrition) เป็นหนึ่งในปัญหาสำคัญของผู้ป่วยมะเร็ง[1] โดยเฉพาะมะเร็งศีรษะและคอ[2,3] หรือมะเร็งหลอดอาหาร[3,4] ซึ่งจะมีปัญหาเกี่ยวกับการกลืนอาหารร่วมด้วยอันเป็นปัจจัยเสริมที่ทำให้เกิดภาวะทุพโภชนาการรุนแรงมากขึ้น การผ่าตัดทำรูเปิดกระเพาะด้วยการส่องกล้องผ่านทางผิวหนัง (percutaneous endoscopic gastrostomy; PEG) ด้วยเทคนิควิธีแทง (push method) เป็นวิธีการรุกรานอย่างน้อยที่สุด (minimally invasive) ซึ่งใช้การส่องกล้องเพื่อช่วยในการสอดสายเข้าไปในกระเพาะอาหาร วิธีนี้มีข้อเด่นมากกว่าวิธีดึง (pull method) เนื่องจากช่วยลดความเสี่ยงของการแพร่กระจายของมะเร็งศีรษะและคอหรือมะเร็งหลอดอาหารไปยังเนื้อเยื่อรอบๆ สายให้อาหารทางผิวหนัง[4-6] แม้กระนั้นก็ยังพบข้อด้อย ได้แก่ ภาวะแทรกซ้อนจากเทคนิคนี้และราคาของวัสดุอุปกรณ์[4,7] ปัจจุบันมีวิธีการและวัสดุอุปกรณ์สำหรับวิธีแทงมากมายในท้องตลาด[6] การใช้สายสวนปัสสาวะ (foley catheter) ถือเป็นอีกหนึ่งวิธีการที่ปลอดภัยและมีการใช้ในหลายสถาบัน เนื่องจากราคาถูกและมีในทุกโรงพยาบาล[8] เทคนิควิธีแทงสำหรับการผ่าตัดทำรูเปิดกระเพาะด้วยการส่องกล้องผ่านทางผิวหนังโดยใช้ไหมผ่านกับดักร่วมกับเครื่องถ่างโลหะอัลเคน (thread the thread though trap and alken metal dilator; 5TAMeD) ได้รับการพัฒนาขึ้นโดยมีความปลอดภัย ประหยัด และทำได้ง่ายสำหรับดูแลโภชนาการในผู้ป่วยโรคมะเร็งกลุ่มนี้[9]

ปฏิบัติงาน

กรณีศึกษาในรายงานนี้ ผู้ป่วยมะเร็งหลอดอาหารชายอายุ 59 ปี มาด้วยอาการกลืนลำบาก (dysphagia) น้ำหนัก

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ลด 9 กิโลกรัมภายใน 2 เดือน ผู้ป่วยได้รับการส่องกล้อง (endoscopy) ร่วมกับการตัดเนื้อออกตรวจ (biopsy) โดยรายงานพยาธิวิทยาพบว่าเป็นมะเร็งเซลล์สความัส (squamous cell carcinoma) ผลการถ่ายภาพรังสีส่วนตัดอาศัยคอมพิวเตอร์ (computed tomography) พบมะเร็งอยู่ที่ทรวงอกช่วงบนและกลาง (upper and middle thoracic) ติดกับท่อลม (trachea) และหลอดลมประธานด้านซ้าย (left main bronchus) (รูปที่ 1) ประเมินการจัดระยะทางคลินิก (clinic staging) ในผู้ป่วยรายนี้ได้เป็น cT4bN+M0 ผู้ป่วยรายนี้ได้รับการพิจารณาเทคนิค 5TAMeD เพื่อให้อาหารเข้าทางเดินอาหารทางสายสำหรับดูแลภาวะโภชนาการ



รูปที่ 1 การถ่ายภาพรังสีส่วนตัดอาศัยคอมพิวเตอร์ทรวงอก (chest computed tomography) พบมะเร็ง (ลูกศร) อยู่ที่ทรวงอกช่วงบนและกลาง (upper and middle thoracic) ติดกับท่อลม (trachea) และหลอดลมประธานด้านซ้าย (left main bronchus)

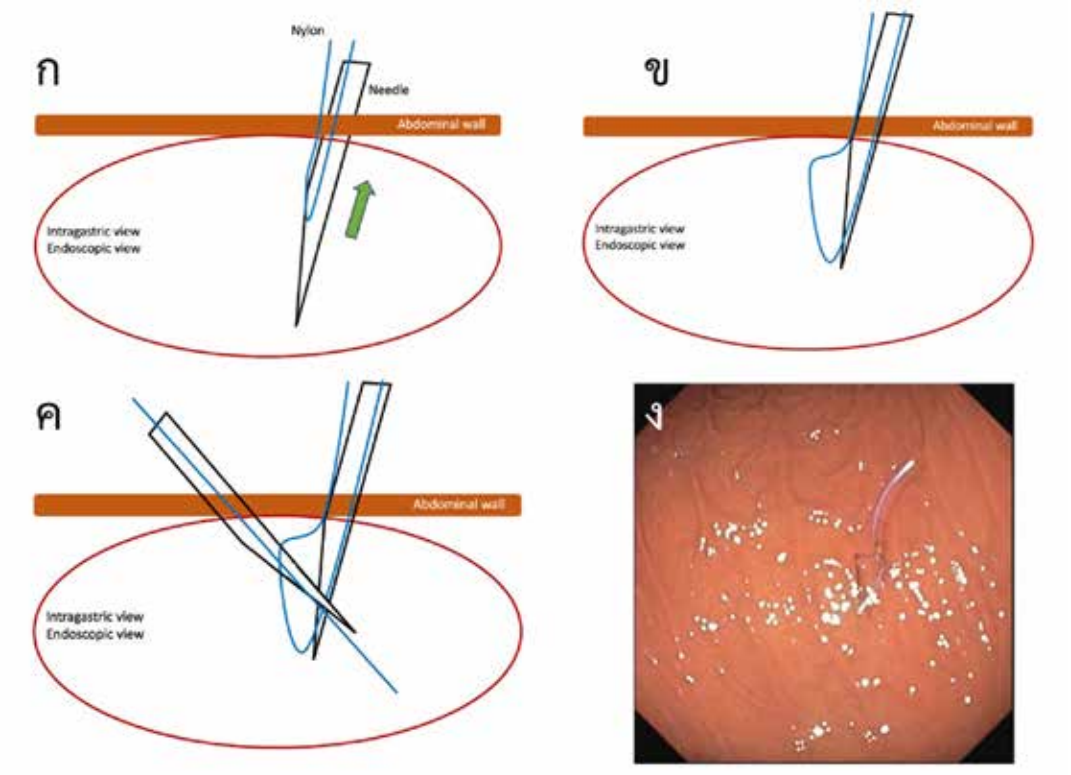
วิธีการดำเนินงาน (วีดิทัศน์อิเล็กทรอนิกส์)

เลือกใช้กล้องที่มีเส้นผ่านศูนย์กลางขนาดเล็กเพื่อผ่านก้อนมะเร็งซึ่งส่งผลทำให้หลอดอาหารแคบ โดยกรณีศึกษาในรายงานนี้ใช้ pediatric gastroscopy (GIF-XP180N; Olympus Corporation) เพื่อการมองเห็นตลอดหัตถการประเมินตำแหน่งที่เหมาะสมสำหรับ PEG ด้วยการส่องแสงผ่าน (transillumination) และการกดนิ้ว นำเข็มสำหรับการเจาะน้ำไขสันหลังเบอร์ 18 อันแรกที่ร้อยไหมไนลอน 2-0 ผ่านรูเข็มแล้วทำการจับรวบกับเข็ม แทงผ่านเข้าภายในกระเพาะอาหารแล้วถอยเล็กน้อยทำให้เกิดลักษณะเป็นบ่วงกับดัก (รูปที่ 2ก, 2ข) แทงเข็มสำหรับการเจาะน้ำไขสันหลังเบอร์ 18 อันที่สองเข้าภายในบ่วงกับดักแล้วทำการร้อยไหมไนลอน 2-0 ผ่านเข็มโดยห่างจากตำแหน่งเข็มอันแรก 2 เซนติเมตร (รูปที่ 2ค, 2ง) จากนั้นทำการดึงเข็มอันที่สอง

