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ORIGINAL PAPER

Endoscopic-assisted breast-conserving treatment: the first Polish review of 30 patients

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Abstract

Introduction: Minimally invasive procedures in breast surgery have gained popularity due to their favorable cosmetic outcomes and oncological results, which are comparable to conventional techniques. However, this approach has not been yet widely adopted in Poland, and its availability is limited to a small number of hospitals in Europe.

Aim: This study aimed to evaluate the safety and feasibility of the first Polish endoscopic breast-conserving surgery (E-BCS).

Materials and methods: A total of 30 patients who underwent E-BCS at two breast cancer centers between July 2024 and September 2025 were included in the study. We assessed the short-term outcomes of E-BCS in patients with early breast cancer or precancerous lesions qualified for local wide excision. The median observation time was 8 months.

Results: All procedures were completed without conversion to open surgery. No severe complications were observed. Postoperative surgical site infection occurred in 1 patient (3.3%). Three patients (10.0%) required reoperation due to positive margins.

Conclusions: Our preliminary data indicate a low risk of complications and short-term safety and feasibility, comparable to the results of conventional surgery, demonstrating that E-BCS is a viable alternative to standard procedures.

Key words

breast cancer, breast conserving treatment, endoscopic breast surgery

Introduction

Breast cancer is the most common malignant neoplasm among women, both in Poland and worldwide [1-3]. The standard treatment for early breast cancer typically involves breast-conserving surgery (BCS) followed by adjuvant radiotherapy, which, accompanied by implementation of multidisciplinary treatment, is now regarded as the gold standard due to its high overall survival rate, non-inferior to mastectomy [4-7].

Since the introduction of BCS, many improvements have been made to optimise oncological and aesthetic outcomes [8]. Currently, there is a trend toward de-escalating surgical treatment, which can lessen the morbidity and improve patients' quality of life without compromising long-term outcomes [9,10]. Minimally invasive breast surgery (MIBS) fits this trend, allowing comparable surgical results to conventional surgery and less trauma at the same time [11].

MIBS originated and was perfected mainly in Asia because of the superior cosmetic results in a population with a higher tendency to keloids and the greater difficulty of achieving an acceptable breast shape in generally smaller breasts [12,13]. It has soon gained popularity and importance worldwide as a solution for better scars, reduced morbidity, and as an efficacious alternative to conventional surgery. The main advantage of MIBS is a small, hidden scar and good overall cosmetic outcome. Additionally, using endoscopic systems provides clear visualization of the resection area, making the procedure precise and effective.

In 2001, Tamaki et al. presented the preliminary results of endoscopic-assisted partial mastectomy in 6 patients [14]. This started an era of development of MIBS procedures, including a wide range of endoscopic-assisted breast procedures, like nipple-sparing mastectomies (E-NSM) with immediate breast reconstruction, sentinel lymph node biopsy (SNB), axillary lymph node dissection (ALND), and free-flap harvesting [15-20].

Aim

Endoscopic-assisted breast surgery is still a novel approach in Poland, available only in a limited number of breast cancer centers [21]. Our study aimed to assess the feasibility of a single-port (SP) endoscopic breast-conserving surgery (E-BCS) technique and to report preliminary surgical and oncological outcomes.

Materials and methods

Study group A total of 30 patients who underwent surgery at two breast cancer centers between July 2024 and September 2025 were enrolled in this retrospective study.

All of the patients underwent local wide excision due to breast cancer or a precancerous breast lesion, diagnosed with core needle biopsy. Patients with locally advanced breast cancer, multifocal or multicentric disease, extensive axillary lymph nodes metastases, contraindications for adjuvant radiotherapy, or poor performance status were excluded from the study.

All of the patients were qualified for breast-conserving treatment according to preoperative ultrasound and mammography. Additionally, a chest X-ray and an abdominal ultrasound, or a chest and abdominal CT scan, were performed to exclude distant metastasis. After proper clinical evaluation, the study included patients in stage 0-II. All patients were deemed eligible for the BCS at the multidisciplinary team (MDT) meeting.

Technique Before surgery, preoperative markings were performed with the patient standing, arms akimbo (Figure 1A). In the operating room, patients were placed in the supine position with their arms adducted to the body to avoid interference with the endoscopic instruments. After the induction of general anesthesia and preparation of the operative field, the tumor location was confirmed with an ultrasound. Next, a guidewire was placed adjacent to the lesion under ultrasound guidance. Blue dye mixed with lidocaine gel was injected at 5-6

places around the resection margins (Figure 1B). Before the skin incision, we used a tumescent solution (20 ml of 1% lignocaine and 0.5 mg of epinephrine diluted in 250 ml 0.9% saline) to reduce the risk of hematoma and facilitate preparation in the proper plane.

