

ORIGINAL ARTICLES

Ultrasound-guided cryoablation: Our experience in percutaneous treatment as an alternative to surgery for fibroadenomas of the breast lesions



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KEYWORDS

Ultrasound-guided cryoablation;
Ablation technique;
Cryotherapy;
Breast;
Fibroadenoma

Abstract

Objectives: To review the tolerance to and medium-term efficacy of ultrasound-guided cryoablation as an alternative to surgical treatment of fibroadenomas of the breast in our hospital.

Methods: We analyzed data from the 12 patients with fibroadenomas treated with ultrasound-guided cryoablation in our hospital between November 2020 and July 2022. Cryoablation was performed with a system using argon gas (Galil Boston Scientific®) or liquid nitrogen (Prosense Ice Cure®) following a triple-phase (freeze-thaw-freeze) protocol of variable duration depending on the size of the lesion. Patients were followed up with ultrasonography at 3, 6, 12, and 18 months.

Results: All patients tolerated the procedure well. Two patients reported moderate pain in the hours immediately after the procedure; no other complications occurred. The findings during follow-up included decreased volume of the fibroadenoma (47.07% at 3 months, 77.79% at 6 months, 81.77% at 12 months, and 88.81% at 18 months), blurring of the nodule's margins, a significantly reduced or absent signal within the lesion in the Doppler study, an echogenic band (representing edema, hemorrhage, and fat necrosis), and hypoechoic areas suggestive of fibrosis surrounding the fibroadenoma.

Conclusions: Cryoablation is done on an outpatient basis, avoiding general anesthesia, thus making it less expensive. Cryoablation yields better cosmetic results than surgery.

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PALABRAS CLAVE

Crioablación guiada por ultrasonidos;
Técnica de ablación;
Crioterapia;
Mama;
Fibroadenoma

Crioablación guiada con ecografía: tratamiento percutáneo alternativo a la cirugía en las lesiones fibroadenomas de la mama, nuestra experiencia

Resumen

Objetivos: Revisar la tolerancia y la eficacia a medio plazo de la crioablación guiada con ecografía realizada como tratamiento alternativo a la cirugía en lesiones fibroadenomas de mama en nuestro hospital.

Método: Se recogieron de los archivos los datos de las 12 pacientes con fibroadenomas tratados con crioablación guiada con ecografía entre noviembre 2020 y julio 2022 en nuestro hospital. Para la crioablación se utilizaron los sistemas Galil Boston Scientific® con gas argón y Prosense Ice Cure® con nitrógeno líquido, con protocolo triple fase (congelación-descongelación-congelación) de duración variable dependiendo del tamaño de la lesión. Se hizo el seguimiento con ecografías, la primera a los 3 meses del procedimiento y posteriormente semestrales hasta los 18 meses.

Resultados: Todas las pacientes toleraron bien el procedimiento, dos de ellas refirieron dolor moderado en las horas siguientes, no hubo ninguna otra complicación. Los hallazgos en el seguimiento fueron: disminución del volumen del fibroadenoma (del 47,07% a los 3 meses, 77,79% a los 6 meses, 81,77% a los 12 meses y 88,81% a los 18 meses), peor definición de los márgenes del nódulo, disminución significativa o desaparición del flujo en el estudio Doppler en la lesión, una banda ecogénica (que representaba edema, hemorragia y necrosis grasa) y zonas hipoecoicas sugerentes de fibrosis rodeando el fibroadenoma.

Conclusiones: La crioablación se realiza de forma ambulatoria, evita una anestesia general es menos costosa y tiene mejor resultado cosmético.

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Introduction

Fibroadenomas are the most common benign tumours of the female breast. Although they mostly commonly appear in the second and third decades of life, they can occur at any age. Approximately 10% of women will have a fibroadenoma in their lifetime, with multiple fibroadenomas occurring in 20% of women. They are proliferative lesions made up of epithelial and connective elements, which originate in the lobules of breast tissue. They are oestrogen-dependent and can grow.^{1–3}

In the majority of cases fibroadenomas are managed conservatively using imaging tests, usually ultrasound, to confirm stability in follow-up. However, in some patients, they may be symptomatic (palpable, painful), cause breast deformity, increase in size or cause anxiety. Surgical removal is the traditional treatment in these cases. Minimally invasive percutaneous ablative techniques offer the opportunity to treat fibroadenomas without surgery, avoiding the possible complications of surgery as well as general anaesthesia.^{1,2,4,5}