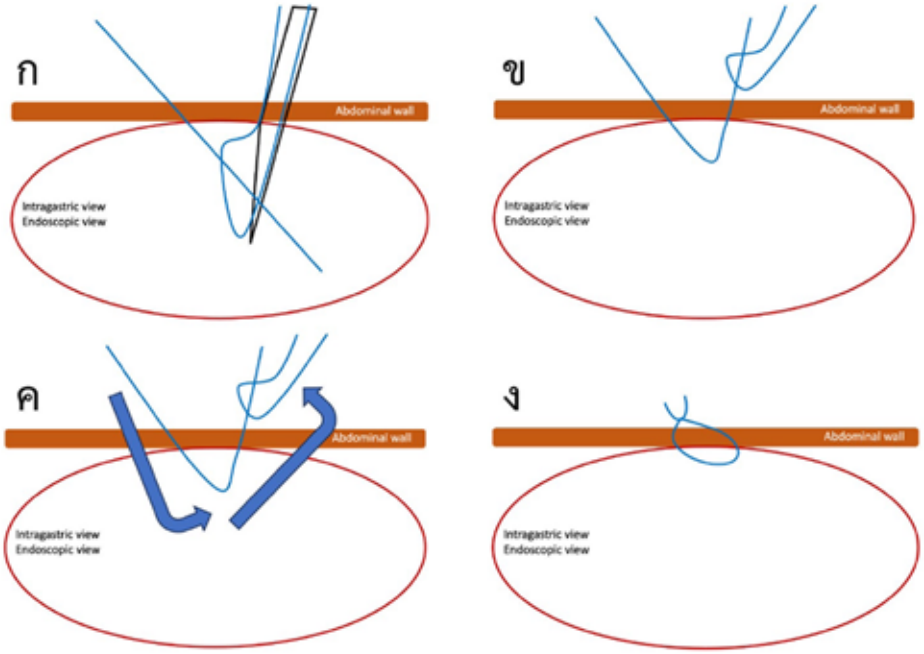
(รูปที่ 3ก) ตามด้วยเข็มอันแรกพร้อมไหมออก ทำให้เกิดลักษณะการผ่านของไหมจากด้านนอกผ่านเข็มอันที่สองเข้าสู่กระเพาะอาหารแล้วออกไปภายนอกผ่านเข็มอันแรก (รูปที่ 3ข, 3ค) ทำการผูกไหม (รูปที่ 3ง) ทำการแทงเข็มตามกระบวนการเดิมอีกครั้งโดยถัดออกไปประมาณ 3-4 เซนติเมตร ตำแหน่งระหว่างไหมผูกทั้งสองถือเป็นตำแหน่งที่ผนังหน้าท้องแนบกับผนังกระเพาะอาหารซึ่งจะใช้สำหรับการแทงเข็มที่มีชั้นนอกเป็นปลอกพลาสติก (over-the-needle catheter) เบอร์ 18 เพื่อใส่ลวดนำ (guidewire) เคลือบสารชอบน้ำ (hydrophilic) จากนั้นใช้เครื่องถ่างโลหะอัลเคน (alken metal dilator) ค่อย ๆ ถ่างขยายเพิ่มขนาดจาก 6 French (Fr) จนถึง 24-Fr (รูปที่ 4ก) แล้วนำเครื่องถ่างโลหะออกแทนที่ด้วยสายสวนปัสสาวะขนาด 20-Fr (รูปที่ 4ข) ทดสอบการให้น้ำผ่านสายเข้าสู่ภายในกระเพาะอาหาร ทำการเย็บผูกสายกับผนังหน้าท้อง

วีดิทัศน์อิเล็กทรอนิกส์ ขั้นตอนเทคนิควิธีแทงสำหรับการผ่าตัดทำรูเปิดกระเพาะด้วยการส่องกล้องผ่านทางผิวหนังโดยใช้ไหมผ่านกับดักร่วมกับเครื่องถ่างโลหะอัลเคนในผู้ป่วยมะเร็งหลอดอาหารระยะลุกลามผ่านมุมการส่องกล้องภายในกระเพาะอาหาร

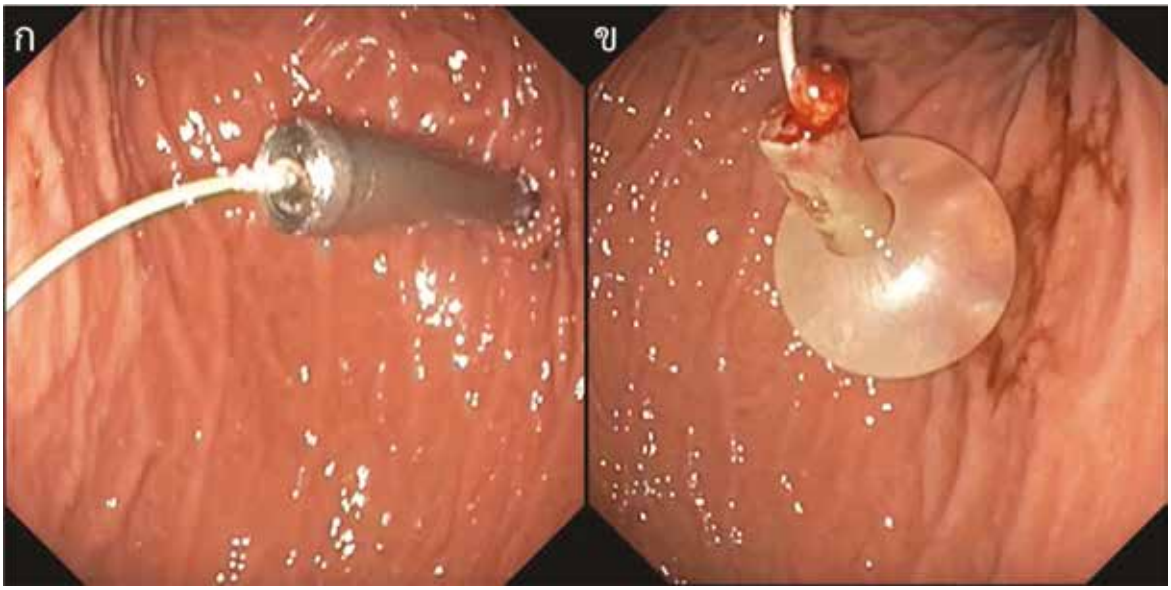
For E-Videos click images below:
https://drive.google.com/file/d/1PqCiX1dM9c4GoKX70xaqY4XrWkrwyg_9/view?usp=sharing



รูปที่ 2 การทำบ่วงกับดัก (2ก, 2ข) เข็มและไหมผ่านเข้าบ่วงกับดัก (2ค, 2ง)



รูปที่ 3 ถอยเข็มออก (3ก) การผ่านของไหมจากด้านนอกผ่านเข็มอันที่สองเข้าสู่กระเพาะอาหารแล้วออกไปภายนอกผ่านเข็มอันแรก (3ข, 3ค) ผูกไหมทำให้ผนังหน้าท้องแนบกับผนังกระเพาะอาหาร (3ง)



รูปที่ 4 เครื่องถ่างโลหะอัลเคน (4ก) นำเครื่องถ่างโลหะออกแทนที่ด้วยสายสวนปัสสาวะ (4ข)



ผลการดำเนินงาน

หลังการผ่าตัดวันแรกผู้ป่วยมีสัญญาณชีพคงที่ ปวดแผลเล็กน้อย ระดับความปวด (pain score) 2 จาก 10 ผู้ป่วยรับการให้อาหารเข้าทางเดินอาหารทางสายได้ดี สามารถกลับบ้านได้ในวันที่สองหลังผ่าตัด ติดตามผู้ป่วยที่ 1 เดือน พบว่าไม่มีภาวะแทรกซ้อนจากการผ่าตัดทำรูเปิดกระเพาะด้วยการส่องกล้องผ่านทางผิวหนังและสามารถรับอาหารซึ่งมีพลังงานได้ตามการคำนวน

สำหรับราคาอุปกรณ์เทคนิควิธีแทงสำหรับการผ่าตัดทำรูเปิดกระเพาะด้วยการส่องกล้องผ่านทางผิวหนังโดยใช้ไหมผ่านกับดักร่วมกับเครื่องถ่างโลหะอัลเคน ดังแสดงในตารางที่ 1

ตารางที่ 1 ราคาอุปกรณ์เทคนิควิธีแทงสำหรับการผ่าตัดทำรูเปิดกระเพาะด้วยการส่องกล้องผ่านทางผิวหนังโดยใช้ไหมผ่านกับดักร่วมกับเครื่องถ่างโลหะอัลเคน (Push method for percutaneous endoscopic gastrostomy using thread the thread though trap and alken metal dilator; 5TAMeD) ข้อมูลโรงพยาบาลธรรมศาสตร์เฉลิมพระเกียรติ ณ เดือนเมษายน 2568

อุปกรณ์	ราคาต่อชิ้น (บาท)	จำนวน (ชิ้น)	ราคารวมต่อหัตถการ (บาท)
เข็มสำหรับการเจาะน้ำไขสันหลัง เบอร์ 18	48	2	96
ไนลอน 2-0	55	3	165
เข็มที่มีชั้นนอกเป็นปลอกพลาสติก เบอร์ 18	23	1	23
ลวดนำเคลือบสารชอบน้ำ	650	1	650
สายสวนปัสสาวะขนาด 20-Fr	27	1	27
รวม			**961**

