

CME

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Management of women at high risk of breast cancer

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Breast cancer is the commonest malignancy diagnosed in women worldwide and accounts for over 30% of all cancers diagnosed in women in the United Kingdom.¹ The average lifetime risk of developing breast cancer for women in the United Kingdom and United States is estimated to be 12%,¹ although this may be an overestimate, as it is not clear what age this assumes a woman lives to and whether full adjustment has been made for those who die young from other causes. It is also unclear whether multiple breast cancers in a single woman are counted as several women with breast cancer.

The risk of breast cancer is multifactorial and is an interaction between environmental, lifestyle, hormonal, and genetic factors.²⁻³ Some women have a particularly high risk of breast cancer owing to their family history, or, less commonly, after supradiaphragmatic radiotherapy for Hodgkin's lymphoma. This review discusses how to identify women who are at high risk of breast cancer as a result of their family history or irradiation and outlines the management options for such women, including surveillance and risk reducing strategies. A further group of women diagnosed on the basis of a breast biopsy as having atypical ductal or lobular hyperplasia are also at increased risk of breast cancer; these women are not discussed further in this review.

When should a woman be considered at high risk of breast cancer?

A risk assessment for breast cancer is complex and no consistent definition or threshold for high risk has been established. Within UK practice, high risk, as defined by the National Institute for Health and Care Excellence,⁴ is a lifetime risk of 30% or greater, which equates to a more than 8% risk of breast cancer at age 40-50 years. The high risk threshold used in the United Kingdom is similar to that in other European countries, although in North America the threshold for screening using magnetic resonance imaging is a lifetime risk of 20-25%.⁵ NICE guidelines have algorithms for identifying high risk women, which include two close (first or second degree)

SOURCES AND SELECTION CRITERIA

We searched PubMed using search terms such as "breast cancer risk" and "hereditary breast cancer." Studies included were those written in English, and included case-control studies, randomised control trials, and meta-analyses. We also consulted relevant national and international guidelines, including those of the National Institute for Health and Care Excellence, and we were part of the NICE Guideline Development Group where all relevant evidence was identified and summarised.

relatives with breast cancer with an average age of less than 50, three with breast cancer aged less than 60, or four with breast cancer at any age. These are "catch all" criteria, which will not make all women who meet these criteria fit the lifetime or 10 year risk criterion. Another high risk criterion includes women with a family history of both breast and ovarian cancer, which specifically highlights the possibility of a BRCA1/2 mutation given the increased risk of both cancers associated with mutations in these genes.

In most women with breast cancer the cause is unknown. Those with breast cancer can be considered at high risk if they meet the criteria mentioned above, including their own breast cancer. Each close relative with a diagnosis of breast cancer increases a woman's risk of developing breast cancer, especially with a diagnosis at a young age (<50 years). Such families may have a genetic predisposition to the development of breast cancer, with about 5% of all breast cancers being attributable to inherited mutations in specific genes such as BRCA1, BRCA2, and TP53. In any individual the genetic risk factors will be modified by other risk factors.

In women of Ashkenazi Jewish descent a family history of breast cancer poses a higher risk than in women of non-Jewish descent because of the high prevalence and penetrance of BRCA1 and BRCA2 mutations (2.5%).⁶ In this population any breast cancer is associated with a 10% carrier rate of BRCA1/2, with higher rates for women with a diagnosis at a younger age. Furthermore, three specific "founder" mutations (two in BRCA1 and one in BRCA2) have been identified within this population, making genetic testing based on only these mutations a much more sensitive and specific test.

It is also clear that women who received supradiaphragmatic radiotherapy at a young age as treatment for Hodgkin's lymphoma have a high risk of breast cancer, which 20-40 years after treatment is nearly as high as that of carriers of BRCA1/2.⁷ The peak risk is around age 14 years, which may be attributable to the accumulation of radiation damage in dividing cells during breast development.

