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

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KEY WORDS

breast cancer, breast-conserving treatment, endoscopic breast surgery

ABSTRACT

INTRODUCTION Minimally-invasive procedures in breast surgery have gained popularity due to their favorable cosmetic outcomes and oncological results comparable to those achieved with 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 surgeries (E-BCSs).

MATERIALS AND METHODS A total of 30 patients who underwent E-BCS at 2 breast cancer centers in Poland between July 2024 and September 2025 were included in the study. We assessed short-term outcomes of E-BCS in women with early breast cancer or precancerous lesions qualified for local wide excision. Median (interquartile range) observation time was 8 (6–13.25) 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%) required reoperation due to positive margins.

CONCLUSIONS Our preliminary data indicate that E-BCS offers a low risk of complications and short-term safety and feasibility. Its outcomes are comparable to those of conventional surgery, making it a viable alternative to standard procedures.

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, noninferior to mastectomy.[4-7]

Since the introduction of BCS, many improvements have been made to optimize oncological and aesthetic outcomes.[8] Currently, there is a trend toward de-escalating surgical treatment, which can reduce the morbidity and improve patients' quality of life without compromising long-term outcomes.[9,10] Minimally-invasive breast surgery (MIBS) falls within this trend, allowing for surgical results comparable to those achieved with conventional surgery, with less trauma.[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 a greater difficulty of achieving an acceptable breast shape in a population with generally smaller breasts.[12,13] It has soon gained popularity and importance worldwide as a solution offering fewer scars, reduced morbidity, and an efficacious alternative to conventional surgery. The main advantages of MIBS are small, hidden scars and good overall cosmetic outcomes. Additionally, using endoscopic systems provides clear visualization of the resection area, making the procedure precise and effective.

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

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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 (57–73)
	≤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 class	I (30–34.9)	3 (10)
		II (35–39.9)	3 (10)
		III (>40)	1 (3.3)
ASA class	II		28 (93.3)
	III		2 (6.7)
Histological type	Lobular carcinoma in situ, florid type		2 (6.7)
	Ductal carcinoma in situ		3 (10)
	Invasive ductal carcinoma	Luminal A	10 (33.3)
		Luminal B	7 (23.3)
	Triple-negative breast cancer		4 (13.3)
	HER2+		4 (13.3)
Tumor location	Upper outer quadrant		18 (60)
	Upper inner quadrant		2 (6.7)
	Lower outer quadrant		8 (26.7)
	Lower inner quadrant		2 (6.7)
cT	Tumor in situ		4 (13.3)
	T1a		0
	T1b		7 (23.33)
	T1c		13 (43.3)
	T2		6 (20)
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; HER2, human epidermal growth factor receptor 2; IQR, interquartile range

AIM Endoscopy-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 the single-port (SP) endoscopic BCS (E-BCS) technique and report preliminary surgical and oncological outcomes.

MATERIALS AND METHODS **Study group** A total of 30 patients who underwent surgery at 2 breast cancer centers (Voivodeship Multidisciplinary Hospital in Gorzów Wielkopolski and Polish Mother's Memorial Hospital in Łódź) between July 2024 and September 2025 were enrolled in the study. Mean (SD) age of the study participants was 63.23 (11.57) years, and mean (SD) body mass index was 28.1 (5.13) kg/m^2. The health status of all patients was assessed using the American Society of Anesthesiologists (ASA) classification: 28 patients were categorized as class II (mild systemic disease) and 3 as class III (severe systemic disease, not incapacitating).

A total of 25 patients were operated on due to breast cancer, 3 due to ductal carcinoma in situ, and 2 due to lobular carcinoma in situ. The individuals with diagnosed breast cancer and clinically negative axillary nodes had SLNB performed during the same procedure, through the same incision. Two patients with clinical nodal metastases were qualified for endoscopic ALND.

In 18 women (60%), the tumor was located in the upper outer quadrant of the breast, in 8 (26.67%) in the lower outer quadrant, in 2 (6.67%) in the upper inner quadrant, and in 2 (6.67%) in the lower inner quadrant. **TABLE 1** presents patient characteristics.

