Breast lumps detected during pregnancy are generally benign and reflect fibroadenoma, lactating adenoma, cysts, infarction of the breast or galactocele. Although rare, the possibility of breast cancer must also be considered to avoid any delays in diagnosis. After patient questioning and clinical examination, the first imaging modality to use is ultrasound. No further assessment is called for if lesions are categorized as BI-RADS 2 and no suspicious clinical signs are observed. Depending on the clinical setting, lesions classified BI-RADS 3 require monitoring and mammographic assessment (which can be helpful in diagnosing cancer and incurs no risk to the embryo or fetus). If the clinical signs are unclear and/or the lesion(s) are categorized as ≥ BI-RADS 4a, then mammography and often biopsy should be performed. Strict BI-RADS scoring (American College of Radiology) should be applied, bearing in mind that benign lesions can appear suspicious during pregnancy, and some cancers can exhibit what seem to be reassuring characteristics.

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The breast during pregnancy

Physiological changes to the breast during pregnancy [1–3]

Estrogen and progesterone production by the corpus luteum during the first trimester of pregnancy and by the placenta during the second trimester, lead to lobule and duct proliferation and development, involution of adipose tissue and increased breast vascularization. Mononuclear inflammatory cells also infiltrate the breast tissue. Estrogens stimulate the developing lactiferous duct system, whereas progesterone stimulates lobule development. The proliferative process is most pronounced during the first 20 weeks of pregnancy.

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Lobule growth continues during the 2nd and 3rd trimesters via cellular proliferation as well as increased cell size. Myoepithelial cells become flattened and less prominent whereas epithelial cells are enlarged. During the 2nd trimester, secretory substances accumulate in the epithelial cells of lobule acini, and during the 3rd trimester increased levels of prolactin promote alveolar cell differentiation and initiate lactogenesis.

During the second half of pregnancy, the proliferative process slows and changes to the secretion pathway involved in milk production increase. Lobule size increases and interlobular adipose tissue disappears until lobules are separated only by thin layers of connective tissue.

The changes to the secretion pathway do not occur evenly within the breast during pregnancy. Some authors consider that localized hyperplastic lactating adenoma, that can cause one or more palpable lumps visible using imaging techniques, is an extreme manifestation of the heterogeneity of this process [1].

Some of the histological changes that occur during pregnancy can be visualized such as physiological adenosis, calcifications within milk-secreting acini and dilated ducts. Preexisting lesions may undergo changes due to variations in the hormonal environment; thus fibroadenoma, hamartoma and fibrocystic breast disease may show secretory, cystic and/or necrotic changes.

Clinical changes

Clinical examination reveals a darkening of the nipple and areola, a more prominent nipple and dilated superficial skin veins as from the end of the first trimester. During the final stages of pregnancy, breast adipose tissue nearly completely disappears and is replaced by hard, tight lobes; the skin becomes thinner. A little colostrum may be released by breast massage. Clinical examination can be challenging due to the increased size of the breasts, their sensitivity and especially their harder, more nodular consistency.

A previously palpable lump can be concealed during pregnancy by hypertrophic breast tissue, or may increase in size, hence the importance of examining the patient’s breasts at the beginning of pregnancy and then at regular intervals during its course.

Changes in imaging findings

Duct ectasia is frequently observed using ultrasound. The breast is more hypoechoic due to lobular hyperplasia and duct dilation; its echogenicity is more or less homogeneous.

Mammograms of pregnant women generally show a higher tissue density because of the young age of the women but also due to glandular development and adipose tissue atrophy, which decreases the sensitivity of mammography. Even so, mammography remains a very helpful modality for diagnosing breast cancer and should therefore be performed if there is the slightest doubt.

Sometimes benign, round and regularly-shaped secretory microcalcifications may be observed.

Pre-pregnancy assessment is important to monitor changes such as increased size or heterogeneity of existing lesions (particularly fibroadenoma, hamartoma and cysts) during pregnancy.