An approximately 3.5 cm incision was made in the anterior axillary line. In patients with diagnosed breast cancer, the same incision was used for sentinel lymph node biopsy (SNB) and was the first step of the surgery, when indicated.

After skin incision and SNB, when needed, the dissection was carried out to the lateral border of the pectoralis major muscle. The dissection area should allow space for a single-port placement (Alexis Wound Retractor, Applied Medical, Rancho Santa Margarita, USA) and include subcutaneous tunneling with Metzenbaum scissors (Figure 1C). After inserting a port with three trocars, we began insufflation at 8 mmHg. For visualization, we used a 30 ° or 0 °, 10-mm-diameter camera endoscope. To dissect breast tissue, we used Voyant (Maryland Fusion Device, Applied Medical, Rancho Santa Margarita, USA), Thunderbeat (Olympus Medical Systems Corp., Tokyo, Japan), or Powerseal (Curved Jaw Sealer & Divider, Double-Action, Olympus, Tokyo, Japan) alternately (Figure 1D).

First, the glandular tissue was freed from the muscle, along with the muscle fascia, under the lesion, and within at least one quadrant of the breast, facilitating access to the tumor and subsequent oncoplastic closure of the defect left by the removed tissues. The resection margin was visible with blue dye, and the breast tissue was cut along the markings (Figure 1E).

The metallic clips were placed at the specimen's border for orientation purposes and within the breast cavity to identify the tumor bed before radiotherapy. After removing the specimen through the axillary incision, the lesion was confirmed intraoperatively with ultrasound and/or a mammogram (Figure 1F and 1G). When hemostasis was secured, we placed a drain and used level I oncoplastic techniques to approximate the breast parenchyma. The wound was closed with layered sutures.

Figure 1 illustrates the surgical technique and early postoperative outcomes.

Outcome measurement We assessed surgical outcomes, including incision length, operating time, and specimen volume, as well as length of hospital stay and postoperative complications according to the Clavien–Dindo classification [22]. We evaluated the oncological safety of the SP E-BCS using the number of procedures with positive margins, short-term breast cancer recurrences, and mortalities.

Statistical analysis The median time of observation after surgery was 8 months (range 3-17 months). The incidence of local or distant recurrence and mortality was assessed at the most recent follow-up, which ended 20 December 2025. Categorical variables were presented as numbers and percentages. Continuous data with normal distributions were expressed as the means with standard deviations, and data with non-normal distributions were expressed as medians and interquartile ranges. All statistical analyses were performed using the statistical package PSPP for macOS (version 2.1.0).

Ethics The study was approved by the institutional Ethical Committee (protocol no. 33/2025; approval date: 15 April 2025).

Results

A total of 30 patients underwent single-port endoscopic breast-conserving surgery. All surgical procedures were complete; no conversion to conventional surgery was required.

Patient characteristics The mean age of the patients in the cohort was 63.3 years (range 37-78), and the mean BMI (body mass index) was 28.1 kg/m². The health status of all patients was assessed using the American Society of Anesthesiologists (ASA) classification: 28 patients were ASA grade II (mild systemic disease), and 3 were ASA grade III (severe systemic disease, not incapacitating).

25 of the patients were operated on due to breast cancer, 3 due to ductal carcinoma in situ, and 2 due to lobular carcinoma in situ. Patients with diagnosed breast cancer and clinically negative axillary nodes had a sentinel lymph node biopsy performed during the same procedure, through the same incision. Two patients with clinical nodal metastasis were qualified for endoscopic axillary lymph node dissection (ALND).

In 18 patients (60%), the tumor was located in the upper outer quadrant of the breast; in 8 (26.67%), the lower outer quadrant; in 2 (6.67%), the upper inner quadrant; and in 2 (6.67%), the lower inner quadrant. Table 1 presents the patients' characteristics.

Surgical and short-term oncological outcomes The mean incision length was 3.8 cm (range 2.5 - 4 cm). The time of endoscopic dissection of the breast tumour varied from 40 to 210 minutes, with a median time of 105 minutes. The median volume of resected tissue was 56 cm³ (range 20 - 200 cm³).

We did not observe any immediate reoperations, and all patients were discharged well. The average hospital stay was 1.2 days (range 1-4 days). Table 2 presents surgical outcomes.

We did not observe severe complications in the study group. Overall, postoperative complications occurred in one patient (3.3%). We observed one surgical site infection, successfully treated with wound dressings and an oral antibiotic. The observed complication was classified as Clavien-Dindo II, as requiring only pharmacological intervention.