All patients underwent local wide excision due to breast cancer or a precancerous breast lesion, diagnosed based on core needle biopsy results. Individuals with locally advanced breast cancer, multifocal or multicentric disease, extensive axillary lymph node metastases, contraindications for adjuvant radiotherapy, or a poor general condition were excluded.

All patients were qualified for breast-conserving treatment according to preoperative ultrasound and mammography. Additionally, chest X-ray and abdominal ultrasound, or chest and abdominal computed tomography, were performed to exclude distant metastasis. After proper clinical evaluation, patients in stages 0–II were included in the study. All participants were deemed eligible for BCS at a multidisciplinary team meeting.

Surgical technique Before surgery, preoperative markings were made, with the patient standing, arms akimbo (**FIGURE 1A**). In the operating room, the participants 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, tumor location was confirmed on ultrasound. Next, a guidewire was placed adjacent to the lesion under ultrasound guidance. Blue dye mixed with lignocaine gel was injected at 5–6 sites 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 of 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 the patients with diagnosed breast cancer, the same incision was used for SLNB, and it was the first step of the surgery, when indicated.

After skin incision and SLNB, when needed, the dissection was carried out to the lateral border of the pectoralis major. The dissection area created space for an SP placement (Alexis Wound Retractor, Applied Medical, Rancho Santa Margarita,