Breast lumps during pregnancy

Clinical examination

When a patient consults for a palpable lump that she has detected, she should be questioned and thoroughly examined in order to confirm the presence of a mass, describe it and prescribe the appropriate complementary investigations.

Questioning should be aimed at determining the date of appearance of the lump, as well as individual patient history (possible known fibroadenoma) and familial history.

Clinical examination is based on careful breast inspection and palpation and comparison with the contralateral side to:
- confirm the presence of the mass;
- identify its location and size;
- describe its consistency and mobility;
- detect related signs: skin retraction, nipple changes, discharge, lymph nodes, signs of inflammation, pyrexia.

Finding a breast lump in a young pregnant woman whose mind is already set on the upcoming birth is a particularly upsetting and stressful situation. Everybody, including the patient, her family but also the clinician, would prefer to say “it’s nothing”, “we shall see once the baby’s been born”. However, since the patient brought herself to consult, something is already wrong — the rot has set in — and the problem must be resolved now, during pregnancy.

Why? Because in the great majority of cases (80%) the lump is benign [3] and the patient can be reassured and continue her pregnancy relieved. And when it is cancer, the delay in diagnosis (still very frequent) due to postponing investigations until after delivery, may have serious consequences.

Indeed, the types of cancer that typically occur during pregnancy are very often aggressive and require fast, multidisciplinary management. Breast specialists consider it to be one of the rare “breast emergencies”. Clinicians should also be aware that efficient treatment of the mother is possible, and can generally be implemented during pregnancy.

Imaging findings during pregnancy [3–10]

The consistency of clinical and imaging findings regarding lump location, size and shape should always be verified.

Ultrasound

Ultrasound is used as the first-line imaging technique. It enables accurate diagnosis of simple cystic lesions and sometimes helps to confirm the clinician’s feeling that there is actually no lump but just normal fibroglandular tissue. It allows accurate investigation of solid lesions.

Benign lesions, particularly fibroadenomas and hamartomas, may increase in size during pregnancy, become heterogeneous and undergo infarction. They may therefore look suspicious by imaging techniques so if in doubt samples should be obtained.

Mammography

When 4-view mammography is performed, the mother receives a dose of radiation of about 3 mGy and the dose
Breast lumps in pregnant women

received by the uterus is lower than 0.03 µGy [6]. The fetus is therefore exposed to a negligible amount of radiation [3–5] of about 0.001 to 0.01 mGy, that is 0.03 to 0.3 mSv (depends on fetal weight and term, etc.). This level of exposure should be compared with the natural weekly radiation that the fetus receives that is estimated at 0.02 mGy [8]. Doses of up to 1 mGy are considered to be acceptable for the fetus [7]. The threshold value above which there exists a risk for the fetus is 50 mGy. Mammography may be performed with a lead screen or apron that approximately halves the dose to the fetus and reassures the patient. Nevertheless, even if the patient is unaware that she is pregnant and mammography is performed without a lead screen there is no risk for the fetus [6].

Mammography should be prescribed on even the slightest doubt after clinical and/or ultrasound examination, because it can be particularly useful for diagnosis in cases of breast cancer [8]. Moreover, if a lesion contains fatty density, its benignity can be affirmed and biopsy avoided.

MRI

On the basis of current knowledge, the injection of gadolinum, as is required for breast MRI, is contraindicated during pregnancy.

Breast samples [9,11]

It is essential that pathologists be aware that the patient is pregnant before assessing breast samples.

Cytological assessment

Pregnancy can lead to false negative, as well as false positive results. False positives are due to atypical nuclear findings (lactational hyperplasia, nucleus enlargement, hyperchromia) and the significant cell mitosis that is observed. If atypical findings are observed, they should not be imputed to pregnancy without additional proof; taking a biopsy is mandatory in these cases.

Fine needle aspiration may be useful for investigating painful cysts with thick fluid contents or if an abscess is suspected.

Biopsy

Taking biopsies is the most reliable method for diagnosing solid masses. Biopsies are generally performed using ultrasound guidance but are sometimes also carried out using stereotactic guidance (microlcalifications). In the latter case, there is a slightly higher rate of complications (milk fistula, infection or bleeding), and post-biopsy compression should be applied for a longer time.