Tumor size ranged from 5 to 40 mm. Nodal involvement was observed in 5 patients: 2 qualified primarily for ALND due to clinically positive nodes, and 3 due to nodal metastases confirmed during frozen section. Three patients (10.0%) had positive margins confirmed by histopathological evaluation and therefore required reoperation. Two patients were qualified for re-BCS, and one for an endoscopic nipple-sparing mastectomy. In all 3 patients, the second procedure met the criteria for R0 resection. Table 3 presents the histopathological evaluation.

Two patients with LCIS had their diagnoses confirmed and were therefore referred for observation. All of the breast cancer patients continued adjuvant treatment according to the current guidelines and MDT recommendations. 28 patients received postoperative radiotherapy. 13 patients were qualified for adjuvant chemotherapy, and 15 patients for adjuvant hormone therapy.

All patients remained under observation in the outpatient clinic. The observation included clinical examinations every 3 months, with the first mammogram performed 6 months after surgery. Time of observation ranged from 3 to 17 months, with a median of 8 months (IQR: 7.25). During the observation period, one patient reported distant metastases, and no local recurrence or mortality occurred.

Discussion

A total of 30 patients underwent E-BCS during the aforementioned period. All procedures were completed without conversion to open surgery. The mean incision length was 3.9 cm, significantly shorter than the literature-reported value for the classic technique [23].

Location in the axillary line and a short incision in E-BCS result in improved cosmetic outcomes compared to open surgery, making the procedure maximally effective with both a good breast shape and a small, well-hidden scar [24].

The median time for endoscopic dissection in our study was 105 minutes. Due to procedural differences among patients, mainly in the axillary node area, we measured only the time required for endoscopic dissection of the breast tumor. The endoscopic portion of the procedure prolongs the surgery, and according to Ozaki et al [19], E-BCS requires 30-50 minutes more than open BCS. The meta-analysis by Li et al [25] shows significantly longer operative time and greater blood loss with E-BCS compared with open BCS, but shorter incision length and superior cosmetic outcomes. Due to the two-center design of our study

and the operations performed by different surgeons, we did not assess the learning curve. The literature indicates that it typically takes 12 to 15 procedures to gain experience and overcome the learning curve, thereby reducing operative time and narrowing the gap between endoscopic and open procedures [25,26].

We observed positive margins in 3 patients (10.0%) in our cohort, an acceptable rate, comparable to that reported in the literature [27]. Depending on the study, the percentage of patients with margin involvement varies, both in E-BCS and in conventional procedures. In E-BCS, positive margins range from 0% to 20% of procedures [25]. A meta-analysis by Bundred et al [28] shows a similar percentage in classic BCS: positive margin burden up to 17.8%. Our result is acceptable; however, given that a positive margin is a risk factor for recurrence, it underscores the need for meticulous marking of the lesion before surgery, especially when the tumour is located far from the incision line [29]. It supports the use of intraoperative ultrasound or mammography, along with blue-dye markings that serve as visual guides during resection. Notably, in previous studies of endoscopic-assisted BCS, the number of R1 resections decreased as the learning curve progressed [26].

In our study, the majority of tumors (60%) were located in the upper outer quadrant of the breast. This location, as well as the lower outer quadrant, is preferable for E-BCS because of its good accessibility and adequate space for single-port placement [30]. The inner quadrants can also be considered for E-BCS, but they are more challenging, both for proper resection and for cavity filling after resection. In our study, only 4 patients had tumors located in the medial part of the breast, and all of them were qualified for endoscopic surgery after overcoming the learning curve. These cases, however, provide a truly superior cosmetic effect, allowing for the avoidance of the scar in the cleavage.

Although the breast surgery morbidity is generally low, possible complications are various, including hematoma, seroma, flap or nipple-areola complex necrosis, wound dehiscence, and

infection [31]. We observed a minor postoperative complication in 1 patient (3.3%) in our cohort, in the form of surgical site infection, successfully treated with oral antibiotics. Similar results were obtained by Sae-lim et al [26] in a review of 65 SP 3D E-BCS procedures, with a total complication rate of 4.6%. Moreover, the authors of the analysis concluded the studies on E-BCS published over the last 20 years. Over the years, the E-BCS technique was perfected by replacing retraction with insufflation and avoiding an additional periareolar incision. These changes could affect the low morbidity of this technique. Compared to the conventional surgery, complication rates in minimal access breast-conserving surgery do not differ [32,33].