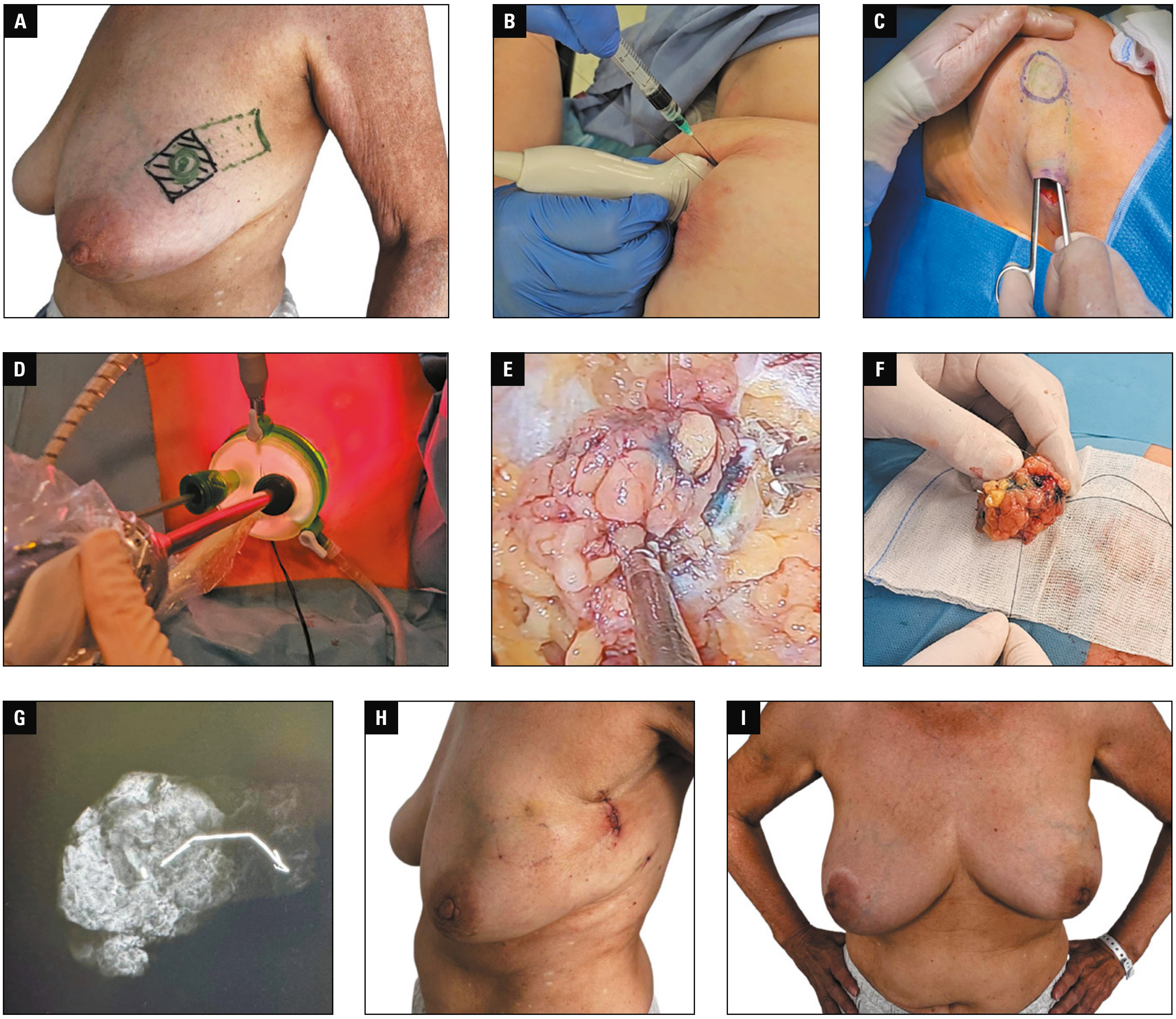

FIGURE 1 A 68-year-old patient with ductal carcinoma in situ, diagnosed based on stereotactic core biopsy results; **A** – preoperative marking of the tumor location with a resection margin and planned 3-cm skin incision in the anterior axillary line; **B** – marking the resection margins with blue dye after inserting the guidewire; **C** – subcutaneous tunneling with Metzenbaum scissors; **D** – dissection with endoscopic tools through a single port; **E** – endoscopic view showing the marking of the resection margin with blue dye; **F** – removed specimen with the guidewire and blue markings; **G** – excision confirmed on intraoperative mammography, showing the guidewire adjacent to the tissue marker; **H**, **I** – early postoperative outcomes

California, United States), and subcutaneous tunneling with Metzenbaum scissors was performed (FIGURE 1C). After inserting the port with 3 trocars, we began insufflation at 8 mm Hg. For visualization, we used a 30° or 0°, 10-mm-diameter camera endoscope. To dissect breast tissue, we used the Voyant (Maryland Fusion Device, Applied Medical), Thunderbeat (Olympus Medical Systems Corp., Tokyo, Japan), or Powerseal (Curved Jaw Sealer & Divider, Double-Action, Olympus, Tokyo, Japan) systems, alternately (FIGURE 1D).

First, the glandular tissue was freed from the muscle, along with the muscle fascia under the lesion and within at least 1 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).

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 on ultrasonography and / or mammography (FIGURE 1F and 1G). When hemostasis was achieved, 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, operative 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 SP E-BCS

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 (37.25–90)
	Range	20–200
Operative time, min	Median (IQR)	105 (95–132.5)
	Range	40–210
Length of hospital stay, d	Mean (SD)	1.2 (0.69)
	Range	1–4

Abbreviations: see **TABLE 1**

TABLE 3 Pathological outcomes (n = 30)

Outcome		Value
pT/ypT	0 (pCR)	1 (3.3)
	In situ	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

using the number of procedures with positive margins, short-term breast cancer recurrences, and mortality.

Statistical analysis Categorical variables were presented as numbers and percentages. Continuous data with normal distributions were expressed as mean (SD), and data with non-normal distribution were expressed as medians and interquartile ranges (IQRs). All statistical analyses were performed using PSPP statistical package for macOS, version 2.1.0 (PSPP, GNU, Free Software Foundation, Boston, Massachusetts, United States).

Ethics The study was conducted in accordance with the Declaration of Helsinki, and was approved by the Ethics Committee of the Polish Mother's Memorial Hospital in Łódź (33/2025). Informed consent was obtained from all study participants.

RESULTS A total of 30 patients underwent SP E-BCS. All surgical procedures were completed successfully, and no conversion to conventional surgery was required.

