UK National Screening Committee

Screening for Hypertension in Children

External review against programme appraisal criteria for the UK National Screening Committee (UK NSC)

Version: One

Dr J. Spiby

Spiby Health

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The UK NSC advises Ministers and the NHS in all four UK countries about all aspects of screening policy. Its policies are reviewed on a 3 yearly cycle. Current policies can be found in the policy database at http://www.screening.nhs.uk/policies and the policy review process is described in detail at http://www.screening.nhs.uk/policyreview

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1. Introduction

This paper reviews screening for hypertension in the UK childhood population (3 to 18 years) against the UK National Screening Committee Criteria 1 to 15 (excluding criteria 4 and 9) for appraising the viability, effectiveness and appropriateness of a screening programme (National Screening Committee 2003). Appraisal against 16 to 22 appears to be premature at this point and 4 and 9 are not relevant.

The UK Screening Committee's present position is that the screening for hypertension should not be offered to children. This policy was reviewed in July 2006 but no significant changes were made.

A literature review was carried in July 2010 looking at the literature published in the last ten years.

2. Background to condition

Blood pressure (BP) is defined as the amount of pressure exerted on the walls of the arteries as the blood moves through them. It is a continuous variable with two measurements recorded – diastolic and systolic. The highest pressure occurs when blood is propelled through the arterial circulation by the contraction of the heart. This is known as the systolic blood pressure (SBP). When the heart relaxes between beats, the pressure in the arterial circulation falls to its lowest level, and this is known as the diastolic blood pressure (DBP). High blood pressure (hypertension) often causes no symptoms or immediate problems but it is a major risk factor for developing a serious cardiovascular disease (conditions that can affect the circulation of blood around the body) such as a stroke or heart disease.

Hypertension in childhood is not a disease entity but a measurement identifying potential future morbidity (essential or primary hypertension) or existing underlying disease (secondary hypertension).

Childhood is considered for the review purposes as between the ages of 3 to 18 years.

The debate about screening for hypertension in adults is based on identifying essential hypertension in order to reduce the risk of further cardiovascular damage. The papers and debate on childhood hypertension are primarily focused on essential hypertension. Some also consider secondary hypertension though not always acknowledging the difference. This review focuses primarily on screening for essential hypertension in childhood.

There are no definitive trials on screening for hypertension in children. This review draws heavily on The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents, the National (US) High Blood Pressure Education Program Working Group on High Blood Pressure in children and adolescents published in the Official Journal of the American Academy of Pediatrics, Pediatrics (US Task Force Fourth Report 2004) and the management of high blood pressure in children and adolescents recommendations of the European Society of Hypertension published in the Journal of Hypertension (Lurbe et al 2009).

3. The condition

3.1 The condition should be an important health problem

Raised blood pressure (BP) is not a disease but a descriptive entity that has an association with increasing risk of future complications, shortening of life and or an underlying causative condition. This relationship is relatively well understood in adults but much less so in children.

Primary hypertension is where there is no identifiable underlying cause. It is usually characterised by mild or stage 1 hypertension and associated with a positive family history of hypertension or cardiovascular disease (US Task Force Fourth Report 2004).

Secondary hypertension is secondary to an anatomical or biochemical lesion/condition such as coarctation of the aorta or renal disease and is more common in children, as a proportion of total cases of hypertension, than in adults. It is more likely that in these cases the blood pressure will be elevated above the 95th centile.

The prevalence of hypertension in childhood is not well documented due to a lack of major studies, variability of BP associated with age, size, ethnicity, difficulties in translating study results between countries and because BP varies on a day-to-day basis .

Jackson et al (2007), using UK data quote a prevalence of 2.6% for high BP and 6.9% for high-normal BP. Secondary hypertension is usually considered to be more common in children than in adults but is still exceedingly uncommon (de Swiet 1986). A prevalence of 0.1% is usually quoted.

Hypertension in adults (Flynn 2008) has well known cardiovascular morbidities and thus a clear significance. In children and adolescents such morbidities are not seen, so the significance is less clear.

There is an increasing consensus that the prevalence of hypertension in children is rising due to increasing obesity in children (Dom-Dzoetja et al 2007, Faulker 2007). Sorof and Daniels (2002) suggest that obese children have a three-fold higher risk of hypertension than non-obese children. Studies in Houston, Texas (Sorof et al 2004) showed the prevalence of hypertension in adolescents to be as high as 10% in those with body mass index over the 97 centile. This is of importance as there is a well-documented increase in obesity in children in the UK (ref http://www.noo.org.uk/NOO_about_obesity/child_obesity/epidemiology)

Conclusion
Childhood hypertension is a relatively uncommon condition for which the present health impact is unclear.