Main etiologies

In the great majority of cases, breast lumps in pregnant women are of benign nature.

A variety of specific etiologies are observed in pregnant women:

- lactating adenoma;
- galactocele;
- infarction (of a preexisting lesion or of healthy parenchyma);
- macromastia (very rare).

Other etiologies are common in women of this age group (average age: 20 to 40 years):

- fibroadenoma;
- cystic disease;
- more rarely hamartoma, mastitis, abscess, etc. (or any other breast disease);
- breast cancer, which is rare but with serious consequence and often diagnosed at a late stage. Cancer must be excluded in pregnant women as it is one of the rare "breast emergencies". As indicated by R. Vashi [5], the radiologist’s most urgent role is to avoid a delay in diagnosis.

Clinicians should be aware that after childbirth and breast-feeding, many benign abnormalities regress spontaneously.

Lactating adenoma [3,12]

Lactating adenoma is benign tumor that usually causes a single mass, however bilateral and multiple adenomas can be found. It occurs during the third trimester of pregnancy (rarely the first or second trimester), as well as during breast-feeding, and regresses once the patient stops breastfeeding. It is characterized by a painless, mobile mass that may become hard and painful when associated with infarction.

Macroscopically, the masses are yellow, lobulated and well-delimited with no capsule. Microscopic investigation of lactating adenoma reveals:

- proliferation of secretory lobules separated by thin layers of connective tissue;
- alveolar lumen filled with proteins, lipids and colostrum;
- a double layer of epithelial and myoepithelial cells.

Immunohistochemistry shows strong binding of the S100 protein.

Ultrasound examination shows a solid mass of benign appearance categorized as BI-RADS 3 (homogeneous well-delimited hypoechoic mass, the main axis of which is parallel to the skin), which mimics fibroadenoma. It can sometimes be difficult to differentiate the lesion from adjacent fibroglandular tissue.

Rarely, atypical findings are observed, in particular:

- zones of anechoic fluid;
- poorly-defined borders (no capsule);
- heterogeneous contents (secretory cells).

When visible on mammograms, lactating adenoma shows up as a well-defined mass. It is sometimes of fat density or other times shows a fluid-fat level (because the secretory lobules contain colostrum) and can therefore be diagnosed as benign.

If the clinical appearance and ultrasound findings are characteristic (solid BI-RADS 3 mass), then the patient may be reassured although followed-up closely (clinical examination and ultrasound). As previously discussed, biopsy is sometimes necessary when ultrasound findings are atypical.
(Fig. 1a–c) (and the lesion does not contain fat on mammography) and/or if the lesion changes significantly (Fig. 2).

Galactocele [3,9]

A galactocele is a retention cyst containing milk, which occurs when a milk duct becomes obstructed (generally due to inflammation). Although most frequently observed after childbirth, it can occur during the third trimester of pregnancy or during breast-feeding. Clinically, it is reflected by a single mass or multiple masses. Using ultrasound, galactoceles are visualized as round or oval structures, the appearance of which depends on the proportions of fluid, protein and fat that they contain. Galactoceles can be:

• anechoic;
• contain a fluid-fat level;
• hypoechoic or with fine echos;
• of complex geometry with a thick wall (inflammation).

When visible on mammograms, galactoceles shows up as a well-defined mass of fat or fluid density (Fig. 3a–c), sometimes with a fat-fluid level, and can therefore be diagnosed as benign.

Clinical examination and ultrasound imaging are usually sufficient, but if in doubt, cytology ascertains the diagnosis.

Breast infarction

During pregnancy, necrosis and bleeding may occur in hypertrophic breast tissue (Fig. 4) or inside another preexisting mass (known or unknown). Infarction generally occurs in:

• fibroadenoma;
• lactating adenoma;
• hamartoma.

The clinical signs may seem suspicious with a poorly-defined, painful mass that can adhere to the skin and cause lymph node enlargement (inflammatory response to necrosis).