Limitations The main limitation of our study is its retrospective design and the limited number of cases. Due to the short observation time, it was not possible to adequately assess disease-free survival (DFS) and overall survival (OS). A small sample size means that our preliminary results, however promising, should be treated with caution.

Our current study does not contain the cost analysis of the E-BCS. The longer operation time and required equipment make it more expensive than conventional BCS. Still, it is crucial to assess the total cost over a longer time perspective, including hospital readmissions.

As the technique is increasingly performed in our centers, we continue to collect all data to expand our sample size. The future direction of research involves comparing SP E-BCS with conventional techniques in terms of surgical outcomes, including complications, rehospitalizations, reoperations, total costs, and oncological outcomes. Further observation of our cohort is necessary to assess long-term oncological outcomes.

Conclusions Our preliminary data show promising results and indicate that E-BCS is feasible as an alternative to conventional surgery. Multicenter, prospective trials are crucial in advancing the technique.

Article information

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Contribution statement Study design: P.P., M.S. P.P.; methodology: P.P., M.S. P.P.; validation: P.P., M.S., P.P.; formal analysis: P.P., M.S., P.P.; resources: P.P., M.S., P.P.; data curation, P.P., M.S., P.P.; writing—original draft preparation, review and editing, P.P., M.S., P.P.; visualization, M.S.; supervision, P. Pluta; project administration, P. Pluta.

Conflict of interest None declared.

AI statement We did not use GenAI to assist with the study design or to create text, images, or other content. We used Grammarly solely for language editing.

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Table 1 Characteristics of the study population (n = 30)		
Characteristic		Value
Age, y	Mean (SD)	63.23 (11.57)
	Range	37–78
	Median (IQR)	64 (16)
	≤50	6 (20)
	>50	24 (80)
BMI, kg/m ²	Mean (SD)	28.1 (5.13)
	Range	19.1–40.2
	Normal weight (18.5–24.9)	8 (26.7)
	Overweight (25–29.9)	15 (50)
	Obesity I (30–34.9)	3 (10)

		II (35–39.9)	3 (10)
		III (>40)	1 (3.3)
ASA classification	II		28 (93.3)
	III		2 (6.7)
Histological type	LCIS florid type		2 (6.7)
	DCIS		3 (10)
	IDC	Luminal A	10 (33.3)
		Luminal B	7 (23.3)
	TNBC		4 (13.3)
	HER2+		4 (13.3)
Tumor location	UOQ		18 (60)
	UIQ		2 (6.7)
	LOQ		8 (26.7)
	LIQ		2 (6.7)
Tumor size, cT	Tis		4 (13.3)
	T1a		0
	T1b		7 (23.33)
	T1c		13 (43.3)
	T2		6 (20)
Nodal involvement, cN	cN0		28 (93.3)
	cN1		2 (6.7)
Neoadjuvant chemotherapy			9 (30)

Data are presented as number (percentage) unless indicated otherwise.

Abbreviations: ASA, American Society of Anesthesiologists; BMI< body mass index; cN, clinical nodal status; cT, clinical tumor stage; DCIS; ductal carcinoma in situ; IDC, invasive ductal carcinoma; IQR, interquartile range; LCIS, lobular carcinoma in situ; LIQ, lower inner quadrant; LOQ, lower outer quadrant; Tis, tumor in situ; TNBC, triple-negative breast cancer; UIQ, upper inner quadrant; UOQ, upper outer quadrant

Table 2 Surgical outcomes (n = 30)		
Outcome		Value
Length of incision, cm	Mean (SD)	3.8 (0.47)
	Range	2.5–4
Specimen volume, cm ³	Median (IQR)	56 (52.75)
	Range	20–200
Operation time, min	Median (IQR)	105 (37.5)
	Range	40–210
Hospital stay, d	Mean (SD)	1.2 (0.69)
	Range	1–4
Data are presented as number (percentage) unless indicated otherwise. Abbreviations: see Table 1		

Table 3 Pathological outcomes (n = 30)

Outcome		Value
pT/ypT	0 – pCR	1 (3.3)
	is	8 (26.7)
	1a	1 (3.3)
	1b	7 (23.3)
	1c	9 (30)
	2	4 (13.3)
pN/ypN	0	25 (83.8)
	1	2 (6.7)
	N2b	1 (3.3)
	N3a	2 (6.7)
Positive margins		3 (10)
Data are presented as number (percentage). Abbreviations: pCR, pathological complete response; pN, pathological nodal stage; pT, pathological tumor stage; ypN, postneoadjuvant pathologic lymph node classification; ypT, postneoadjuvant pathologic tumor classification		