SUMMARY POINTS

The risk of breast cancer is multifactorial, but some women will have a high risk because of a genetic predisposition or, rarely, as a consequence of radiotherapy at a young age. Women with a family history suggestive of a genetic predisposition to cancer should be referred to local genetics services for formal assessment.

Annual magnetic resonance imaging and mammography (unless a carrier of the TP53 gene) in high risk women identifies more breast cancers than does mammography alone.

Risk reducing bilateral salpingo-oophorectomy and risk reducing mastectomy reduces the risk of breast cancer by 50% and 90-95%, respectively, in carriers of BRCA1 and BRCA2 mutations.

Chemoprevention with drugs such as tamoxifen for five years reduces the risk of breast cancer by about 30% and can be a useful alternative to risk reducing surgery.

Table 1 | Breast cancer associated cancer predisposition syndromes and associated risk of breast cancer⁹

Disease gene	Location	Tumours	Tumour age (years)	Risk (%)	Birth incidence of mutations	Life expectancy
CHEK2	22q	Breast cancer	>25	20	1 in 200	?Normal
ATM	11q	Breast cancer	>25	20	1 in 200	?Normal
BRIP		Breast cancer	>25	20	1 in 1000	?Normal
PALB2		Breast cancer	>25	30-40	<1 in 1000	?Normal
NF1	17q	Neurofibroma, glioma, breast cancer	1st year, 1st year, >25	100, 12, 17	1 in 2600	54-72 years
PTEN Cowden	10q	Breast cancer, thyroid	>25, 30	60, 10	1 in 200 000-250 000	Reduced in women
PJS/STK11	19p	Gastrointestinal malignancy, breast	20, >25	60, 40	1 in 25 000	58 years
LFSTP53	17p	Sarcoma, breast cancer (women), gliomas	1st year, >16, 1st year	80, 95, 20	1 in 30 000	Severely reduced
CDH1	16q	Gastric, breast (women)	>16, >35	70-80, 20-40	Rare	Reduced
BRCA2	13q	Breast/ovary (women), prostate (men), pancreas	>18, >30, >30	40-90, 20, 5	1 in 800	68 years
BRCA1	17q	Breast (women), ovary	>18, >20	60-90, 40-60	1 in 1000	62 years

Table 2 | Referral criteria for family history and genetics clinics⁴

Referral to family history clinics/secondary care	Referral to genetics clinics/tertiary care
One first degree relative with breast cancer at age <40 years	Triple negative breast cancer at age <40 years
One first degree male relative with breast cancer at any age	Two first or second degree relatives with breast cancer at age <50 years
Two first or second degree relatives with breast cancer at any age	Three first or second degree relatives at age <60 years with breast cancer
Two close relatives with breast cancer at any age and a close relative with ovarian cancer	Four first degree relatives with breast cancer at any age
Three first or second degree relatives with breast cancer at any age	Ovarian or male breast cancer at any age and on same side of family and any of: one first or second degree relative aged <50 years; two first or second degree relatives aged <60 years; another ovarian cancer at any age
Three first or second degree relatives with breast cancer at any age	Any breast cancer and Jewish ancestry

*For bilateral breast cancer each breast cancer counts as one relative.

Which genes are implicated in a high risk of breast cancer?

Several genes are associated with a high risk of breast cancer. Of the known high risk genes, mutations in BRCA1 and BRCA2 are the most common and account for about 20% of the familial component. Germline mutations in other high risk genes such as TP53, PTEN, and STK11 are less common and identified in less than 1% of families with breast cancer (table 1).⁸

Carriers of mutations in BRCA1 and BRCA2 have a high lifetime risk of breast cancer (around 65-85% with BRCA1 and 40-85% with BRCA2)¹⁰⁻¹² as well as a high risk of ovarian cancer (40-60% with BRCA1 and 10-30% with BRCA2). BRCA2 mutations also confer an excess risk of prostate cancer, pancreatic cancer, and melanoma. The frequencies of BRCA1/BRCA2 mutations in breast cancer populations unselected for family history or age of diagnosis are, however, low and account for about 2-3% of breast cancers overall,¹³ but they are about 10% in founder populations such as Ashkenazi Jewish.