The efficacy and safety of cryoablation of fibroadenomas have been demonstrated in multiple publications.^{3,5,6}

In the United States, cryoablation and percutaneous excisional vacuum-assisted biopsy (VAB) have been approved for use in clinical practice by the Food and Drug Administration for the treatment of fibroadenomas and are included in the management algorithm for fibroadenomas in the American Society of Breast Surgeons' Guidelines.^{4,7}

Cryoablation may be particularly useful in women with multiple fibroadenomas who have previously undergone surgery for one of them or who prefer to avoid surgical intervention^{8,9} and as an alternative to VAB for nodes too large to be removed by this technique.

The aim of this retrospective study is to review the mid-term tolerance and efficacy of ultrasound-guided cryoablation as an alternative treatment to surgery and VAB in fibroadenomas of the breast in our unit.

Methods

We retrospectively studied the cases of 12 patients with fibroadenomas treated with cryoablation at our centre between November 2020 and July 2022.

In all cases except one, where treatment was indicated for several large fibroadenomas, the indication for cryoablation in palpable fibroadenomas was the enlargement of the lesion in at least two of the three ultrasound measurements. All were women seeking treatment and procedures to treat single stable fibroadenomas were excluded.

After finding an enlarged fibroadenoma on follow-up ultrasound, ultrasound-guided core needle biopsy (CNB) was performed to confirm the diagnosis histologically prior to treatment. Diagnostic CNBs were performed with 14G Acecut from Léleman® (TSK Laboratory, Hirayanagi-Cho, Tochigi-Ken, Japan) or 14G Bip-HistoCore® (BIP GmbH, Türkenfeld, Germany) needles, obtaining 3–5 cylinders.

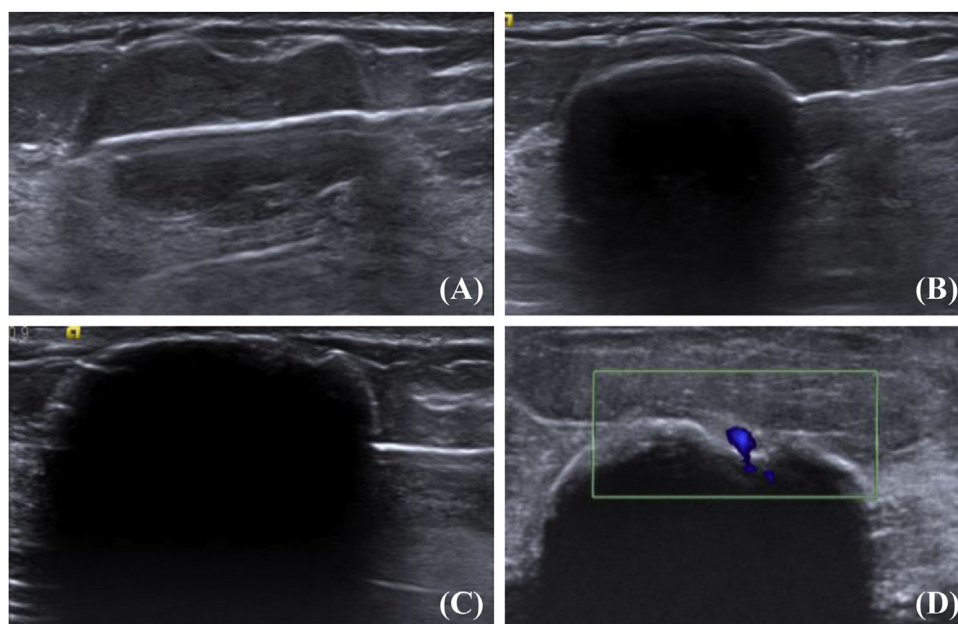


Figure 1 Ultrasound-guided cryoablation procedure. (A) The cryoablation needle passes through the fibroadenoma along its long axis. (B) Ice ball formation: convex linear echogenic image with posterior acoustic shadow. (C) The ice ball increases in size until the fibroadenoma is completely engulfed. The prescribed time is maintained. Subsequently, passive thawing starts followed by a new freezing phase. (D) In another case, a concavity is observed on the surface of the ice ball due to heating of the adjacent blood vessel (orthogonal plane).