วิจารณ์

เทคนิควิธีแทงสำหรับการผ่าตัดทำรูเปิดกระเพาะด้วยการส่องกล้องผ่านทางผิวหนังถือเป็นวิธีการรุกรานอย่างน้อยที่สุดที่หลีกเลี่ยงการแพร่กระจายของมะเร็งไปยังเนื้อเยื่อรอบๆ สายให้อาหารทางผิวหนังในผู้ป่วยมะเร็งศีรษะและคอหรือมะเร็งหลอดอาหาร[4-6] โดยปัจจุบันมีเทคนิคและอุปกรณ์สำหรับวิธีแทงหลากหลายในท้องตลาด[6] แต่ยังคงพบรายงานภาวะแทรกซ้อนโดยเฉพาะท่อเลื่อนหลุด (tube dislodgement)[7] นอกจากนี้ราคาของอุปกรณ์ที่ค่อนข้างสูงถือเป็นอีกข้อจำกัดหนึ่งที่สำคัญของการเข้าถึงวิธีการดังกล่าวซึ่งพบจากการศึกษาของผู้นิพนธ์ในประเทศไทย[4] ผู้ป่วยที่มีเศรษฐานะยากจนต้องได้รับการผ่าตัดแบบเปิดทำรูเปิดกระเพาะ (open gastrostomy) แม้วิธีการนี้จะเป็นวิธีการดั้งเดิมที่ทำกันต่อเนื่องมาอย่างยาวนานแต่มีปัญหาหลักคือ การปวดแผลผ่าตัด แผลเป็น (scar) และอาจเกิดภาวะแทรกซ้อนของบาดแผล (wound complication) นอกจากนี้ในหลายโรงพยาบาลและสถาบันมีการใช้สายสวนปัสสาวะประยุกต์ทดแทนสำหรับการให้อาหารเข้า



ทางเดินอาหารทางสายผ่านกระเพาะอาหารเพื่อประหยัดงบประมาณ ซึ่งมีการศึกษายืนยันถึงประสิทธิภาพ ความปลอดภัย และความสะดวก[10] โดยมีรายงานการศึกษาในประเทศไทยที่ได้ผลเช่นเดียวกัน[11]

เมื่อพิจารณาราคาอุปกรณ์เทคนิควิธีแทงสำหรับการผ่าตัดทำรูเปิดกระเพาะด้วยการส่องกล้องผ่านทางผิวหนังที่มีจำหน่ายอยู่ในปัจจุบัน ราคา 17,716 บาท (ราคาสินค้าที่จำหน่ายในโรงพยาบาลที่ใช้เทคนิควิธีแทงและการเย็บยึดกระเพาะ) เทียบกับเทคนิค 5TAMeD พบว่าประหยัดค่าใช้จ่ายได้ 16,755 บาทหรือร้อยละ 94.58 โดยในทางปฏิบัติสำหรับประเทศไทยลวดนำยังสามารถผ่านการทำไร้เชื้อ (sterilization) แล้วนำกลับมาใช้ซ้ำ ซึ่งสามารถประหยัดค่าใช้จ่ายลงได้อีกอย่างมาก

จากเหตุดังกล่าวผู้นิพนธ์และคณะได้ทำการพัฒนาเทคนิค 5TAMeD ซึ่งจากกรณีศึกษาในรายงานนี้แสดงให้เห็นถึงประสิทธิภาพในการดูแลภาวะโภชนาการ ความปลอดภัย ความปวดน้อยหลังผ่าตัด และมีราคาถูก

TAMeD จากพจนานุกรมเคมบริดจ์แปลว่า “to control something dangerous or powerful”[12] ส่วนพจนานุกรมอังกฤษ-ไทย แปลว่า “เชื่อง เชื่อฟัง ควบคุม”[13] ซึ่งเทคนิค 5TAMeD นั้น ผู้นิพนธ์ให้คำจำกัดความ 5 ข้อตามความหมายที่สัมพันธ์กับหัตถการคือ 1) ควบคุมเข็มอันแรกที่ร้อยไหมสามารถทำให้เกิดบ่วงกับดักได้ง่าย 2) ควบคุมเข็มอันที่สองร้อยไหมเข้าบ่วงกับดักได้ง่าย 3) ควบคุมทำซ้ำในข้อ 1 และ 2 ได้ง่าย 4) ควบคุมเครื่องถ่างโลหะอัลเคนค่อย ๆ ถ่างขยายเพิ่มขนาด ทำภายใต้มุมมองการส่องกล้องซึ่งมีความปลอดภัย 5) ควบคุมการแทนที่ด้วยสายสวนปัสสาวะหรือสายให้อาหารเข้าทางเดินอาหารอื่นได้ง่าย

อย่างไรก็ตามการศึกษานี้ยังมีข้อจำกัดเนื่องจากเป็นเพียงกรณีศึกษาโดยติดตามผู้ป่วยที่ 1 เดือนหลังผ่าตัด นอกจากนี้หากก้อนมะเร็งมีการอุดกั้นทำให้ไม่สามารถผ่าน pediatric gastroscopy อาจต้องพิจารณาการผ่าตัดแบบเปิดทำรูเปิดกระเพาะเพื่อให้การดูแลภาวะโภชนาการสำหรับกรณีนี้ แผนการศึกษาของหัตถการนี้ถัดไปควรทำในผู้ป่วยที่มีจำนวนมากขึ้น หลากหลายสถาบัน โดยทำการเปรียบเทียบกับวิธีการอื่น และติดตามหลังการผ่าตัดทั้งระยะสั้นและระยะยาว จะเป็นสิ่งที่ช่วยสร้างองค์ความรู้ให้กับเทคนิค 5TAMeD ในผู้ป่วยมะเร็งศีรษะและคอ และมะเร็งหลอดอาหารต่อไปในอนาคต

กิตติกรรมประกาศ

ขอบคุณ ผศ.นพ.ธีรยุทธ ตั้งไพฑูรย์ และ พว.เสาวนีย์ เบ็ญมาศ สำหรับการให้คำแนะนำการใช้เครื่องถ่างโลหะอัลเคนซึ่งถือเป็นส่วนสำคัญสำหรับการพัฒนาเทคนิค 5TAMeD เพื่อใช้กับผู้ป่วยมะเร็งศีรษะและคอ และมะเร็งหลอดอาหาร

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Original Article

Transient Femoral Nerve Dysfunction During Open Lichtenstein Repair Under Local Anesthesia: A Retrospective Cohort Study

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ABSTRACT

Background: Transient femoral nerve dysfunction (TFND) following inguinal hernia repair under local anesthesia is likely underrecognized because symptoms are typically self-limited. This study evaluated the incidence, clinical presentation, and factors associated with TFND after open inguinal hernia repair under local anesthesia.

Methods: A retrospective cohort study was conducted in 636 consecutive patients undergoing open Lichtenstein inguinal hernia repair under local anesthesia between March 2018 and March 2026. TFND was defined as transient postoperative sensory disturbance over the femoral dermatome and/or motor weakness impairing knee extension or weight-bearing ambulation. Patients were assessed postoperatively until symptom resolution and discharge. Univariable and multivariable logistic regression analyses were performed to identify factors associated with TFND.

Results: TFND occurred in 74 patients (11.6%), including 26 (4.1%) with isolated sensory dysfunction and 48 (7.6%) with motor weakness. All neurological deficits resolved spontaneously within 1.5 – 6 hours without permanent sequelae or unplanned admission. Multivariable analysis identified complex hernia (adjusted odds ratio [aOR] 5.93, $p < 0.001$), advanced operative phase (phase 2: aOR 6.78, $p = 0.001$; phase 3: aOR 13.65, $p < 0.001$), female sex (male sex: aOR 0.30, 95% CI 0.13–0.66; $p = 0.017$), and left-sided hernia (right-sided hernia: aOR 0.45, 95% CI 0.29–0.83; $p = 0.004$) as independent factors associated with TFND. Outpatient day surgery was independently associated with lower TFND risk (aOR 0.41, $p = 0.006$). The composite case-mix index increased progressively across phases ($p < 0.001$).

Conclusions: TFND after open inguinal hernia repair under local anesthesia occurred in 11.6% of patients but was uniformly transient and self-limited, resolving spontaneously within 1.5 to 6 hours without permanent neurological sequelae or unplanned hospital admission. Multivariable analysis

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identified complex hernia (aOR 5.93), advanced operative phase (phase 2: aOR 6.78; phase 3: aOR 13.65), female sex, and left-sided hernia as independent risk factors for TFND, while ODS was independently protective (aOR 0.41). These findings indicate that TFND is predominantly associated with operative complexity and evolving anesthetic infiltration behavior across the surgeon experience trajectory, rather than a simple dose-dependent effect of local anesthetics. The composite case-mix index demonstrated progressive increase in operative burden across phases supporting the multidimensional nature of TFND risk in this setting. Refinement of infiltration technique, including ultrasound guidance in complex cases, may improve perioperative safety.