Most breast cancers that arise in carriers of the BRCA1 mutation are “triple negative”—that is, the cancers lack receptors for oestrogen, progesterone, and human epidermal growth factor receptor 2 (Her2).¹³ The immune phenotype of cancers associated with BRCA2 mutations reflect that of sporadic cancers, with most cancers expressing receptors for oestrogen and progesterone with only 16% triple negative.¹⁴

When and how should a family history be taken?

Although 2004 guidelines from NICE did not advocate taking a family history proactively, much has changed in terms of extra available surveillance and preventive options for

those women with at least moderate risk.¹⁵ Moderate risk as defined by NICE is a lifetime risk of 17-29% or a 10 year risk at age 40 of 3-7.9%. When risk is being assessed in primary or secondary care, at least a two generation family history, including paternal relatives, should be taken from women seeking advice. A family history of breast cancer should also be sought in women aged more than 30 starting combined oral contraception and women aged more than 50 starting combined hormone replacement therapy. Women meeting at least moderate risk criteria (for instance a mother or sister with breast cancer at age <40 or two close relatives at any age) should be offered a referral to secondary care (the local family history clinic or breast clinic) but for women with a known family gene mutation, direct referral to genetic services is appropriate (table 2). In the United Kingdom, family history clinics are available in most localities, with over 100 countrywide, but models may differ in other countries. Nonetheless, much management of familial breast cancer does take place in secondary care around the world, with surveillance organised by local breast surgeons and gynaecologists.

When referred to a secondary care clinic, women will have a preclinic questionnaire administered to assess eligibility or a family history elicited directly. Other non-genetic risk factors such as pregnancy history and age at menarche and menopause are also taken. The woman’s risk is assessed usually by use of a risk algorithm such as Tyrer-Cuzick¹⁶ or BOADICEA.¹⁷ If a woman is in the high risk category (lifetime risk ≥30%) or she or her affected relative has a 10% or more chance of carrying a BRCA1/2 mutation she will be offered referral to a tertiary care genetics service. Extra surveillance will be offered as appropriate (table 3). An assessment will also be made of others in the family who may benefit from screening or genetic testing. Use of a risk algorithm to assess the 10% threshold can be made in family history clinics using a simple scoring system such as the Manchester score¹⁸ or a computer algorithm such as BOADICEA.¹⁷ Women from founder populations such as Ashkenazi Jewish (carrier frequency 2.5%) and Icelandic (0.5%) can be considered for BRCA1/2 testing with much less significant family histories. Several algorithms may be used in tertiary care. The figure shows an example of a risk output from Tyrer-Cuzick version 6. Fully comprehensive algorithms such as Tyrer-Cuzick incorporate family history with other known risk factors such as age at menarche and menopause and at first full term pregnancy, overweight or obesity, and breast biopsy information. Newer risk factors

Table 3 | Screening for women at high risk of breast cancer*⁴

Age (years)	Annual mammographic surveillance	Annual breast magnetic resonance imaging
≤29	No surveillance	TP53 carrier†
30-39	Known or suspected BRCA1/BRCA2 mutation	Known or suspected BRCA1/BRCA2/TP53 mutation
40-49	Known or suspected BRCA1/BRCA2 mutation	Known or suspected BRCA1/BRCA2/TP53 mutation
50-59	Known or suspected BRCA1/BRCA2 mutation	Known TP53 mutation
60-69	Known or suspected BRCA1/BRCA2 mutation	Known TP53 mutation

*For guidance on surveillance for women at moderate risk of breast cancer see National Institute for Health and Care Excellence guidelines.⁴

†Mammographic surveillance is not recommended for TP53 carriers owing to risk of ionising radiation in this patient group.

such as mammographic density are being incorporated. Efforts are under way internationally to target screening, and preventive measures by proper risk stratification and accurate risk assessments are vital to this aim.