Before undergoing the cryoablation procedure, patients signed an informed consent form, which described the technique and its possible risks and benefits as well as guaranteeing the anonymity of any images and information from their medical records should they be used for teaching or scientific purposes.

An Acuson 2000 ultrasound machine® (Siemens, Berlin, Germany) with an 18 MHz transducer was used.

The ICEfx Galil Boston Scientific® (Boston Scientific Way, Marlborough, MA, USA) with argon gas using 14 and 17 G needles and the Prosense Ice Cure® (IceCure Medical, Caesarea, Israel) with liquid nitrogen using 13 G needles were used interchangeably for the cryoablation. In one case, two needles were employed at the same time on the same lesion. In six cases, ice ball coverage of the nodule was found to be incomplete after a first freeze-thaw-freeze cycle, so a second cycle was performed after repositioning the needle to ensure that the ice ball completely engulfed the remaining part of the fibroadenoma.

The cryoablation procedures were performed by the seven radiologists at the Breast Unit, with between five and 25 years of experience.

The procedure was performed with the patient in the supine position. After administering local anaesthetic at the access point, ultrasound guidance was used to insert the cryoablation needle through the centre of the nodule along its long axis, going about 5 mm beyond the nodule. Orthogonal images were obtained to document the central positioning of the needle in the fibroadenoma.

The usual freeze-thaw-freeze protocol was applied, with phases of varying duration depending on the system used, the size of the fibroadenoma, its distance from the skin and

the desired ablation margin. Cold adds to the local anaesthetic effect of the injected anaesthesia.

Ultrasound was used to monitor the formation and growth of the ice ball in real time until it completely engulfed the nodule (Figs. 1–3). When the lesions were very superficial, a warm saline bag was applied to the patient's skin during the procedure to minimise the possibility of frostbite.

After the procedure, following removal of the needle, compression was applied to the access point until haemostasis was achieved.

Patients were asked to rate the degree of pain as mild, moderate or severe at the end of the procedure and at the first follow-up at three months.

Ultrasound check-ups were performed three and six months after the procedure, with six-monthly check-ups to 18 months post-procedure.

The following variables were recorded: number of patients, age (years), measurement of the long axis (mm) and volume (cc) of the fibroadenoma before cryoablation, distance between the most superficial edge of the lesion and the skin (mm), cryoablation system and needle used, total duration of the protocol applied (minutes), pain (mild, moderate or severe), other complications, measurement of the long axis (mm) and volume (cc) of the fibroadenoma and ultrasound findings at each subsequent check-up.

Quantitative data were described by median, mean $\pm$ standard deviation.

Results

We examined the cases of 12 patients aged between 16 and 47 years old (median 35, mean 34.7 ± 9.6).

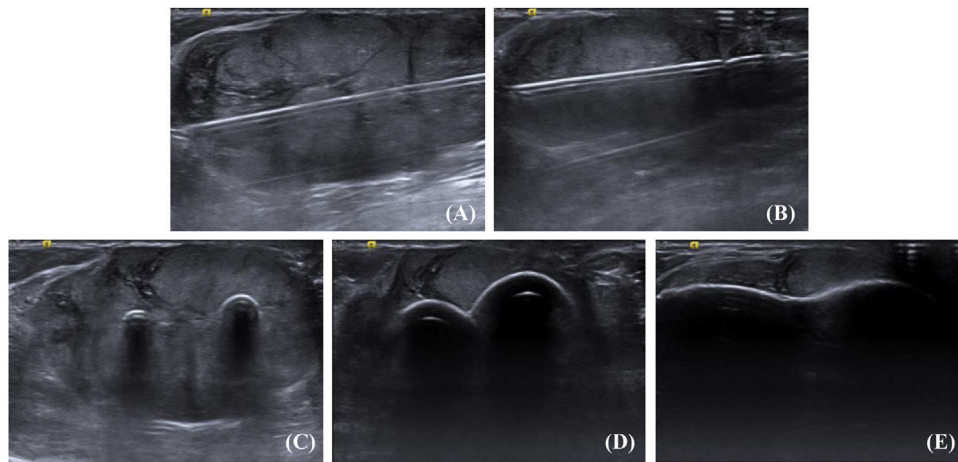


Figure 2 (A and B) Fibroadenoma of 6 cm. Given its size, two Ice Rod Ithaw® 17 G needles were used. Two needles passing through the fibroadenoma along its long axis. (C–E) Same nodule in orthogonal planes. Formation of the two ice balls that end up joining together to engulf the fibroadenoma.