Using imaging techniques, the mass appears solid and often heterogeneous, and can be associated with axillary lymphadenopathy.

Figure 1. Twenty-six year-old patient, 8th month of pregnancy, no family history, with a palpable lump in the union of left internal quadrants: a: ultrasound showing an oval-shaped mass, the larger axis of which is horizontal, discreetly heterogeneous, without posterior enhancement, BI-RADS 4a; b and c: bilateral mammograms (MLO view) showing dense breasts with a round, partially delimited, 40-mm lesion classified ACR4a. Ultrasound-guided microbiopsy evidenced lactating adenoma.

Figure 2. Thirty-four year-old patient, 2nd trimester of 2nd pregnancy, no family history with a palpable lump. History of lactating adenoma diagnosed and biopsied during first pregnancy in 2012. It then measured 37×35 mm and has grown to now measure 60×40 mm. Ultrasound findings: mass with large axis in horizontal plane, microlobulated borders, BI-RADS 4. Ultrasound-guided microbiopsy evidenced lactating adenoma.

Biopsy is generally required due to the presence of a heterogeneous solid mass (therefore categorized as BI-RADS 4 or 5). Fine needle aspiration is not recommended as it is not a reliable method owing to ischemic necrosis.

Macromastia

Macromastia is a very rare condition (1/100,000 pregnancies). It is generally bilateral, of unknown etiology and
Breast lumps in pregnant women

Figure 3. Forty-five year-old patient, last trimester of pregnancy, no family history, with a small lump in the union of right upper quadrants: a: ultrasound showing a very hypoechoic round structure, without posterior enhancement, with well-defined borders and a discreetly irregular wall BI-RADS 4b; b and c: mammography (CC and MLO views) showing a translucency (consistent with the location and size of the lesion), due to fatty content, and demonstrating its benign nature: galactocele.

Figure 4. Twenty-eight year-old patient, no family history, with a palpable lump during the first trimester of pregnancy. Ultrasound findings: well-delimited hypoechoic mass with a small anechoic central zone and clear posterior enhancement. The shape is round and there are bilateral cysts. The lesion is classified as BI-RADS 3, with a decision of monitoring. It remains stable during pregnancy. The lesion is biopsied due to its non-disappearance after childbirth: breast parenchyma with milk-secreting lobules and ischemic necrosis.

causes major hypertrophy of the breasts, each breast weighing up to 7 kg or sometimes even more. Besides the discomfort caused by the condition, it is associated with serious complications such as ulcerated skin lesions, breast infarction, bleeding from the dilated breast vessels.

Diagnosis is made by clinical examination; biopsy not advised because of the risk of secondary infection and bleeding. Histologically, the condition is due to an increase of the volume of breast gland and connective tissue but not of the adipose tissue.

Macromastia patients receive drug therapy (bromocriptine) but sometimes breast reduction surgery is required.

Fibroadenoma

Fibroadenoma is the most frequently observed tumor during pregnancy. It can:

- appear de novo;
- preexist and increase in size due to the high levels of estrogens;
- become infarcted (mainly large fibradenomas).

Clinical examination reveals a hard, mobile lump that becomes painful and non-mobile if infarcted.

It has a typical BI-RADS 3 appearance using ultrasound (oval shape, main axis parallel to skin, hypoechoic and homogeneous, well-delimited with possible posterior enhancement). During pregnancy more atypical findings can be observed due to ischemic changes, bleeding and increased size. The fibroadenoma can therefore appear heterogeneous with poorly-defined or unclear borders and a fluid component [10].