Counselling

Counselling includes advising women about their risk of breast cancer and what they can do about it, as well as the possibility of genetic testing. Although many genes and genetic factors have been identified, currently there is really only good utility in offering testing for women with high risk genes and in particular mutations in BRCA1 and BRCA2. Testing will usually start with the woman who has breast or ovarian cancer to develop a definitive test for that family. Women undergoing testing need to be aware of the likelihood of testing positive for a mutation that causes disease as well as for a variant of uncertain significance (about 5% of BRCA1/2 tests find missense mutations, most of which are thought to be harmless).

The decision to undergo presymptomatic testing for a known BRCA1/2 mutation can involve complex emotions and bring back memories of a relative’s diagnosis, treatment, and death. Many women do not choose to have testing, and those that do may leave this for many years, particularly if they are a young adult when first eligible. As such most genetics centres see women at least twice before taking a predictive sample. Women who are considering being tested for a known family mutation or being considered for testing where no living relative is available will need a full discussion of their risks for breast and ovarian cancer, how these can be managed, and any effects on life or health insurance dependent on where they live.

How are high risk women followed up?

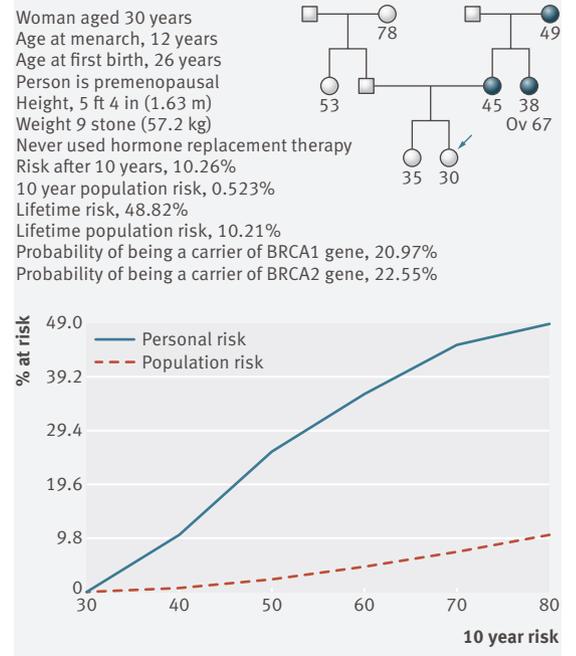
Surveillance

Breast screening aims to diagnose cancer earlier to allow timely therapeutic intervention that may consequently be more effective than if left to later. In all women, breast screening with mammography is predicted to reduce breast cancer mortality,¹⁹ although controversy remains about the absolute benefit of screening as well as the impact of over-diagnosis and overtreatment of screen detected low grade and in situ breast cancers. In the United Kingdom, women are offered screening from age 47-50 within the NHS breast screening programme. Many similar screening programmes exist across Europe and worldwide.

Mammographic screening of younger women is generally less effective than of older women because of increased breast density. Digital mammography is more accurate than film mammography in younger women with dense breasts

and is therefore recommended for the high risk population. There are, however, concerns about exposing young women to regular doses of ionising radiation. One study modelled the risk of radiation induced cancers against reductions in mortality from mammographic screening in carriers of the BRCA mutation and suggested no net benefit of mammographic screening in women aged less than 30.²⁰ NICE advocate no mammography in women aged less than 30 with a familial risk.² Breast magnetic resonance imaging, with no exposure to radiation, has a sensitivity of about 80% and identifies more cancers in high risk women than does mammography (sensitivity 30-40%).^{21 22} Magnetic resonance imaging is less specific, leading to additional imaging and biopsies. In high risk women, surveillance with both magnetic resonance imaging and mammography is better than either test alone.^{22 23}