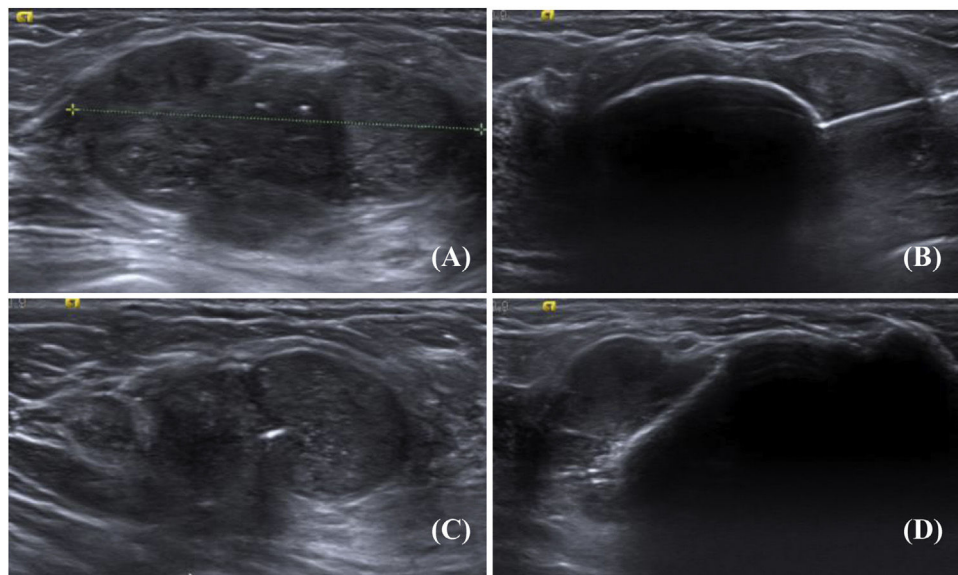


Figure 3 Fibroadenoma of 38 mm, cryoablation with Icepearl needle® 14 G, covering the entire nodule in two freeze-thaw-freeze cycles. (A) Fibroadenoma of 38 mm in the UOQ of the left breast. (B) First freeze-thaw-freeze cycle covering the internal two thirds of the fibroadenoma. (C) A portion of the fibroadenoma remains uncovered by the ice ball. (D) Second cycle covering the remaining external portion after repositioning the needle.

All the fibroadenoma were palpable, ranging between 23 and 64 mm in size along the long axis (median 37.5; mean 40.3 ± 13.5), with volumes of between 3.9 and 61.5 cc (median 14.3; mean 19.4 ± 18.3). The distance from the most superficial edge of the lesion to the skin ranged between 0 and 9 mm (median 2.1; mean 2.9 ± 2.6).

The procedure took a total of between 15 and 52 min (median 30; mean 29.8 ± 11.7).

All patients tolerated the procedure well; while two referred to moderate pain in the hours following the procedure, there were no other complications (Table 1).

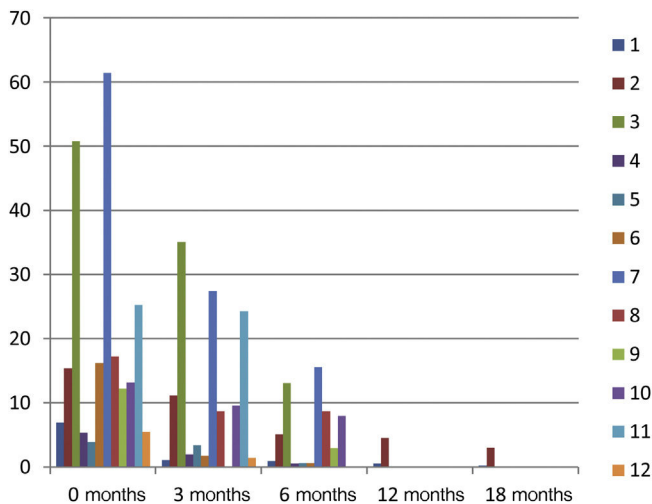
Currently, follow-up ranges from 90 and 675 days (mean 237). The main finding during follow-up was the reduction in the size of the fibroadenoma. The mean reduction in