Further investigation:

- if discovered during pregnancy:
  - fibroadenomas of typical appearance (BI-RADS 3) can either be simply monitored closely (clinical examination and ultrasound every 1–2 months) or biopsied to avoid the stress related to regular monitoring. The course of action depends on the setting (risk factors, anxiety) as well as local practice and lesion size. Thus a 10-mm BI-RADS 3 mass will more often be monitored whereas for a 30-mm lesion biopsy might be the preferred option,
  - fibroadenomas of atypical appearance (≥ BI-RADS 4) require biopsy;
- if fibroadenoma was diagnosed prior to pregnancy (retrieval imaging, puncture and biopsy results):
  - if stable, monitoring is not required,
  - a 20% increase in size compared with previous imaging is acceptable [3] if the appearance is still benign (BI-RADS 3). In such cases, clinical and ultrasound follow-up should be scheduled and the patient reassured,
  - biopsies should be collected if in doubt (substantial increase in size, morphological change, ambiguous) (Fig. 5a–b);
• if there are multiple fibroadenomas:
  ○ usually monitoring (clinical and ultrasound) is recommended in presence of multiple nodules classified BI-RADS 3,
  ○ if in doubt, the most suspicious nodule can be biopsied (Fig. 6),
  ○ if the diagnosis of fibroadenoma is confirmed, the other nodules should be monitored.

Figure 5. Twenty-six year-old patient, 4th month of pregnancy with a mobile painless lump of the left superolateral quadrant. The patient indicates that she has had this mass for 6 years (no imaging findings), but that its size has recently increased. No family history:
a: ultrasound showing a well-delimited round mass with posterior enhancement, an oblique larger axis and heterogeneous structure. Categorized BI-RADS 4a; b: Mammography, MLO view, dense breast containing a round well-delimited mass with a macrocalcification, BI-RADS 3. Biopsy evidenced fibroadenoma.

Figure 6. Thirty-year-old patient with familial risk factors followed for probable multiple fibroadenoma of the right breast since 2010. Ultrasound examination at 4th month of pregnancy: enlargement of one of the nodules (9 mm in 2011, 22 mm at present), still categorized as BI-RADS 3. In addition, two other nodules were observed (not shown): an unchanged 8-mm BI-RADS 2 nodule and 9-mm BI-RADS 3 nodule that was not described previously. It was decided to biopsy the enlarged nodule. Biopsy evidenced fibroadenoma with peripheral foci of lactating metaplasia. The 9-mm BI-RADS 3 nodule was monitored using ultrasound at 6 and 8 months then after childbirth. It remained stable.

Figure 7. Thirty-four year-old patient, 2nd month of pregnancy with a painful 30-mm lump of the left upper quadrant and a familial history of breast cancer (mother at age 59). Ultrasound examination categorized as BI-RADS 3 (complicated cyst), confirmed by fine needle aspiration.

Fibrocystic disease

There are no real differences with cystic disease in non-pregnant women. Cysts can be simple or complicated, single or multiple. The term “complicated” should only be used for cysts of thick fluid contents and no wall.

Puncture can be performed to diagnose complicated cysts (Fig. 7) as well as to drain pressurized and/or painful cysts.

Hamartoma

In most cases, ultrasound findings are typical (soft, painless mass: “breast-in-breast” appearance) and hamartoma can be diagnosed. However diagnosis can be more challenging if its size increases and/or its appearance changes (associated infarction). In such cases, hamartomas are visualized as atypical solid masses. Mammographical assessment may be helpful by revealing fatty density and therefore it can be diagnosed as benign. If this is not the case, then biopsy should be performed.

Mastitis, abscess

Conditions of infectious origin are rare during pregnancy; they are more frequent during breast-feeding. Diagnosis is based on clinical signs:
• inflammation (redness, heat, pain);
• painful lump (abscess);
• axillary lymph node enlargement;
• fever, hyperleukocytosis.

As for all cases of breast inflammation, biopsies should be taken if the patient does not respond quickly to drug treatment (antibiotics, 10 days).
Pregnancy-associated breast cancer (PABC) [13—23]

PABC is defined as breast cancer that occurs during pregnancy or within the year following childbirth. It is a rare disease that accounts for only 6–10% of all breast cancers in women aged under 40 years. Only a small proportion of cases occur during pregnancy (approx. 20%), most are detected post-parturition. The average age of onset is 34 years. In about a third of cases, PABC is diagnosed in women with a moderate to high risk of breast cancer. Patient questioning on familial history is therefore essential and women with a significant risk should be examined carefully. For this reason, Chopier and Rouzier [19] recommended that genetic investigation be carried out systematically for patients with PABC. Nonetheless, in the great majority of cases, breast cancer occurs in young women with no noteworthy history, so the possibility of cancer should not be excluded in a 25-year-old woman just because she has no family history of the disease.