National² and international guidelines recommend enhanced screening for women with a very high risk of familial breast cancer who have not had risk reducing mastectomies (table 3). This includes annual surveillance with magnetic resonance imaging from age 30-49 years for women who have a known BRCA1, BRCA2, or TP53 mutation or are at a more than 30% probability of such and, for BRCA1/2, annual mammography from the age of 40 to 69. UK guidelines also recommend the use of annual mammography and magnetic resonance imaging in women who have received supradiaphragmatic radiotherapy when less than 36, starting eight years after treatment.²⁴



Tyrer-Cuzick readout of a woman (arrowed) at high risk of breast cancer. The woman is eligible without genetic testing for annual screening by magnetic resonance imaging aged 30-50 and for genetic testing. Her affected mother and aunt, if alive, can be offered genetic testing for BRCA1/2 as they qualify on all algorithms (Manchester score 30 is well above the 15 threshold for 10%). If they are not alive the proband and her sister could have genetic testing as they have a >10% chance of a BRCA1/2 mutation. The sister, now aged 35, could be offered tamoxifen for five years

ADDITIONAL EDUCATIONAL RESOURCES

Healthcare professionals

National Institute for Health and Care Excellence.

Familial breast cancer: classification and care of people at risk of familial breast cancer and management of breast cancer and related risks in people with a family history of breast cancer. (Clinical guideline 164.) NICE, 2013—current UK guidance on the management of patients at high risk of breast cancer due to their family history

Hilgart JS, Coles B, Iredale R. Cancer genetic risk assessment for individuals at risk of familial breast cancer. *Cochrane Database Syst Rev* 2012;2:CD003721—assesses the impact of risk assessment services on this group of patients

National Cancer Institute Cancer Topics

(www.cancer.gov/cancertopics/pdq/genetics/breast-and-ovarian/HealthProfessional)

—information about breast cancer genetics, other risk factors, and breast cancer prevention

Patients

Breast Cancer Care

(www.breastcancercare.org.uk/breast-cancer-information/breast-awareness/am-i-risk/family-history-assessment)

Cancer Research UK

(www.cancerresearchuk.org/cancer-help/type/breast-cancer/about/risks/definite-breast-cancer-risks)

Breast cancer surveillance is non-invasive, has few adverse long term effects, and does not interfere with child bearing. The risk of false positive results can lead to additional investigations, including imaging and biopsies, and some women find magnetic resonance imaging unacceptably claustrophobic. Furthermore, magnetic resonance imaging does not prevent breast cancer and there is no evidence as yet that breast screening reduces the risk of breast cancer deaths in high risk women.

When is prophylactic surgery or chemoprevention considered?

Risk reducing mastectomies

Women with high risk of breast cancer may decide to undergo surgery to reduce their risk. Bilateral risk reducing mastectomies remove most but not all breast tissue. Case-control studies in patients with BRCA1/2 mutations found that surgery reduced the risk of breast cancer by 90-95%.²⁵ Although randomised trials comparing the efficacy of bilateral risk reducing mastectomy with regular surveillance would be an ethical challenge, prospective observational studies have been published, with one study of more than 2000 years of patient observation finding 57 breast cancer cases in the surveillance group compared with none in the surgical group.²⁶ Overall survival benefits from bilateral risk reducing mastectomy alone have yet to be shown, but one study reported that any form of risk reducing surgery in women with BRCA1 or BRCA2 mutations improved survival,²⁷ and in two recent studies contralateral mastectomy has been shown to improve survival in women with BRCA1/2 mutations.^{28 29}

Bilateral risk reducing mastectomy is a major undertaking for women, who need time to discuss their options and the risks of each procedure, including the potential for ongoing interventions such as surgical revisions and nipple tattooing. There is a small (about 2-5%) possibility of finding an occult malignancy during risk reducing mastectomy, despite preoperative screening investigations.²⁶ Several studies have evaluated the psychological impact of bilateral risk reducing mastectomies, which in general (but not universally)