volume at three months was $47.07 \pm 29\%$, median 50%, at six months of $73.95 \pm 18\%$, median 75%, at 12 months of $78.20 \pm 13\%$, median 71% and at 18 months of $88.81 \pm 12\%$, median 89% (Fig. 4) (Table 2). Nodules presented with a less defined border that made measurements difficult. Doppler studies of the lesion showed a significantly reduced or absent signal. An echogenic band that represented oedema, haemorrhage and fat necrosis, as well as hypoechoic areas, suggesting fibrosis surrounding the fibroadenoma.

Fibroadenomas smaller than 3 cm ceased to be palpable at between three and six months. In the remaining cases the patient noticed a change in volume on palpation.

Table 1 Twelve patients with fibroadenomas treated with cryoablation.

Patient	Age (years)	System/Needle	Duration full protocol (min)	Distance to skin (mm)	Complications
1	34	Nitrogen		15	1
2	46	Nitrogen		15	5
3	47	Argon, Ice Rod I-Thaw® 17 G, 2 needles		32	0
4	36	Argon, IcePearl® 14 G		24	9
5	43	Argon, IcePearl® 17 G		20	5
6	34	Argon, IcePearl® 14 G		32	5
7	16	Nitrogen		52	1
8	19	Argon, IcePearl® 17 G		22	1.5
9	34	Argon, IcePearl® 14 G		37	2
10	39	Argon, IcePearl® 17 G		30	2.3 Pain
11	30	Argon, Ice force® 14 G		48	1
12	39	Argon, IcePearl® 14 G		30	2.5 Pain
Average	34.75		29.75	2.94	

**Figure 4** Volume of fibroadenomas: evolution over time in the 12 cases. The vertical axis shows the volume in cc and the horizontal axis shows the time elapsed since cryoablation (months).

Discussion

Cryoablation significantly reduces the volume of fibroadenomas.

The low temperatures reached cause cell death by direct and indirect mechanisms. The technique is performed in three phases: first freezing, passive thawing and second freezing. In the first freezing phase, the extracellular water freezes earlier due to higher intracellular osmolarity, which causes the water to leave the cell and the cell to dehydrate. Ice crystals that also form inside the cell during this phase damage organelles and membranes. During passive thawing, the osmotic gradient is reversed, the cell swells and ruptures. The influx of water into the cell lowers intracellular osmolarity, raising the freezing point and increasing intracellular ice. The freezing phase is repeated because the damaged tissue efficiently transmits the low temperatures and thus expands the area of necrosis.

Endothelial damage, platelet aggregation, microthrombus formation and the resulting ischaemia are among the additional indirect mechanisms by which cryoablation causes tissue damage.^{8,9}

There are two possible mechanisms of action in cryoablation equipment, both of which form an ice ball along the distal area of the needle. The lethal zone ($< -30^{\circ}\text{C}$) is about 5 mm inside the margin of the ice ball visible on ultrasound.⁸⁻¹⁰

In liquid nitrogen devices, as liquid nitrogen circulates through the uninsulated distal part of the needle, the temperature in the surrounding tissue decreases rapidly. In general, these devices generate large ice balls more quickly than argon gas devices. These systems support a single cryoablation needle per procedure. Although they are beginning to be used in other parts of the body, they are currently principally used in the breast.

In argon gas-powered equipment, the mechanism of action is based on the Joule-Thomson cooling effect caused by the rapid decompression of argon gas through the valve at the tip of the cryoablation needle. With these systems, multiple needles can be used at the same time, allowing for greater customisation of the size and shape of the ice ball. Argon gas devices are also used for ablation in other parts of the body.⁹⁻¹¹ (Fig. 5)

The American Society of Breast Surgeons recommends the following as criteria for indicating possible cryoablation or percutaneous excision of fibroadenomas using VAB: correct visualisation of the lesion with ultrasound, histological confirmation of fibroadenoma prior to treatment, diagnosis concordant with imaging findings, physical examination and patient history, and lesions smaller than 4 cm at their long axis; however, it does not establish fibroadenomas over this size as a contraindication.^{4,7}

Treatment of fibroadenomas is nowadays a cheaper and more readily available procedure, with many centres employing excision with VAB. Cryoablation is a simple, less invasive technique associated with fewer complications, which can be very useful in the treatment of nodules too large to be removed by VAB. In our experience cryoablation of fibroadenomas longer than 4 cm is feasible and safe.