The strong association of essential hypertension in children with obesity and the increase in childhood obesity suggest that hypertension and pre-hypertension are becoming, or could become, a significant health issue in the young.

3. 2 The epidemiology and natural history of the condition, including development from latent to declared disease, should be adequately understood and there should be a detectable risk factor, disease marker, latent period or early symptomatic stage

The epidemiology and natural history of childhood hypertension, though becoming better understood, remains relatively unclear.

Cheng and Wang (2008), using meta-analysis techniques, showed that BP measured in childhood (after 7 or 8 years) does predict future BP. The data was from diverse populations and they considered the evidence for BP tracking from childhood into adulthood to be strong. Other studies (Daniels et al 1998, Daniels 2008) suggest that cardiovascular disease and other end organ effects of hypertension do have their origins in childhood. However, although these studies suggest elevated BP in childhood is predictive of adult hypertension on a population basis the exact relationship is unclear. The recent European guidelines on treatment of paediatric hypertension (Lurbe et al 2009) acknowledge that although recent developments in pathophysiological and clinical research have enabled greater understanding there still remains a lack of long-term observational and intervention studies. Due to the lack of sufficiently long-term follow-up surrogate markers of hypertensive end-organ damage (heart, blood vessels and kidney) have been used instead. Again the body of available data is substantially smaller than in adults (Lurbe 2007, Sinha et al 2007). Left ventricular hypertrophy (LVH) (Daniels et al 1998, Brady et al 2008), thickening and stiffening of large arteries (Lande et al 2006) and urinary albumin excretion (UAE) (Grunfeld 1990) are among the most valuable markers.

Conclusion

The epidemiology and natural history of the condition are not sufficiently understood.

3.4 All the cost-effective primary prevention interventions should have been implemented as far as practicable

The main cost-effective, primary prevention intervention is the reduction of childhood obesity. Although this is now a UK policy priority it has not been implemented as far as is practicable as evidenced by the wide range of proposed interventions and schemes to address the issue (http://www.noo.org.uk/NOO_about_obesity/child_obesity/epidemiology).

Interventions for childhood obesity are not dependent on knowing the BP.

Conclusion

All cost-effective primary prevention interventions are not implemented as far as practicable.

4.1 There should be a simple, safe, precise and validated screening test

The Test

The standard test, as stated in US Fourth Report (US Task Force Fourth Report 2004) and supported in the European guidelines (Lurbe 2009), for identifying hypertension in children over three years is by auscultation using a standard clinical sphygmomanometer and stethoscope placed over the brachial arterial pulse, proximal and medial to the cubital fosse and below the bottom edge of the cuff. As the size of the arm in children varies according to age and size, the

cuff should be appropriate to the size of the child's upper right arm. That is, the cuff should be at least 40% of the arm circumference at the midway point between of the upper arm. Not all cuffs are manufactured to provide the right dimensions as proposed in this report, although the report recommended that they should be. If the cuff is too small there will be an over-estimation of the blood pressure.

The gold standard sphygmomanometer is the mercury sphygmomanometer. However, these are less commonly used due to concerns about the toxicity of mercury. Non-mercury ascultatory devices are considered to be reliable substitutes if properly and regularly validated, but both can be inaccurate due to poor BP-taking technique (EU 2009).

Ideally, when taking a child's BP the child should not have had any stimulant drugs or food, have been sitting quietly for five minutes and sitting upright with the right arm supported.

As BP varies within an individual an elevated BP must be confirmed on repeated visits before a definitive diagnosis is made. BP tends to fall as the patient accommodates (reduced anxiety), regression to the mean and because BP is not static. At least three measurements on separate occasions are suggested. This advice is based on experience and evidence that BP varies rather than any controlled trial.

The US Fourth Report (2004) suggests that children under the age of three should only have their blood pressure taken in special circumstances which are included in the report.