Generally the patient consults for a large (or even very large) palpable lump that she discovered herself. Invasive carcinoma (that can be associated with carcinoma in situ) is usually diagnosed with poor prognosis factors [16]: lymph node involvement, high-grade tumors, hormone-receptor negative and HER2 positive.

Lesions are generally categorized as BI-RADS 4 or 5 by ultrasound examination. Even so, the appearance of PABC is not always typical of malignancy. Ayyappan et al. [15] reported the high frequency of lesions having a horizontal main axis (60%) and posterior enhancement (60%). This is probably due to the high proportion of rapidly developing grade 3 infiltrating ductal carcinomas that progress too quickly to induce stromal reaction (Fig. 8a–e). Analysis of the borders should be particularly meticulous, and any lesion with microlobulated and/or irregular borders should be categorized as at least BI-RADS 4. In high-risk patients, especially BRCA1 mutation carriers, breast cancers are often of pseudo-benign appearance, and biopsy should be performed if even the slightest doubt exists (Fig. 9a–b). On rare occasions, ultrasound does not perform well [16], especially if the lesion does not have a typical malignant appearance or if the condition is exclusively or predominately intraductal.

It is interesting to note that mammography contributes to diagnosis in all studies (75–80% of cases with lesions

![Figure 8](image-url)

Figure 8. Thirty-eight year-old patient, 6th month of twin pregnancy with a palpable, clinically suspicious lump of the right superolateral quadrant staged T2 N0. Familial history of breast cancer (cousin at age 40). Mammography (CC views [a, b] and MLO views [c, d]; note that the lead apron is visible) revealed dense breasts (type 4) with asymmetrical density of convex margins of the right superolateral quadrant (BI-RADS 4). Ultrasound (e) showed a mass with microlobulated borders and a hyperechoic halo and posterior enhancement (BI-RADS 4). Biopsy evidenced grade 3 RH+ Her2— invasive ductal carcinoma (IDC). The patient was treated with neoadjuvant chemotherapy (first 2 sessions during pregnancy), then after childbirth at 8 months by caesarian section, tumor resection, axillary lymph node dissection, radiotherapy and tamoxifen. Still in remission 6 years later.
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Figure 9. Thirty-six year-old patient with BRCA1 mutation, 6th month of pregnancy. Recent appearance of a solid mass within the left superolateral quadrant with a hard 1-cm axillary lymph node. a, b: mammograms (MLO view, note that the lead apron is visible) show dense breasts with a spiculated structure in the upper left breast. Post-biopsy (benign) markers in the right breast; c: ultrasound revealing a homogeneous, hypoechoic oval-shaped mass with microlobulated borders, BI-RADS 4b; d: ultrasound of the left axillary region: suspicious round lymph node showing cortical thickening and no hilum. Ultrasound-guided microbiopsy and fine needle aspiration of the lymph node evidenced grade 3 N+ IDC. The patient was treated by tumor resection and axillary lymph node dissection, then after childbirth by adjuvant chemotherapy, radiotherapy, and hormone therapy.

classified BI-RADS 4 or 5) despite high breast density. Indeed, either the mass is visible on the mammogram (often with unclear and sometimes spiculated borders) or architectural distortion and/or irregular microcalcifications can be observed. In the series we reported previously [16], 55% of patients had suspicious microcalcifications which contributed to diagnosis (Fig. 10a–b).