Keywords: Transient femoral nerve dysfunction (TFND), Lichtenstein hernia repair, Local anesthesia, Inguinal hernia, One-day surgery (ODS)

Introduction

Inguinal hernia repair is one of the most frequently performed surgical procedures globally, with an estimated 20 million operations conducted annually.[1] While surgical approaches have evolved to include laparoscopic (TEP, TAPP) and robotic-assisted techniques, open mesh repair remains the gold standard, particularly the Lichtenstein tension-free technique.[1,2] Due to its shorter learning curve, cost-effectiveness, and low complication rates, it is highly recommended by the HerniaSurge Guidelines (2018, 2023). Specifically, performing this procedure under local anesthesia (LA) is strongly recommended as the first-line choice for elderly and frail patients with significant comorbidities.[1,3] This approach facilitates rapid recovery, minimizes the risk of urinary retention and is a cornerstone of Ambulatory or One Day Surgery (ODS) programs, which have been a national healthcare priority in Thailand since 2019.[4]

Despite its high safety profile, regional anesthesia in the inguinal area is not without challenges. Beyond systemic toxicity (LAST), Transient Femoral Nerve Dysfunction (TFND) is a clinical concern. The femoral nerve (L2–L4) lies posterior to the transversalis fascia and enters the thigh beneath the inguinal ligament within the femoral sheath, potentially placing it at particular risk of involvement during inguinal field infiltration.[5,6] Reported TFND incidence ranges from 3% to 8.8% across prior studies.[8,9,10] These rates likely underestimate the true incidence because most previous reports did not employ systematic postoperative neurological assessment and primarily captured motor deficits, potentially overlooking transient sensory disturbances. Furthermore, existing evidence is limited to small



case series (n = 10–54)[8,9,10] and has not examined independent risk factors using multivariable analysis, nor characterized how operative case-mix evolves across the surgeon experience continuum. To provide a biological rationale for TFND, additional anatomical background from Gray's Anatomy and Skandalakis' Surgical Anatomy was incorporated, highlighting the anatomical relationship between the deep inguinal ring, iliopubic tract, femoral canal, and femoral nerve, and supporting a potential pathway for local anesthetic spread from the inguinal region to the femoral compartment.[5,6]

Although temporary, TFND carries meaningful clinical consequences in the ODS setting. Impaired weight-bearing ambulation from quadriceps weakness substantially increases the risk of postoperative falls during early mobilization — a critical patient safety concern for same-day discharge. Unexpected neurological symptoms may necessitate prolonged recovery room observation and may ultimately precipitate unplanned hospital admission or delayed discharge.

Previous studies have suggested several potential mechanisms for transient femoral nerve dysfunction (TFND). Higher local anesthetic doses may increase the likelihood of anesthetic spread beyond the intended tissue planes, potentially resulting in transient femoral nerve blockade.[10] Complex hernias often require broader dissection and hydrodissection, which may facilitate anesthetic spread toward the femoral compartment.[8] Surgeon experience may also influence anesthetic infiltration behavior and case selection, thereby modifying TFND risk.[9] However, the relative contribution and independence of these factors remain unclear.

Therefore, this study aimed to evaluate the incidence, clinical characteristics, and independent factors associated with TFND following open Lichtenstein inguinal hernia repair under local anesthesia in a large consecutive single-surgeon cohort spanning an eight-year period, and to characterize the evolution of operative case-mix across surgeon experience phases.

Materials and Methods

Study Design and Population

This study was a retrospective cohort analysis conducted at Phatthalung Hospital, Thailand. We included all adult patients who underwent inguinal hernia repair under local anesthesia over an 8-year period (March 2018 to March 2026).

Participants

Inclusion Criteria: All adult patients who underwent open inguinal hernia repair under local anesthesia performed by a single surgeon (the author).

Exclusion Criteria: Patients with pre-existing neurological deficits of the lower extremities, incomplete medical records, or those whose anesthesia plan was converted to general or spinal anesthesia intraoperatively.

All procedures were performed by a single experienced general surgeon (>600 inguinal hernia cases) using a standardized operative and anesthetic protocol, thereby reducing variability related to different operators.

Based on previous reports of femoral nerve palsy following ilioinguinal-iliohypogastric block and established groin anatomy, we hypothesized that TFND may result from local anesthetic spread through deep tissue planes toward the femoral compartment. Surgeon experience was considered an indirect determinant through evolving case selection, operative complexity, and infiltration behavior. The proposed conceptual framework is illustrated in Figure 1.

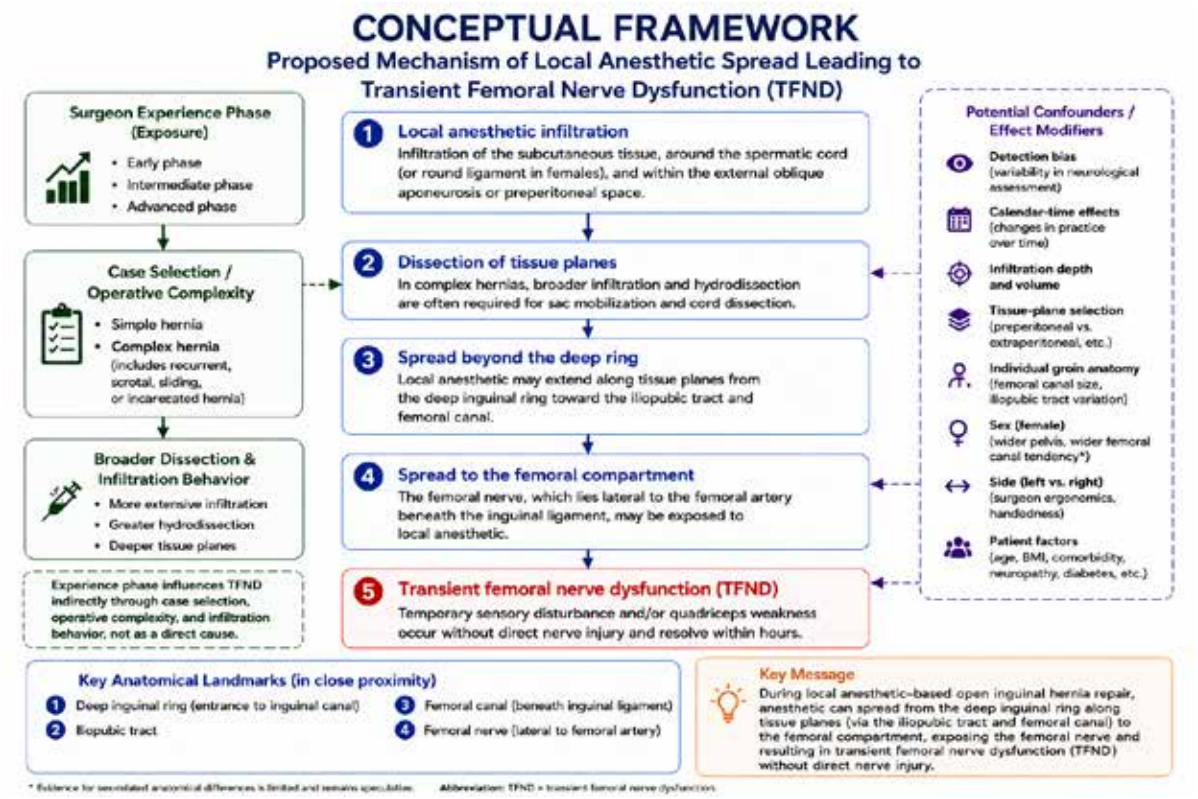


Figure 1 Proposed conceptual framework of factors associated with transient femoral nerve dysfunction (TFND).

Author- generated conceptual framework. The framework illustrates the hypothesized relationship between surgeon experience, operative complexity, anesthetic infiltration behavior, and subsequent local anesthetic spread toward the femoral compartment leading to transient femoral nerve dysfunction. The model was developed a priori to guide variable selection and interpretation of study findings.