Table 2 Follow-up: volume reduction.

Patient	Size (mm)	Volume (cc)	% vol. reduction 3 months	% vol. reduction 6 months	% vol. reduction vol. 12 months	% vol. reduction 18 months
1	30	6.9	84.06	86.96	92.75	97.10
2	42	15.4	27.27	66.88	70.78	80.52
3	62	50.8	30.91	74.21	71.06	–
4	26	5.3	62.26	90.57	–	–
5	23	3.9	12.82	84.62	–	–
6	37	16.2	89.51	96.30	–	–
7	64	61.5	55.45	74.63	–	–
8	41	17.3	49.71	49.71	–	–
9	37	12.2	–	76.23	–	–
10	38	13.2	27.27	39.39	–	–
11	55	25.3	3.95	–	–	–
12	29	5.5	74.55	–	–	–
Mean	40.3	19.5	47.07	73.95	78.20	88.81

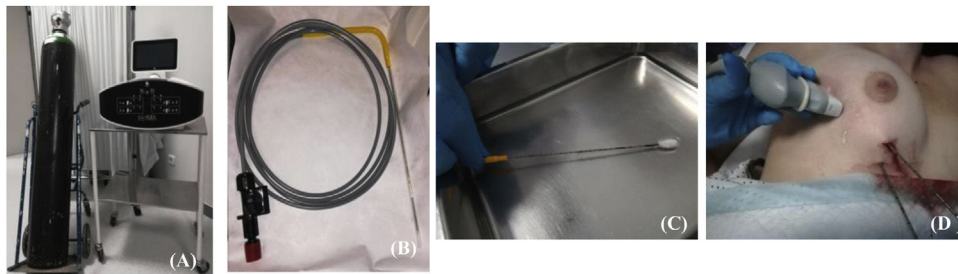


Figure 5 Galil Boston Scientific® cryoablation system. (A) Device with four double ports for eight needles and argon gas bullet. (B) IceSphere needle®. (C) Pre-testing of the needle with formation of the ice ball in a serum bath. (D) Introduction of two needles into the lesion, guided by ultrasound.

This procedure is claimed to be effective, thanks to the possibility of customising the size and shape of the ice ball according to the number of needles used and the different gauges chosen in argon gas systems, and the formation of large ice balls when liquid nitrogen systems are used.¹¹

Ultrasound means the proximity of the ice to the skin can be monitored throughout the process.

Published studies mention that the most suitable lesions for cryoablation are located at least 5 mm, and ideally 1 cm, from the skin.⁹ Some teams describe the injection of saline between the fibroadenoma and the skin thus increasing the distance between them and protecting the skin from possible frostbite in the case of very superficial nodules.^{5,6,8} In our patients the proximity of the lesion to the skin did not cause any complications. Where lesions were very superficial, a warm saline bag was applied over the patient's skin throughout the procedure to protect it.^{8,10}

Possible complications of cryoablation described are pain during or in the hours following the procedure, frostbite with blistering, ecchymosis or haematoma, infection and depigmentation.

The response to treatment and the speed of fibroadenoma resorption may be related to the initial size of the fibroadenoma. The number of freezing cycles, the duration of the freezing and thawing phases, the size of the ice ball

and the temperature applied are factors that may also influence the speed of fibroadenoma resorption.⁵

In published work, fibroadenomas smaller than 2 cm have been shown to respond best, while larger fibroadenomas appear to have slower rates of volume reduction and incomplete resorption.