Surgical and short-term oncological outcomes Median time of observation after surgery was 8 (6–13.25) months (range, 3–17 mo). The incidence of local or distant recurrence and mortality was assessed at the most recent follow-up, which ended on December 20, 2025. Mean (SD) incision length was 3.8 (0.47) cm. The time of endoscopic dissection of the breast tumor varied from 40 to 210 minutes, with median (IQR) time of 105 (95–132.5) minutes. Median (IQR) volume of the resected tissue was 56 (37.25–90) cm^3 (range, 20–200 cm^3).

There were no immediate reoperations, and all patients were discharged in a good condition. Mean (SD) length of hospital stay was 1.2 (0.69) days. Surgical outcomes are outlined in **TABLE 2**.

We did not observe severe complications in the study group. Overall, postoperative complications occurred in 1 patient (3.3%)—a surgical site infection, successfully treated with wound dressings and an oral antibiotic. The observed complication was classified as Clavien–Dindo grade II, requiring only pharmacological intervention.

Tumor size ranged from 5 to 40 mm. Nodal involvement was identified 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%) had positive margins confirmed on histopathology, and required reoperation. Two patients were qualified for re-BCS, and 1 for endoscopic nipple-sparing mastectomy. In all 3 patients, the second procedure met the criteria for R0 resection. **TABLE 3** presents the histopathological evaluation.

Two participants with lobular carcinoma in situ had their diagnoses confirmed and were referred for observation. All breast cancer patients continued adjuvant treatment according to the current guidelines and multidisciplinary team recommendations. As many as 28 individuals received postoperative radiotherapy, 13 were qualified for adjuvant chemotherapy, and 15 for adjuvant hormone therapy.

All patients remained under observation in an outpatient clinic. The observation included clinical examinations every 3 months, with the first mammography performed 6 months after surgery. During the obesrvation period, 1 patient reported distant metastases, and no local recurrence or mortality occurred.

DISCUSSION A total of 30 patients underwent E-BCS during the study period. All procedures were completed without conversion to open surgery. Mean (SD) incision length was 3.8 (0.47) centimeters, 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, as compared with open surgery, making the procedure maximally effective, with a good breast shape and a small, well-hidden scar.[24]

Median time for endoscopic dissection in our study was 105 minutes. Due to procedural differences among the 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. A meta-analysis by Li et al[25] showed significantly longer operative time and greater blood loss with E-BCS, in comparison with open BCS, but shorter incision length and superior cosmetic outcomes. Due to the 2-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%) in our cohort, which is an acceptable rate, comparable to that reported in the literature.[27] Depending on the study, the percentage of patients with margin involvement varies, in both E-BCS and conventional procedures. In E-BCS, positive margins range from 0% to 20%.[25] A meta-analysis by Bundred et al[28] reported a similar percentage in classic BCS—a positive margin burden of 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 tumor is located far from the incision line.[29] It supports the use of intraoperative ultrasonography or mammography, along with blue-dye markings that serve as visual indications during resection. Notably, in previous studies on E-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 due to its good accessibility and adequate space for SP placement.[30] The inner quadrants can also be considered for E-BCS, but they are more challenging, for both proper resection and 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 the surgeons gained experience in this technique. These cases, however, provide a truly superior cosmetic effect, allowing to avoid the scar.

Although morbidity following breast surgery is generally low, possible complications are numerous, 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—a surgical site infection, successfully treated with oral antibiotics. Similar results were obtained by Sae-lim et al[26] in a review of 65 3-dimensional SP E-BCS procedures, with a total complication rate of 4.6%. Moreover, the authors of the analysis synthesized 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. In comparison with conventional surgery, complication rates in minimal-access BCS 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 and overall survival. A small sample size means that our preliminary results, however promising, should be interpreted with caution.

This study did not include a cost analysis of E-BCS. Longer operative 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 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 a feasible alternative to conventional surgery. Multicenter, prospective trials are crucial in advancing the technique.

ARTICLE INFORMATION

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