The tables needed to confirm the BP

As the normal range of BP varies with body size and age, standard tables based on gender, age and height need to be consulted to provide a precise classification of the child's BP. Thus to determine the final BP the child's sex, height and age are required to plot against the measured Systolic and Diastolic BP. These tables have traditionally been developed in the US and are based on data from 70,000 American children. The BP centiles have been calculated for each sex, age group and for seven height centile categories (www.pediatrics.org/ 1720 Journal of Hypertension 2009, Vol 27 No 9 cgi/content/full/114/2/S2/555). Height centiles are based on the growth charts of the Center for Disease Control and Prevention (www.cdc.gov/growthcharts). In Europe, reference values were obtained in 1991 by pooling data from 28,043 individuals using the auscultatory method of taking the BP measurement (de Man 1991). Unfortunately these tables do not include age, sex and height together. Kaelber (2009) proposed a simplified US table which reduced the number of values. He suggests this makes it easier to use the US tables but does not provide evidence to prove this point. Their proposal suggests that the existing tables are too complicated for routine use.
According to the European guidelines (Lurbe et al 2009) the US tables remain the reference despite being based on a US population which they suggest has a higher BP than in Europe. They support continued use of the US tables as they are based on a large set of data whilst the European data is much smaller, does not have age, sex and height together or uses difference ages.

In the UK (Jackson 2007) stated that BP measurement is often not measured and that understanding the clinical significance of BP readings in children in the UK is hampered by the lack of UK data. She reviewed BP data from seven national health and social surveys between 1995 and 1998 to produce blood pressure centiles for the UK. The centiles are based on data collected using a consistent and rigorous method, from nearly 23,000 children and young people aged between 4 and 23 years living in Great Britain. The measurements were taken using an automated BP machine as this was the method used in the health and social surveys. Her paper

concludes that differences between the two sets of tables most likely reflect the different methods of taking the BP and that the UK centile tables should be used with caution if the BP is measured with a mercury sphygmomanometer. Jackson's tables are published in the UK but have not been adopted consistently. Jackson considers that, as they were based on measurements taken in the mid-1990s, they will need updating and revising to retain relevance to contemporary children. She suggests that the tables are more appropriate to UK practice as they are based on a population of UK children.

Automatic oscillometric devices

The US Fourth Report (2004) states that auscultation is the preferred method of measurement and the US tables are based on using the standard mercury sphygmomanometer. The Report acknowledges that oscillometric devices are convenient and minimize observer error but they don't provide identical measures to auscultation and thus shouldn't be used for diagnosis. Oscillometric devices determine mean BP rather than systolic and diastolic BP directly. They were originally designed for use during anaesthesia where accuracy is less crucial (MHRA 2005). These devices should be validated using an established protocol. Few have been validated for children and this inevitably increases the complexity of taking BP and the opportunity for reduced validity of BP results.

A comparison of the two methods of measuring BP in children was undertaken (Park et al 2001) in Texas. With a study population of 7208 children aged between 5 and 17 they concluded that the Dinamap system (oscillometric) was 10 mmHg higher than auscultator for systolic readings and 5 mm Hg for diastolic reading, thus precluding the interchange of reading by the two methods. They suggest that the automated device should be used with caution as a diagnostic tool. The general consensus according to the European guidelines is that diagnosis by an automated machine should, ideally be confirmed by auscultation.

Current practice in taking children's BP

In the UK taking blood pressure in children is not routine practice. Professor Abdol Tavabie, Postgraduate GP Dean, Kent, Surrey and Sussex Postgraduate Deanery, says that GPs would take a child's BP if there was a clinical indication and training practices would be expected to have the requisite cuffs and BP tables. Dr Sheila Shribman, National Clinical Director for Children, Young People and Maternity Services, Department of Health considers that the paediatric training curriculum includes measurement and interpretation of blood pressure (BP) in children. Paediatric units are expected to be able to measure blood pressure at all ages. Paediatricians will measure BP when clinically indicated by the nature of the illness or its treatment but generally do not routinely carry out opportunistic BP screening. One study in a London district general hospital A & E (Burchell et al 2005) looked at 1006 consecutive patient records and found 9 percent of those under 16 year olds had had their BP taken. A study in the Royal Glamorgan Hospital that reported in the BMJ.com explored current practice amongst paediatricians in out-patient clinics (Nayak 2008). There was a low response rate (25%) and of those who did reply 23 % never measured BP routinely, 50% measured it in less than 50% of clinical episodes and only 15% routinely measured BP.

Dr N Thalange, one of the authors of the UK report on blood pressure centiles for Great Britain (Jackson 2007) in personal correspondence says "BP is rarely measured outside of a hospital setting, and only uncommonly, even in hospital. The biggest drive for measuring blood pressure has been the NICE guidelines on BP measurement in children treated for ADHD. There has been comparatively low uptake of the charts in standard paediatric practice (much less in non-

paediatric settings). In general practice, lack of suitable cuffs is probably the main obstacle to measurement of BP in children."