For this reason, if clinical and/or ultrasound findings are inconclusive or suspicious, bilateral mammography should be performed. In our study, we used both CC and MLO

Figure 10. Thirty-seven year-old patient, begining (6 weeks amenorrhea) of 4th pregnancy with a clinically suspicious lump of the right superolateral quadrant staged T2 N1; a: mammography (CC view); b: mammography (enlarged image) showing a spiculated mass with numerous, irregular and polymorphic microcalcifications (BI-RADS 5). Biopsy evidenced grade 3 IDC and high grade DCIS. Following discussion with the patient, therapeutic abortion was performed, then mastectomy and axillary lymph node dissection followed by chemotherapy, radiotherapy and hormone therapy. Still in remission 7 years later.
views for each breast. Out of the 22 cases of breast cancer detected during pregnancy, mammography caught up for the ultrasound false-negatives and, vice-versa, ultrasound found the cancers missed by mammography [16].

Patients may be treated surgically at any time during pregnancy and chemotherapy may be initiated from the 2nd trimester on. The main risk for the fetus is prematurity. Even if little is known about the long-term effects on the child, none of the studies carried out reported significant excess mortality or morbidity. Radiotherapy is generally contraindicated during pregnancy, as is hormone therapy.

Numerous different oncological, obstetrical, psychological and personal parameters (choice, mother’s age, other children, risk factors) need to be taken into account. Therapeutic abortion does not improve the patient’s prognosis, and should be considered on a case-by-case basis. It may be recommended at the very beginning of pregnancy for severe forms of breast cancer if prognosis would be worsened by delaying chemotherapy until the 4th month.

In practice

Following patient questioning and careful clinical examination, bilateral ultrasound is used as the first-line imaging technique. The next steps depend on ultrasound findings.

If ultrasound reveals a typical BI-RADS 2 cyst (cyst, galactocele)

The patient can be reassured and further investigation is not needed.

If ultrasound reveals a lesion classified BI-RADS 5

As for non-pregnant patients, complete bilateral mammography should be performed and ultrasound-guided biopsy samples collected.

Normal ultrasound findings

If ultrasound findings are normal, consistent with the clinical examination and no real mass is detected, then the patient should be reassured. The obstetrician will continue to examine the breasts regularly during normal pregnancy visits.

On the other hand, if clinical findings are ambiguous or suspicious (mass, related signs), then bilateral mammography should be performed, and if still in doubt biopsies taken. Robbins [8] reported that the negative predictive value (for PABC) of the combination of mammography and ultrasound was 100%. In the series of patients we studied [16], mammographic and ultrasound findings were never both negative for patients with breast cancer.

Complicated cyst classified BI-RADS 3

Stringent criteria need to be applied:

- round- or oval-shaped lesion;
- uniformly hypoechoic or with fine echos;
- well-defined borders;
- posterior enhancement;
- no wall.

Depending on local practice and the clinical setting, the lesion is either punctured in order to diagnose a thick-fluid cyst, galactocele, or even an abscess, or monitored by regular clinical and ultrasound examination (every 1–2 months). Atypical puncture findings should not be attributed to pregnancy, but should lead to biopsy to clarify the diagnosis.

One must be careful with partly fluid (complex) masses, which must be categorized as BI-RADS 4 and not BI-RADS 3. They can reflect changes in a benign lesion (fibroadenoma, hamartoma, lactating adenoma, infarction) but also necrotic cancer.

Solid mass of benign appearance classified BI-RADS 3

Depending on local practice, clinical setting (patient at risk) and lesion size, there are three possibilities:

- regular clinical and ultrasound monitoring (every 1–2 months, to rapidly detect a progressing lesion);
- mammography (MLO view ± CC view) to ensure there are no suspicious structures (particularly microcalcifications) and increase diagnostic confidence, or even reclassify the lesion as BI-RADS 2 (fatty density);
- immediate biopsy.

Masses categorized as BI-RADS 3 generally reflect fibroadenoma, lactating adenoma, hamartoma or galactocele. Nevertheless, caution should be observed when diagnosing breast masses in BRCA1 mutation carriers.

Solid mass of indeterminate or suspicious appearance classified BI-RADS 4

Mammography (MLO view ± CC view) should be performed. If the mass shows partially fatty density and/or a fluid-fat level, it can be reclassified BI-RADS 2 and the patient reassured. In all other cases, biopsy should be performed.