Surgical Procedure

Open Lichtenstein tension-free mesh repair was performed under local anesthesia with monitored anesthesia care (MAC). Stepwise ilioinguinal and iliohypogastric nerve blocks, followed by layered local infiltration using diluted Lidocaine and Bupivacaine solutions, were applied according to a standardized institutional protocol.[13,14,15,16] Supplemental infiltration was administered intraoperatively as required according to operative complexity and patient discomfort. (Figure 2)

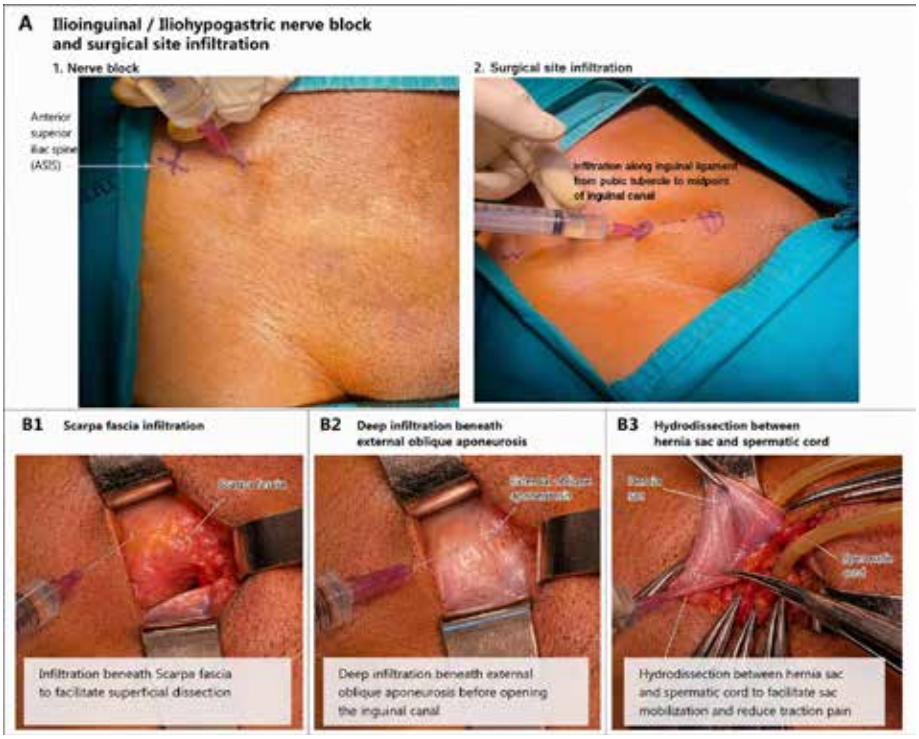


Figure 2 Operative technique of inguinal hernia repair under local anesthesia.
(A) Ilioinguinal and iliohypogastric nerve block followed by local infiltration at incision site (level of internal inguinal ring to external inguinal ring at pubic tubercle)
(B1) Infiltration beneath Scarpa fascia during early dissection.
(B2) Deep infiltration beneath the external oblique aponeurosis before opening the inguinal canal.
(B3) Hydrodissection between the hernia sac and spermatic cord facilitating sac mobilization and reducing traction pain.

Outcome Measures and Variables

The primary outcome was transient femoral nerve dysfunction (TFND), defined as transient postoperative sensory disturbance and/or motor weakness within the femoral nerve distribution identified immediately after surgery and resolving completely within 24 hours (pre-specified outer limit for outcome ascertainment). In this cohort, all observed deficits resolved within 1.5–6 hours; no case required reclassification as a non-transient deficit.Variable

Postoperative neurological assessment was performed by the operating surgeon (T.P.) immediately following emergence from monitored anesthesia care (MAC), prior to discharge from the recovery area. All 636 consecutive cases underwent a standardized two-component protocol. Sensory function was evaluated using pin-prick testing with an unfolded paper clip applied to the anterior thigh and the medial aspect of the knee on the operative side, with direct comparison to the contralateral side; asymmetric or diminished pain perception constituted a positive sensory finding. Motor function was assessed in two sequential steps: first, active knee extension against gravity compared with the contralateral limb; second, surgeon-assisted standing with full weight-bearing on the operative limb — inability to extend the knee, asymmetric weakness on comparison, failure to bear full weight unassisted, or tendency to fall was recorded as motor weakness. TFND was diagnosed when either component was positive. In patients with confirmed TFND, repeated assessments were performed at regular intervals until complete symptom resolution; discharge was permitted only after full neurological recovery was confirmed on repeat examination. For ODS patients, postoperative telephone follow-up was performed according to the institutional ODS protocol by ODS nurses at 24 hours, 2 days, and 3 days after surgery to assess symptom resolution and detect any delayed or persistent neurological deficits. Inpatients with confirmed TFND underwent serial bedside neurological reassessment until complete resolution was documented prior to ward discharge. All patients — both ODS and inpatients — attended a scheduled one-month outpatient follow-up, at which wound healing, general recovery, and neurological status were formally evaluated.

Definitions and Consolidation

To ensure statistical robustness and prevent model overfitting, primary predictors were categorized and consolidated based on clinical relevance:

Hernia complexity was classified according to the Nyhus classification system[17,18]. For statistical analysis, Nyhus type I hernias were categorized as “simple,” whereas Nyhus types II–IV, including wide neck indirect, direct, pantaloon, femoral, and recurrent hernias, were categorized as “complex”



to improve statistical robustness and maintain an adequate events-per-variable ratio.

Surgeon experience was categorized into three operative phases according to cumulative case volume: phase 1 (cases 1–200), phase 2 (201–400), and phase 3 (> 400 cases).

Surgical Setting: Patients were grouped into One Day Surgery (ODS) or Inpatient care models.

Total dosages of Bupivacaine and Lidocaine were calculated as mg/kg to evaluate their association with TFND.

Outcome: The primary outcome was the incidence of Transient Femoral Nerve Dysfunction (TFND)

Data Quality Control

All data were extracted by the primary investigator (T.P.) from original medical records using a standardized data extraction form. Data completeness and consistency were verified before statistical analysis.

Statistical Analysis

Continuous variables were summarized as mean ± standard deviation or median (interquartile range), while categorical variables were expressed as frequencies and percentages. Univariable logistic regression analysis was initially performed to identify variables associated with TFND.

Clinically relevant variables, including operative complexity, surgeon experience phase, operative setting (ODS versus inpatient), operative duration, anesthetic dosage per body weight, sex, and operative side, were entered into multivariable logistic regression models regardless of univariable statistical significance. A reduced final model was presented to preserve model stability and events-per-variable adequacy. Model discrimination was assessed using receiver operating characteristic (ROC) analysis and area under the curve (AUC). Multicollinearity was evaluated using variance inflation factors (VIF).

Composite case-mix index.

To quantify the evolution of operative burden across surgeon experience phases independently of phase itself, a composite case-mix index was constructed for each patient. The index was the individual predicted probability of TFND from: logit(P[TFND]) = $\beta 0 + \beta 1$(complexity) + $\beta 2$(bupivacaine mg/kg), with complexity coded 0/1 (Nyhus I vs. II–IV) incorporating hernia complexity (simple vs. complex) and bupivacaine dose per body weight (mg/kg) as sole predictors, with operative experience phase intentionally excluded. This approach isolates the contribution of anatomical complexity and anesthetic utilization two factors independently associated with TFND from the phase variable under investigation. The resulting index provides a continuous, patient-level, phase-independent estimate of operative burden, ranging from 0 to 1. Mean case-mix index values were compared across experience phases using the Kruskal Wallis test, with post-hoc pairwise Mann–Whitney U tests corrected by the Bonferroni

method. A linear trend across ordered phases was evaluated by linear regression of the index on phase number (1, 2, 3). Statistical significance was defined as $p < 0.05$ for all analyses. All statistical analyses were performed using R version 4.5.3 (R Foundation for Statistical Computing, Vienna, Austria).

A reduced final model was derived using backward elimination guided by Akaike Information Criterion (AIC) minimization. Variables were retained if their removal increased AIC or if they were deemed clinically essential, with a minimum events-per-variable ratio of ≥10 maintained throughout.

The analytic dataset was complete for all study variables. Patients with incomplete medical records had been excluded according to the pre-specified exclusion criteria, and no missing data imputation was required. Univariable analyses in Table 2 were performed solely for the purpose of variable selection and descriptive characterization of individual associations, and not as hypothesis-testing procedures in their own right. Correction for multiple comparisons was deliberately not applied to these 13 univariable tests, consistent with standard practice in logistic regression model building, in which such correction would inappropriately restrict variable entry and risk excluding clinically important predictors. The multivariable model, which accounts for the simultaneous interplay of all predictors, provides the primary adjusted estimates and constitutes the confirmatory analysis.

This study was approved by the Institutional Review Board (IRB) of Phatthalung Hospital (Approval No. 13-2569). Informed consent was waived owing to the retrospective nature of the study and the use of de-identified patient data.

Results

A total of 636 patients were enrolled in the study. The study population was predominantly male (94.5%) with a mean age of 62.5 ± 15.1 years. Right-sided hernias were more frequent, occurring in 57.2% of cases. The mean operative time was 48.55 ± 11.55 minutes. Regarding anesthesia, the mean dosages for Lidocaine and Bupivacaine were 5.11 ± 0.9 mg/kg and 1.63 ± 0.29 mg/kg, respectively. According to the Nyhus classification, 39.3% of hernias were classified as simple (Type I), whereas 60.7% were categorized as complex (Types II–IV). Within the complex group, Nyhus Type II (23.6%) and Type IIIa (21.9%) were the most common. Postoperatively, Transient Femoral Nerve Dysfunction (TFND) was observed in 74 patients (11.6%), comprising 26 cases (4.1%) of pure sensory dysfunction and 48 cases (7.6%) of motor weakness. Transient femoral nerve dysfunction (TFND) was uniformly self-limited. Most symptoms resolved spontaneously within approximately 2 hours postoperatively (range 1.5–6 hours), with no persistent neurological deficits or unplanned conversion from outpatient day surgery to inpatient admission.