TIPS FOR NON-SPECIALISTS

Breast cancer in general is a multifactorial disease and only about 5% of breast cancers are due to inherited mutations in high risk genes such as BRCA1/2 and TP53

Genetic testing for high risk genes is performed only after suitable counselling in family history clinics and with informed consent

QUESTIONS FOR FUTURE RESEARCH

Does surveillance with magnetic resonance imaging improve overall survival in patients at high risk of breast cancer?

What are the differences in clinical and psychological outcomes in women who chose to have or chose not to have risk reducing surgery?

Is chemoprevention effective in carriers of BRCA1/2 mutations and in women who received supradiaphragmatic radiotherapy at a young age?

Are aromatase inhibitors more effective than tamoxifen at reducing the risk of breast cancer in women at high risk?

show good levels of satisfaction and reduced anxiety after the procedure.^{30 31}

Bilateral risk reducing salpingo-oophorectomy

Women who have inherited mutations of BRCA1 and BRCA2 may also undergo risk reducing bilateral salpingo-oophorectomy. This reduces the risk of ovarian and breast cancer; a meta-analysis of all case series of the procedure suggesting that bilateral salpingo-oophorectomy performed before natural menopause reduces the risk of breast cancer by up to 50%.³² This is thought to be due to the reduction in circulating oestrogen. The benefits of risk reducing bilateral salpingo-oophorectomy may be greater in carriers of the BRCA2 mutation compared with BRCA1 mutation, which is likely to relate to the greater frequency of oestrogen receptor positive breast cancer in carriers of the BRCA2 mutation. Nevertheless, ongoing breast surveillance is still recommended in these women and there are some prospective case series that suggest the incidence of breast cancer after risk reducing bilateral salpingo-oophorectomy is still high.³³

The ideal age for risk reducing bilateral salpingo-oophorectomy remains uncertain, but studies suggesting an earlier age of onset of cancers in carriers of the BRCA1 mutation support earlier intervention compared with carriers of the BRCA2 mutation. A surgical menopause can result in acute symptoms and long term risks of oestrogen deficiency. Although the use of hormone replacement therapy after natural menopause has been in decline since the association between breast cancer and hormone replacement therapy use in the Million Womens Study,³⁴ the use of hormone replacement therapy for women with BRCA1 and BRCA2 mutations until the age of an expected menopause seems to be safe³⁵ and is advised.⁴ Risk reducing bilateral salpingo-oophorectomy at ages 38-40 for carriers of the BRCA1 mutation and at ages 40-45 for carriers of the BRCA2 mutation would seem to be a reasonable balance.

Chemoprevention

In women with a diagnosis of (an oestrogen receptor positive) cancer, selective oestrogen receptor modulators,

such as tamoxifen and raloxifene, and aromatase inhibitors reduce the risk of recurrence of that cancer as well as the risk of a contralateral primary breast cancer. Such drugs have therefore been investigated as preventive agents as an alternative to risk reducing surgery in women with a high risk of breast cancer. Tamoxifen has efficacy in premenopausal and postmenopausal women, whereas aromatase inhibitors are only effective in postmenopausal women. Raloxifene only has efficacy data in postmenopausal women.

A meta-analysis of randomised trials of selective oestrogen receptor modulators for breast cancer prevention, with data on 83 000 women, showed a 38% reduction in incidence of oestrogen receptor positive (but not oestrogen receptor negative) breast cancer with five years of treatment.³⁶ The absolute benefit of treatment depended on the absolute risk of breast cancer, but overall this equated to a need to treat 42 women to prevent one cancer. Similar to the benefit of adjuvant endocrine treatment for breast cancer, the benefits of chemoprevention extend beyond the five years that the drug is taken, with evidence of risk reduction extending to at least five years after completion.