Previous studies have concluded that there is a 73–99% volume reduction at 12 months in fibroadenomas measuring up to 4.2 cm and an average volume reduction of 40.6% at 6 months and 87.3% at 12 months.^{1,2,12} In fibroadenomas up to 2 cm (on average) the volume reduction at 12 months is 89–97%.¹

Golatta et al. found a 100% reduction at 12 months in 93% of the 58 treated fibroadenomas measuring a maximum of 3 cm, with a mean volume of 1.2 cc.⁶

Kaufman et al. postulated that the entire lesion may be resorbed within two to three years following cryoablation; they presented 17 fibroadenomas smaller than 2 cm which at 12 months have a mean volume reduction of 100%.³ In our patients, the mean reduction in fibroadenoma volume at three months was 47.07%, at six months 73.95%, at 12 months of 78.20% and at 18 months of 88.81%. There are limitations to our study, namely the small number of patients and limited follow-up time.

Although a larger number of patients and longer follow-up is necessary, it seems clear that cryoablation reduces the

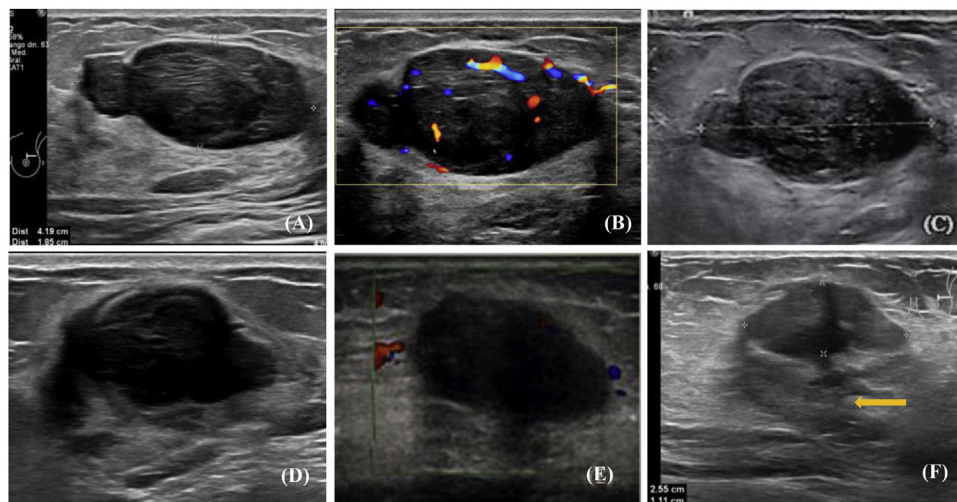


Figure 6 Fibroadenoma of 42×18 mm before and after cryoablation. (A) B-mode ultrasound of the fibroadenoma before the procedure. (B) Doppler study of the nodule before cryoablation. (C) Same fibroadenoma, B-mode ultrasound, follow-up 12 days after the procedure, the nodule measures 37 mm, with surrounding echogenic halo. (D) Same nodule, B-mode ultrasound three months after cryoablation. The fibroadenoma measures 35×21 mm, with a less well-defined border surrounded by an echogenic halo. (E) Same fibroadenoma, Doppler study, follow-up at seven months. The size (26×14 mm) and vascularisation have decreased. Echogenic halo is observed. (F) Same nodule, B-mode ultrasound at 17 months, the fibroadenoma measures 25×11 mm, has a less well-defined border, associated echogenic halo and a hypoechoic area of fibrosis (arrow).

volume of fibroadenomas. However, the number of cases and follow-up time presented in this study are not sufficient to demonstrate that this technique may lead to the complete disappearance of the nodule and it is possible that very large fibroadenomas will not disappear completely. In these cases they decrease in size, stop growing and become palpable. That said, it is also not our aim to make the nodule disappear completely, as they are benign lesions.

The technique has several advantages over VAB in that it is simple, less invasive and has fewer complications. In the case of partial excision with VAB, it is possible that the residual lesion will continue to grow, whereas with cryoablation this does not occur.

Follow-up ultrasound findings included less well-defined fibroadenoma margins, a significantly reduced or absent signal on Doppler study and an echogenic band representing oedema, haemorrhage and fat necrosis, or hypoechoic areas suggestive of fibrosis surrounding the lesion (Fig. 6).