Table 1 Baseline demographic and operative characteristics of the study population

Characteristic	Value
Total cases	636
Age, years	62.54 ± 15.06
BMI, kg/m²	22.20 ± 2.93
Operative time, min	48.55 ± 11.55
Lidocaine dose (mg/kg)	5.11 ± 0.98
Bupivacaine (mg/kg)	1.63 ± 0.29
ASA class, n (%)	
ASA 1	114 (17.9)
ASA 2	398 (62.6)
ASA 3	124 (19.5)
Diagnosis complexity, n (%)	
Simple hernia	250 (39.3)
Complex hernia	386 (60.7)
Nyhus II	150 (23.6)
Nyhus IIIa	139 (21.9)
Nyhus IIIb	78 (12.3)
Nyhus IIIc	6 (0.9)
Nyhus IV (recurrent)	13 (2.0)
Care setting, n (%)	
ODS	338 (53.1)
Inpatient	298 (46.9)
Side, n (%)	
Right	364 (57.2)
Left	272 (42.8)
Sex, n (%)	
Male	601 (94.5)
Female	35 (5.5)
Intraoperative sedation, n (%)	
No	583 (91.7)
Yes	53 (8.3)
Outcome, TFND, n (%)	74 (11.6)
Sensory dysfunction	26 (4.1)
Motor dysfunction	48 (7.6)
Operative phase, n (%)	
Phase 1 Early	200 (31.4)
Phase 2 Middle	200 (31.4)
Phase 3 Late	236 (37.1)

Values are mean ± SD or n (%)



Univariable logistic regression analysis was performed to evaluate factors associated with TFND. Variables with $p < 0.10$ in univariable analysis or considered clinically relevant were subsequently entered into the multivariable logistic regression model.

Table 2 Univariable analysis of factors associated with TFND

Variable	Univariable OR	95% CI	*P* value
Age (per year)	1.02	1.00 -1.03	0.075
ASA class			
ASA 1	Reference		
ASA 2	1.16	0.58 - 2.33	0.669
ASA 3	1.69	0.77 - 3.74	0.191
BMI	1.01	0.93 - 1.10	0.78
Male sex	0.30	0.14 - 0.65	0.002
Right-sided hernia	0.50	0.30 - 0.81	0.005
Operative time	1.00	0.98 - 1.02	0.87
Lidocaine dose (mg/kg)	0.98	0.77 - 1.26	0.82
Bupivacaine dose (mg/kg)	1.72	1.17 - 2.53	0.006
Complex hernia	5.43	2.68 - 11	<0.001
Intraoperative sedation	1.63	0.72 - 3.35	0.209
Experience phase 2	4.82	1.85 - 12.5	0.001
Experience phase 3	11.3	4.62 - 27.4	<0.001
ODS vs IPD	0.59	0.33 - 1.04	0.069

OR, odds ratio; CI, confidence interval; TFND, transient femoral nerve dysfunction.



Based on these univariable logistic regression analysis results, variables with $p < 0.10$ (age, sex, operative side, Bupivacaine dose, hernia complexity, experience phase, and operative setting) were entered into the multivariable logistic regression model. This approach was used to evaluate the independent association of each factor while accounting for the interplay between surgical experience, operative selection patterns, and hernia complexity.

Table 3 Multivariable analysis of factors associated with TFND

Variable	Adjusted OR	95% CI	*P* value
ODS vs IPD	0.41	0.22-0.78	0.006
Male sex	0.30	0.13-0.66	0.017
Right-sided hernia	0.45	0.29-0.83	0.004
Complex hernia	5.93	2.80-12.55	<0.001
Experience phase 2	6.78	2.39-18.4	0.001
Experience phase 3	13.65	4.17-28.87	<0.001

OR, odds ratio; CI, confidence interval; TFND, transient femoral nerve dysfunction. The final reduced model showed AUROC 0.81 and no substantial multicollinearity (all VIFs < 1.5).

Multivariable analysis identified operative complexity and advanced operative phase as the strongest independent predictors of TFND. ODS remained independently associated with lower odds of TFND after adjustment for operative complexity, operative duration, surgeon experience phase, sex, and operative side.

Given the observed differences in operative characteristics across experience phases, multivariable adjustment was performed to reduce potential confounding related to operative selection patterns and hernia complexity.

Although Bupivacaine dose per body weight was associated with TFND in univariable analysis, the association was attenuated after multivariable adjustment and was not retained in the final reduced model.

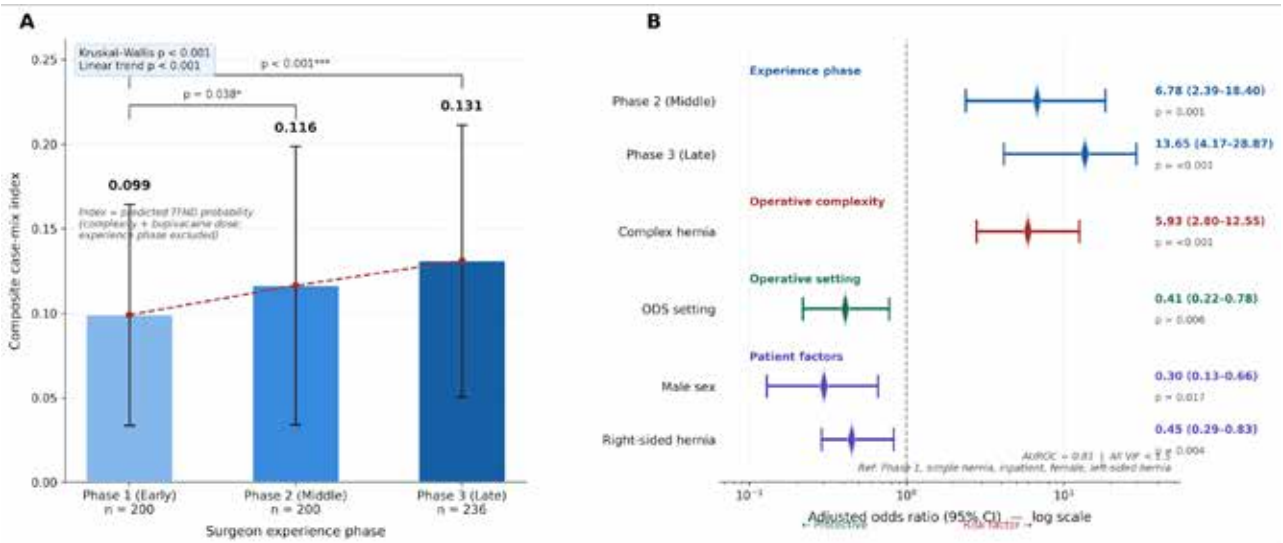


Figure 3 Composite case-mix index and adjusted predictors of TFND across surgeon experience phases. Composite case-mix index across surgeon experience phases. Error bars represent +1 standard deviation. Significance brackets indicate Bonferroni-corrected Mann-Whitney U pairwise comparisons. The dashed line indicates the linear trend across ordered phases (A). Forest plot of adjusted odds ratios (aOR) from the final reduced multivariable logistic regression model for transient femoral nerve dysfunction (TFND) (B).

Diamond markers indicate point estimates; horizontal lines indicate 95% confidence intervals. aOR, adjusted odds ratio; CI, confidence interval; ODS, outpatient day surgery; TFND, transient femoral nerve dysfunction.

The composite case-mix index represents a patient-level score of operative difficulty — derived from hernia complexity and bupivacaine dose, independent of experience phase — enabling phase-neutral comparison of operative burden across the experience continuum.

The composite case-mix index increased significantly and progressively across experience phases (Phase 1: 0.099 ± 0.065; Phase 2: 0.116 ± 0.082; Phase 3: 0.131 ± 0.080; Kruskal–Wallis $p < 0.001$; linear trend $p < 0.001$). Pairwise comparisons using Bonferroni-corrected Mann–Whitney U tests demonstrated significant differences between Phase 1 and Phase 2 ($p = 0.038$) and between Phase 1 and Phase 3 ($p < 0.001$), while the difference between Phase 2 and Phase 3 did not reach significance after correction ($p = 0.329$), indicating that the principal shift in operative burden occurred between the early and subsequent phases.

Notably, although the proportion of complex hernias did not increase monotonically across



phases (63.5%, 52.5%, and 65.3% in phases 1–3, respectively), the composite index rose consistently. This apparent discrepancy reflects the concurrent and substantial evolution in bupivacaine utilization (Phase 1: 1.46 ± 0.30 mg/kg; Phase 2: 1.72 ± 0.24 mg/kg; Phase 3: 1.69 ± 0.25 mg/kg; $p < 0.001$), which offset the relatively lower proportion of complex hernias in Phase 2, collectively elevating the composite operative burden beyond what hernia classification alone could capture.

TFND incidence increased progressively and significantly across phases: 2.5% in Phase 1, 11.0% in Phase 2, and 19.9% in Phase 3 ($p < 0.001$). Pairwise comparisons demonstrated stepwise increases between all phase pairs: Phase 1 versus Phase 2 (OR 4.82, 95% CI 1.85–12.54; $p = 0.001$), Phase 2 versus Phase 3 (OR 2.01, 95% CI 1.16–3.50; $p = 0.012$), and Phase 1 versus Phase 3 (OR 9.70, 95% CI 3.78–24.91; $p < 0.001$). Operative characteristics across experience phases are summarized in Table 4.