Other studies have investigated the use of the aromatase inhibitors, exemestane and anastrozole, as chemopreventive agents. The recently published IBIS-II study, in which 3864 postmenopausal women were randomly assigned to anastrozole 1 mg daily or to placebo, showed an enhanced risk reduction with anastrozole treatment for five years compared with the risk reduction seen in the studies using selective oestrogen receptor modulators. After five years of follow-up 40 women in the anastrozole arm had developed breast cancer compared with 85 in the placebo arm (hazard ratio 0.47, 95% confidence interval 0.32 to 0.68).³⁷ Selective oestrogen receptor modulators and aromatase inhibitors have yet to be compared head to head in the same study.

No study has as yet shown an overall survival advantage from any chemopreventive strategy. Furthermore, from the

available evidence the drugs prevent the incidence of oestrogen receptor positive but not oestrogen receptor negative cancers and may not be as effective in BRCA1 carriers where triple negative cancers predominate. Chemoprevention can be associated with potentially serious adverse events—for example, tamoxifen causes a small excess risk of venous thrombosis (around 4-7 events per 1000 women over five years) and endometrial malignancy (around 4 excess cases per 1000, with most of the excess risk in postmenopausal women).³⁸ Aromatase inhibitors (which are not currently approved for chemoprevention by NICE) cause loss of bone mineral density and an increased risk of osteoporosis. All women starting treatment with an aromatase inhibitor should have baseline bone mineral density monitoring according to national guidelines.³⁹

The uptake of chemoprevention worldwide is low despite favourable national guidance by NICE (for tamoxifen and raloxifene), the American Society of Clinical Oncology, and other institutions. Possible explanations for this include concerns about side effects of the drugs and a lack of awareness among women and healthcare providers.⁴⁰ For women at high risk of an oestrogen receptor positive breast cancer, these drugs can be a useful option if they wish to avoid or delay risk reducing surgery. The drugs are, however, less effective than risk reducing surgery and have the potential for serious adverse events. The potential benefits and risks of these drugs require careful counselling and quantifying, which may best be performed within secondary or tertiary care settings. Decision aids are being developed to help women make a decision regarding treatment with these drugs.

Competing interests: AA was an expert member of the NICE Familial Breast Cancer Guideline Development Group (2013 update). GE was the chair of the same group. GE and AA are coauthors of a manuscript in preparation.

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References are in the version on bmj.com.

ANSWERS TO ENDGAMES, p 38 [For long answers go to the Education channel on \[bmj.com\]\(http://bmj.com\)](#)

ANATOMY QUIZ

Lateral radiograph of the knee

- A: Quadriceps tendon
- B: Patellar tendon
- C: Hoffa's fat pad (infrapatellar fat pad)
- D: Tibial tuberosity
- E: Neck of fibula

STATISTICAL QUESTION

Non-parametric statistical tests for two independent groups: numerical data

The Kruskal-Wallis test (answer a), Mann-Whitney U test (answer b), and the Wilcoxon rank sum test (answer c) could all have been used to compare the duration of parenteral nutrition in infants with simple gastroschisis versus those with complex gastroschisis.

PICTURE QUIZ

A man with a palpable abdominal mass and night sweats

- 1 The computed tomogram shows aneurysmal dilation of the abdominal aorta, with a thickened wall and a cuff of enhancing periaortic fibrotic tissue.
- 2 The diagnosis is inflammatory abdominal aortic aneurysm, a variant of conventional abdominal aortic aneurysm (AAA). This condition is characterised by a markedly thickened aortic wall and a rind of inflammatory soft tissue surrounding the aneurysm, which can cause adherence of adjacent structures.
- 3 Like conventional AAA, inflammatory aneurysms should be repaired when the diameter reaches 5.5 cm or more. Endovascular repair is now preferred to open surgical repair because the associated morbidity is lower.