Conclusions

VAB is an accepted and cheap procedure that is habitually used. In the case of large fibroadenoma, cryoablation is a simple to manage, less invasive, technique with fewer complications. Cryoablation achieves a significant reduction in the volume of fibroadenomas that may even disappear. It is an innovative, safe and effective technique, minimally invasive for the patient, and is well tolerated. Complications are infrequent, minor and it offers a better cosmetic result as it avoids scarring. It is performed on an outpatient basis with local anaesthetic, thus avoiding hospital admission and general anaesthesia, saving health and economic resources, as well as helping to manage surgical waiting lists.

Author contributions

- 1 Research coordinators: TDBD and MJRN.
- 2 Development of study concept: TDBD, MJRN, MVCC, DGA, YNM, FGM.
- 3 Study design: TDBD, MJRN, MVCC and JMOG.
- 4 Data collection: TDBD, MJRN, DGA, MVCC, YNM, FGM and JMOG.
- 5 Data analysis and interpretation: TDBD, MVCC, DGA and YNM.
- 6 Statistical analysis: TDBD.
- 7 Literature search: TDBD, MJRN, YNM, and JMOG.
- 8 Writing of article: TDBD, MJRN, MVCC, DGA.
- 9 Critical review of the manuscript with intellectually relevant contributions: JMOG.
- 10 Approval of the final version: TDBD, MJRN, MVCC, DGA, YNM, FGM and JMOG.

Conflicts of interest

None.

References

1. Peek MCL, Ahmed M, Pinder SE, Douek M. A review of ablative techniques in the treatment of breast fibroadenomatata. *J Ther Ultrasound*. 2016;4(1):1–8.
2. Niu L, Wu B, Xu K. Cryosurgery for breast fibroadenomas. *Gland Surg*. 2012;1(2):128–31.
3. Kaufman CS, Littrup PJ, Freeman-Gibb LA, Smith JS, Francescatti D, Simmons R, et al. Office-based cryoablation of breast fibroadenomas with long-term follow-up. *Breast J*. 2005;11(5):344–50.
4. Management of Fibroadenomas of the Breast. The American Society of Breast Surgeons Official State-

- ment; 2008 [accessed el 15 de junio de 2022] <https://www.breastsurgeons.org/resources/statements>
5. Consensus Guideline on the Use of Transcutaneous and Percutaneous Ablation for the Treatment of Benign and Malignant Tumors of the Breast. The American Society of Breast Surgeons, <https://www.breastsurgeons.org/docs/statements/Consensus-Guideline-on-the-Use-of-Transcutaneous-and-Percutaneous-Methods-for-the-Treatment-of-Benign-and-Malignant-Tumors-of-the-Breast.pdf>; 2018 [accessed el 15 de junio de 2022].
 6. Sheth M, Lodhi U, Chen B, Park Y, McElligott S. Initial institutional experience with cryoablation therapy for breast fibroadenomas: technique, molecular science, and post-therapy imaging follow-up. *J Ultrasound Med.* 2019;38(10):2769–76.
 7. Ward RC, Lourenco AP, Mainiero MB. Implementing breast cryoablation in practice. *J Breast Imaging.* 2020;2(1):61–6.
 8. Roknsharifi S, Wattamwar K, Fishman MDC, Ward RC, Ford K, Faintuch S, et al. Image-guided microinvasive percutaneous treatment of breast lesions: where do we stand? *RadioGraphics.* 2021;41(4):945–66.
 9. Roca Navarro MJ, Garrido Alonso D, Navarro Monforte Y, García Martínez F, Díaz de Bustamante Durbán T, Córdoba Chicote MV, et al. Eficacia de la crioablación guiada con ecografía en el tratamiento del cáncer de mama de bajo riesgo. *Radiología.* 2022:S0033833822001394.
 10. Ward RC, Lourenco AP, Mainiero MB. Ultrasound-guided breast cancer cryoablation. *Am J Roentgenol.* 2019;213(3):716–22.
 11. Golatta M, Harcos A, Pavlista D, Danes J, Klein R, Simovich P, et al. Ultrasound-guided cryoablation of breast fibroadenoma: a pilot trial. *Arch Gynecol Obstet.* 2015;291(6):1355–60.
 12. Graña-López L, Pérez-Ramos T, Villares A, Vázquez-Caruncho M. Tratamiento con crioablación de lesiones de mama: nuestra experiencia. *Radiología.* 2022;64:49–53.