Table 4 Operative case-mix, perioperative characteristics, and clinical outcomes across surgeon experience phases

Variable	Phase 1 (Early) n = 200	Phase 2 (Middle) n = 200	Phase 3 (Late) n = 236	*p* value
Hernia complexity, n (%)				
Simple (Nyhus I)	73 (36.5)	95 (47.5)	82 (34.7)	0.015
Complex (Nyhus II–IV)	127 (63.5)	105 (52.5)	154 (65.3)	
Nyhus II	47 (23.5)	42 (21.0)	61 (25.8)	
Nyhus IIIa	57 (28.5)	30 (15.0)	52 (22.0)	
Nyhus IIIb	18 (9.0)	29 (14.5)	31 (13.1)	
Nyhus IIIc	1 (0.5)	2 (1.0)	3 (1.3)	
Nyhus IV (recurrent)	4 (2.0)	2 (1.0)	7 (3.0)	
Sex, n (%)				
Male	191 (95.5)	195 (97.5)	215 (91.1)	0.011
Female	9 (4.5)	5 (2.5)	21 (8.9)	
Surgical care setting, n (%)				
Outpatient day surgery (ODS)	96 (48.0)	104 (52.0)	138 (58.5)	0.085
Inpatient admission (IPD)	104 (52.0)	96 (48.0)	98 (41.5)	
Anesthetic dose, mean ± SD				
Bupivacaine dose (mg/kg)	1.46 ± 0.30	1.72 ± 0.24	1.69 ± 0.25	< 0.001
Lidocaine dose (mg/kg)	5.40 ± 1.27	5.07 ± 0.79	4.91 ± 0.76	< 0.001
Operative outcomes				
Operative time (min)	52.41 ± 9.99	48.51 ± 11.32	45.32 ± 12.02	< 0.001
Sedation used, n (%)	23 (11.5)	18 (9.0)	12 (5.1)	0.050
Composite case-mix index†, mean ± SD				
Case-mix index	0.099 ± 0.065	0.116 ± 0.082	0.131 ± 0.080	< 0.001
Clinical outcome, n (%)				
TFND (any)#	5 (2.5)	22 (11.0)	47 (19.9)	< 0.001
Sensory dysfunction	2 (1.0)	3 (1.5)	21 (8.9)	
Motor weakness	3 (1.5)	19 (9.5)	26 (11.0)	

Values are n (%) or mean ± SD. ODS, outpatient day surgery; IPD, inpatient admission.

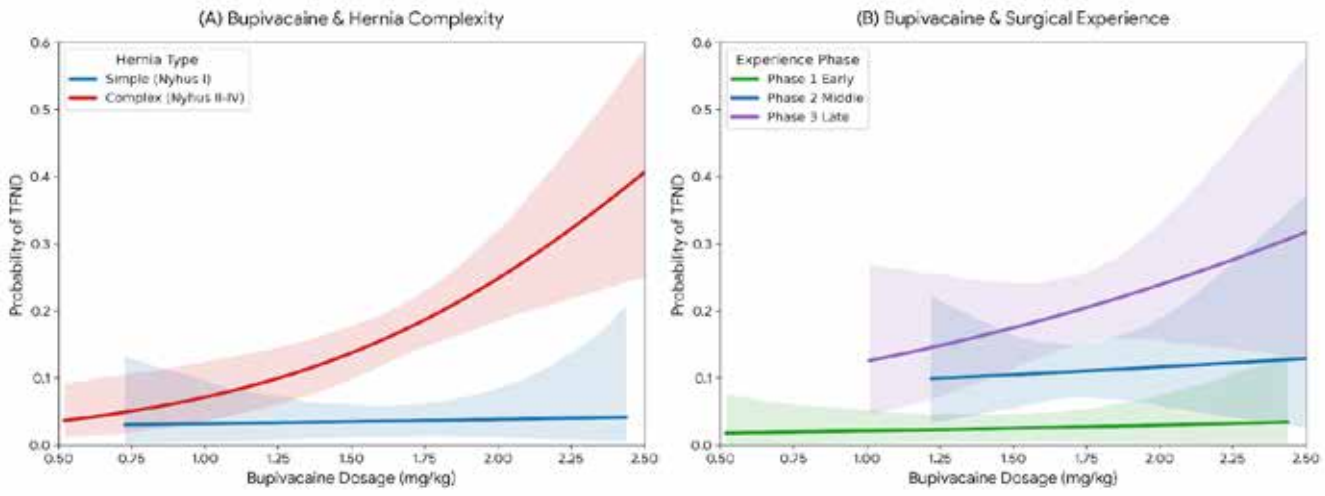


Figure 4 Exploratory relationship between hernia complexity (A), surgeon experience phase (B), and Bupivacaine dose in relation to TFND probability. Exploratory relationship between hernia complexity (A), surgeon experience phase (B), and Bupivacaine dose in relation to TFND probability.

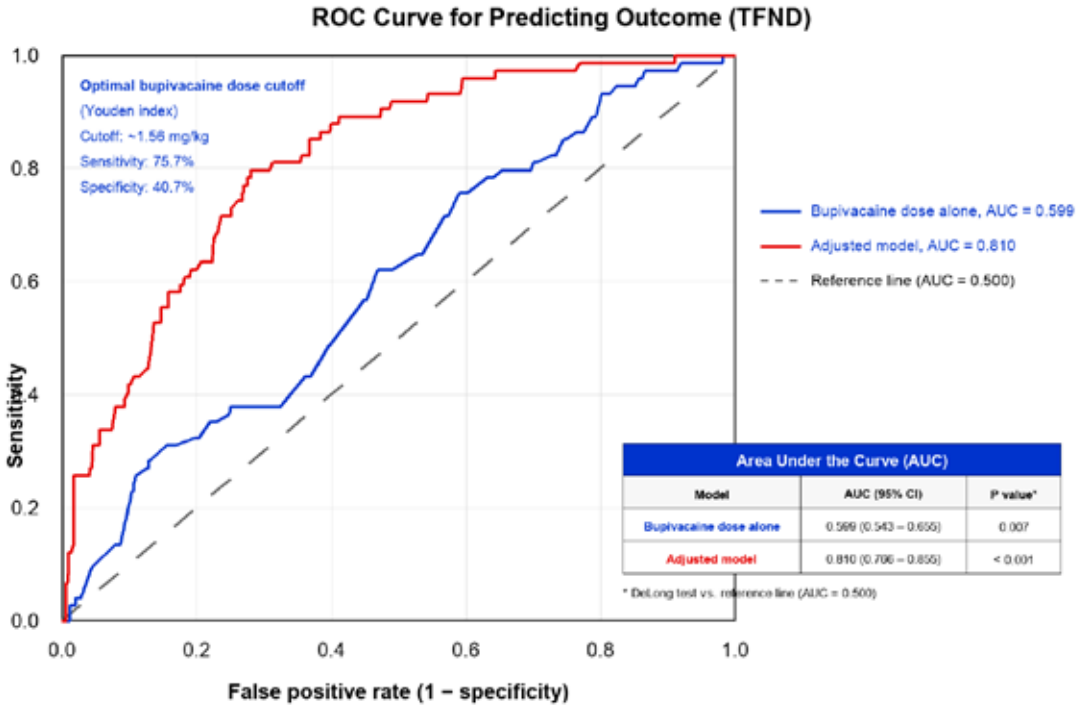


Figure 5 ROC curve comparing predictive performance of Bupivacaine dose alone versus the adjusted multivariable model for TFND prediction



Predicted TFND probability according to bupivacaine dose, stratified by hernia complexity and surgeon experience phase. Higher predicted TFND probability was observed mainly in complex hernias and later operative phases.

Bupivacaine dose alone showed limited discrimination (AUROC 0.599), whereas the adjusted model showed better discrimination (AUROC 0.810). The Youden-derived bupivacaine cutoff was 1.56 mg/kg.

Discussion

The present study demonstrates that TFND following open Lichtenstein repair under local anesthesia occurs in 11.6% of patients higher than previously reported rates of 3%–8.8%[8,9,10] but is uniformly transient and self-limited. The absence of permanent neurological deficits or unplanned admissions in this cohort supports the characterization of TFND as a reversible conduction-block or pressure-related phenomenon rather than structural femoral nerve injury.[19,20,21] The higher observed incidence likely reflects systematic postoperative neurological assessment, capturing transient sensory symptoms that are frequently omitted in routine clinical documentation.

Operative complexity and advanced surgeon experience phase emerged as the dominant independent predictors. Complex hernias were associated with an approximately six-fold increase in TFND risk, consistent with the hypothesis that technically demanding groin dissection, broader tissue-plane infiltration, and extensive preperitoneal manipulation may facilitate anesthetic spread toward the femoral compartment.[11,21] Importantly, operative phase remained an independent predictor after adjustment for hernia complexity, indicating that the phase effect is not explained by case-mix differences alone.