When biopsy results are benign and consistent then the patient should be reassured. A control ultrasound examination can be scheduled after childbirth, but is not urgent.

However if the biopsy reveals the presence of malignant tissue, exhaustive bilateral mammography must be performed without fail if not already done (at least two views per breast) so as not to miss any homolateral or contralateral microcalcifications.

Conclusion

Breast masses discovered during pregnancy should be investigated immediately either to reassure the patient (most lesions are benign), or if necessary, rapidly implement treatment when breast cancer is diagnosed since any delay in diagnosis and therapy can jeopardize successful management.
Take-home messages

Palpable breast lumps in pregnant women
- It is a frequent and stressful situation. Investigation should be immediate and not delayed until after childbirth.
- Most lesions are benign (80%). They are either:
  - common in women of this age group: notably fibroadenoma, cyst, hamartoma,
  - or related to pregnancy: lactating adenoma, galactoceles, infarction of a benign lesion.
- Breast cancer is a rare but serious disease; it needs to be excluded without delay.
  - Imaging
  - Ultrasound is the first-line imaging technique.
  - Mammography is indicated:
    - if there is the slightest doubt after clinical and/or ultrasound examination,
    - despite high breast density, mammography very often contributes to the diagnosis of cancer, and its results are complementary to ultrasound (microcalcifications),
    - if the lesion is found to be of fatty density it can be reclassified as BI-RADS 2 and biopsy is not required (some lactating adenomas, galactoceles and hamartomas);
    - it incurs no risk for the embryo or the fetus.
- Due to ischemic changes and bleeding and/or an increase in size during pregnancy, some benign lesions may appear as ambiguous and require biopsy. Collecting samples
- Fine needle aspiration should only be used for cystic lesions, and clinicians should be aware of the risk of false-negative and false-positive results.
- Depending on local practice and the clinical setting, solid lesions classified BI-RADS 3 should be monitored regularly by ultrasound (every 1–2 months), or biopsied. Biopsies must be collected for lesions classified BI-RADS 4 or BI-RADS 5.

Clinical case

Forty-one year-old patient, 7th month of pregnancy, consulting for a palpable lump in the right superolateral quadrant that appeared 2 months ago. Palpation was difficult during clinical examination. The mass measured 25 mm and homolateral axillary lymph node enlargement was observed. Ultrasound examination (Fig. 11) revealed:
- a structure consistent with the palpable mass in the right superolateral quadrant (axillary lymph node not shown);
- a mass in the right lower quadrant;
- a mass in the left upper quadrant.

Questions

1. Should mammography be performed?
2. How would you classify these lesions?
3. What is the appropriate management of this patient: monitoring, biopsy, multiple biopsies?

Answers

1. Yes, because the clinical findings are suspicious (mass associated with a palpable lymph node) and ultrasound findings > BI-RADS 3. Bilateral mammographic findings were normal (not shown).
2. The main axis of the lesion in the right superolateral quadrant is horizontal but it is heterogeneous and its borders are microlobulated: BI-RADS 4. The lesion in the right lower quadrant is oval, well-delimited and homogeneous: BI-RADS 3. The lesion in the left upper quadrant is bilobed but its main axis is vertical and its borders are discreetly irregular: BI-RADS 4.
3. Both lesions classified BI-RADS 4 should be biopsied. The lesion classified BI-RADS 3 can simply be monitored if the two others are found to be benign. This patient was from Cameroon and needed a definitive result before returning home (monitoring not possible): all three lesions were therefore biopsied and the right axillary lymph node punctured.
4. The following results were obtained: Lesion in the right superolateral quadrant: secretary metaplasia of the breast parenchyma with numerous foci of pseudoangiomatous stromal hyperplasia (PASH). Fine needle aspiration biopsy of axillary lymph node: benign reaction. Lesion in the left upper quadrant: fibroadenoma. Lesion in the right lower quadrant: pseudotumoral sclerosing adenosis. All the lesions were in fact benign and the patient was free to leave without requiring follow-up.
Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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