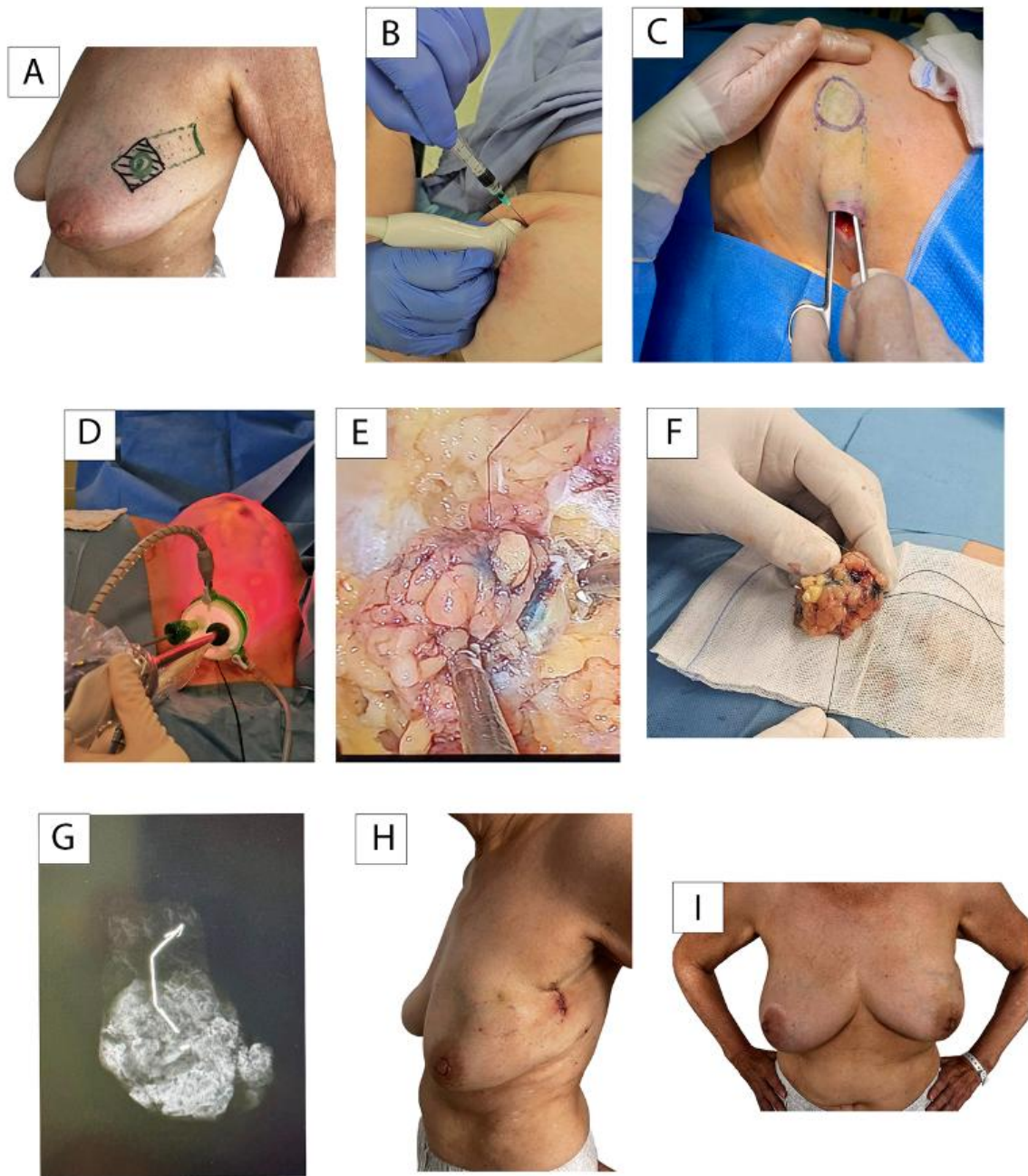


Figure 1 – 68-year-old patient with DCIS, diagnosed with stereotactic core biopsy; **A** – preoperative marking of the tumor location with resection margin and planned 3 cm skin incision in the anterior axillary line; **B** – marking the resection margins with the blue dye after inserting the guidewire; **C** – subcutaneous tunneling with Metzenbaum scissors; **D** – dissection with endoscopic tools through a single port; **E** – endoscopic view - blue dot

marking the resection margin; **F** – removed specimen with the guidewire and blue dots; **G** – excision confirmed with the intraoperative mammogram – guidewire adjacent to the tissue marker; **H, I** – early postoperative outcomes

Short title: E-BCS: the first Polish review of 30 patients