Collectively, these findings support the conceptual framework proposed in Figure 1, suggesting that TFND is mediated by operative complexity and anesthetic infiltration behavior rather than anesthetic dose alone.

The counterintuitive phase–TFND association reflects two concurrent behavioral changes: progressive dose escalation (1.46 → 1.72 → 1.69 mg/kg across phases; $p < 0.001$) and expansion to higher-complexity cases, including incarcerated hernias and emergency presentations, that were previously more often managed under general anesthesia. Both factors may increase the likelihood of anesthetic spread toward the femoral compartment. The identical anesthetic formulation across phases supports a behavioral rather than pharmacological explanation for this association.

The composite case-mix index reveals that overall operative burden increased progressively across the experience trajectory — even when hernia complexity alone did not increase



monotonically — by capturing both complexity and anesthetic utilization in a single phase-neutral metric. The apparent paradox of a rising case-mix index in Phase 2 despite lower complex hernia proportions is explained by substantially increased bupivacaine utilization (1.72 vs. 1.46 mg/kg), reflecting broader anesthetic infiltration strategies employed during technically demanding cases. Operative burden in this setting is thus multidimensional, encompassing hernia anatomy, infiltration extent, and anesthetic utilization.

Several anatomical mechanisms may explain femoral nerve vulnerability during inguinal field block. The femoral nerve traverses the iliopsoas compartment posterior to the transversalis fascia, in close proximity to the deep tissue planes accessed during Lichtenstein repair.[5,6,11,12,21] Anesthetic spread along the iliac fascia toward the femoral sheath has been demonstrated in cadaveric studies, particularly during percutaneous ilioinguinal-iliohypogastric block or preperitoneal infiltration.[21] The transient and fully reversible character of TFND in this cohort is consistent with a temporary conduction block rather than axonal injury.

Between the inguinal ligament and the iliopectineal line, the subinguinal space is divided into three compartments: the lateral neuromuscular compartment containing the iliopsoas muscle, femoral nerve, and lateral femoral cutaneous nerve; the vascular compartment containing the femoral artery and vein; and the femoral canal.[5,6] The femoral sheath — a prolongation of the transversalis fascia into the thigh — envelops the femoral vessels and canal, and is embryologically and anatomically a specialization of the transversalis fascia and transversus abdominis aponeurosis.[5,6] During layered local infiltration for inguinal hernia repair, anesthetic agents infiltrated along the posterior wall of the inguinal canal or deep to the transversalis fascia may track within these fascial planes toward the lateral neuromuscular compartment, placing the femoral nerve at risk of transient conduction block.

The association of female sex with TFND warrants consideration. Female patients typically demonstrate a broader gynecoid pelvic configuration, wider subpubic angle, and greater femoral triangle dimensions compared with males — anatomical features documented in systematic reviews of inguinal-pubic anatomy.[25] Cadaveric morphometric studies further confirm that the femoral neurovascular bundle lies significantly closer to the inguinal canal in female specimens compared with males (2.02 ± 0.44 cm vs. 2.63 ± 0.38 cm; $p < 0.001$; Cohen's d = 1.48),[26] and that the deep inguinal ring is significantly smaller and more slit-like in female specimens, with proportionally wider femoral canal dimensions.[24,25] These anatomical differences collectively provide a plausible mechanistic basis for the

higher TFND risk observed in female patients, as anesthetic spread along fascial planes toward the femoral compartment is more likely when the neurovascular bundle lies in closer proximity to the inguinal field.[21] However, it should be noted that female patients comprised only 5.5% of the present cohort (n = 35), and the wide confidence interval of the sex-related estimate (aOR 0.30 for male sex, 95% CI 0.13–0.66) reflects this limited sample size. This finding should be interpreted as hypothesis-generating pending prospective confirmation with greater female representation.

The independent association of left-sided hernia with higher TFND risk is an additional observation of clinical interest. Although the precise mechanism remains uncertain, potential explanations include asymmetrical groin anatomy between sides, differences in surgeon ergonomics and operative positioning during right-handed dissection of the left groin — a phenomenon supported by evidence that surgeon handedness introduces operative asymmetry between dominant and non-dominant sides across multiple surgical disciplines[27] — altered tissue traction vectors, or differences in infiltration angulation relative to the femoral nerve axis. This observation is hypothesis-generating and warrants further investigation.

The independently associated lower risk of TFND observed in ODS patients is clinically important. Although this finding may partly reflect selective allocation of lower-risk patients to outpatient settings, it persisted after multivariable adjustment for complexity, phase, and other covariates. The progressive ODS expansion across phases (48.0% to 58.5%) supports its safety even as operative complexity increased.

Bupivacaine dose was significantly associated with TFND in univariable analysis but was attenuated and not retained after multivariable adjustment. Exploratory analyses demonstrated that bupivacaine dose alone provided limited discriminative performance (AUROC 0.599), and higher predicted TFND probability was concentrated in complex hernias and advanced operative phases rather than distributed by dose alone. These findings suggest that bupivacaine utilization primarily serves as a surrogate marker of operative complexity and tissue-plane exposure, rather than an independent neurotoxic agent at the doses employed in this cohort.

This study has several limitations. The retrospective single-center design limits causal inference and generalizability. TFND was clinically diagnosed without electrophysiological confirmation; however, given the uniformly transient and self-limited course, formal electro-diagnostic testing was neither warranted nor feasible. The study reflects outcomes from a single experienced surgeon; findings may not be directly applicable to surgeons at different stages of their learning curve or to laparoscopic

techniques. Unmeasured technical variables including infiltration depth, tissue-plane targeting, and patient-specific groin anatomy could not be fully characterized.

Despite these limitations, this study provides one of the largest analyses of TFND after open local-anesthesia hernia repair (PubMed search May 2026; no larger single-surgeon series identified), with a novel framework for characterizing operative burden evolution. The findings have direct implications for operator training, patient counseling, and infiltration technique refinement. Furthermore, the proportion of female patients was small (5.5%, n = 35), limiting the precision of sex-related odds ratio estimates and warranting cautious interpretation; this finding should be considered hypothesis-generating pending confirmation in prospective studies with greater female representation. The experience phases defined herein are specific to the cumulative caseload of a single surgeon and cannot be directly extrapolated to other practitioners without knowledge of their individual operative volumes. Additionally, increasing clinical awareness of TFND across later phases may have contributed to higher detection rates — an ascertainment bias inherent to retrospective design that cannot be fully excluded.

The three experience phases span a calendar period from 2018 to 2026. During COVID-19 (2020–2021), elective cases were curtailed to urgent and selected ODS only, shifting Phase 2 toward lower-complexity presentations; pharmaceutical confounding is limited as anesthetic protocol was unchanged.

The surgeon experience phase captures simultaneously evolving behaviors that cannot be disentangled retrospectively: case-complexity expansion, increasing anesthetic volumes, and potentially greater detection vigilance. Early-phase redirection of higher-complexity cases to general anesthesia likely underestimates Phase 1 TFND risk. Identical anesthetic formulation throughout partially mitigates pharmaceutical confounding.

Conclusion

TFND following open Lichtenstein repair under local anesthesia occurred in 11.6% of patients but was uniformly transient and self-limited, with complete spontaneous resolution within 1.5–6 hours and no permanent neurological sequelae. Multivariable analysis identified complex hernia (aOR 5.93), advanced operative phase (phase 2: aOR 6.78; phase 3: aOR 13.65), female sex, and left-sided hernia as independent risk factors for TFND, while ODS was independently associated with lower odds of TFND (aOR 0.41). These findings suggest that TFND risk is more strongly associated with operative complexity and evolving anesthetic infiltration behavior across the surgeon experience continuum, rather than anesthetic dose alone.

The composite case-mix index provided a



novel and preliminary framework for quantifying operative burden evolution across experience phases, demonstrating that increasing TFND incidence parallels a progressive rise in the composite operative challenge rather than hernia classification alone.

The lower TFND risk observed among outpatient day surgery patients, persisting after multivariable adjustment, suggests that ambulatory inguinal hernia repair under local anesthesia can be safely performed in appropriately selected patients, even as operative complexity increases across a surgeon's experience trajectory.

These findings have practical implications for perioperative counseling and operative planning, particularly in complex cases and for female or left-sided presentations. Refinement of local-anesthesia infiltration techniques — including potential adoption of ultrasound guidance to improve tissue-plane precision and minimize inadvertent femoral nerve exposure — warrants prospective evaluation.[22,23] Future studies with standardized neurological outcome assessments and imaging correlation are needed to further characterize the anatomical determinants of TFND and validate strategies for its prevention.

Conflict of Interest:

The author declares no conflict of interest.

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Author Contributions:

T.P. (sole author) was responsible for study conception and design, ethical approval, data collection, statistical analysis, data interpretation, and manuscript preparation and revision.

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