Is the test valid?

It is well documented that at least three BP measurements are required to identify hypertension in a child. This is because BP is not a stable measurement and there is a tendency to revert to the norm. BP in the same patient varies depending on the time of day and a variety of other influences, therefore it is inevitable that there will be a high level of false positives for any one BP measurement.

In a study of 549 children over 3 years of age, BP was measured at triage at McGill University Children's Hospital Toronto, where they state that most children have their BP taken in emergency departments. It was found that BP was raised in 26% of the children when using automated measurement. However, after follow-up no "true" cases of hypertension were found whilst a large number of false positives were identified (Stewart 2008). It was suggested this was because the study was done in an emergency department where elevation due to stress may be expected.

A renowned general practitioner in the UK (Tudor Hart 2008) measured the BP annually of all the children in his practice (total population size 1700). The results were not published but in correspondence he says that "the measurements extremely difficult … because measurements are so unstable … we found several with very high systolic pressures … when repeated by the same observer in my office where the children were accustomed to examinations of all kinds, all these high pressures fell within normal limits."

Conclusion

There is not a simple, acknowledged and validated test for identifying childhood hypertension.

6. The distribution of test values in the target population should be known and a suitable cut-off level defined and agreed

Jackson et al (2007) states that there is no current standard UK definition of hypertension in children.

The US definition from the Fourth Report (2004) is usually accepted. It defines the condition as an average systolic and/or diastolic blood pressure ≥95th centile for gender, age and height on three or more separate occasions. The working group also introduced the concept of "pre-hypertension" which it defines as a blood pressure level ≥90th centile but <95th centile. For adolescents (not defined in the recommendations) a BP level ≥120/80 is said to be considered prehypertensive. This definition is based on the normative distribution of BP in healthy children in the US population data. The Fourth Report also suggests two stages of hypertension to support clinical evaluation and management.

Jackson et al (2007) suggest that the definition of hypertension in children is more problematic and that the use of US data for the UK population is not appropriate. Using UK population data they proposed that ≥ 98th centile represents hypertension and that measurements between the 91st and 98th centiles should be considered to be high normal blood pressure for age. However, despite using different centiles Jackson suggests that "these cut offs are similar to the recommendations made in the Taskforce Report on High blood Pressure in Children and Adolescents in the USA 2004".

Conclusion

The distribution of the test values in the target population are not defined and agreed.

7. The test should be acceptable to the population

There have been no studies considering the acceptability of the test to the population. However, there is good evidence of "white-coat hypertension" which is where a child is hypertensive in the clinical setting but normotensive outside of the clinical setting. It is considered that "white-coat hypertension" is induced by the experience of the clinical setting. Tudor Hart (2000), in his annual measurement of BP in his practice's children found several children who reverted to normal BP when measured in his office where he felt that the children were accustomed to examinations of all kinds.

Experience also indicates that children need to be settled and not anxious. This may be a difficulty with younger children and children with behavioural difficulties.

Conclusion

There is little evidence on the acceptability of the test.

8. There should be an agreed policy on the further diagnostic investigation of individuals with a positive test result and on the choices available to those individuals

If raised BP is confirmed on several repeated visits and measurements, the next diagnostic stage, if available, is ambulatory blood pressure monitoring (ABPM). A portable BP device is worn by the patient and the BP recorded over a longer period. This allows confirmation of the hypertension as well as identification of any episodic or other patterns. This requires specialist equipment and full paediatric support. The ABPM provides a more sensitive and specific method to substantiate raised BP especially in borderline cases. However, it is not regularly available and requires considerable time and commitment to fit the device and to educate the patient and parents. (Simckes 2002). The more recent European guidelines (Lurbe 2008) confirm that ABPM is not always available (although does not differentiate between European countries). Home monitoring is considered to be closer to ABPM results than clinic measurements based on a study sample of 100 six to 18-year-olds (George 2008).

Both the Fourth Report (2004) and the European guidelines (Lurbe et al 2009) provide guidelines for further diagnostic investigation. There are no specific UK guidelines. There is no data of how many children diagnosed with potential hypertension are further investigated using these guidelines in the UK. The main thrust of these guidelines is to rule out secondary hypertension and identify if there is any end-organ damage.

The European guidelines (Lurbe 2008) state that genetic analysis has not yet been demonstrated to have a clear role to play in the routine assessment of children with hypertension but that there are rare causes of monogenic childhood hypertension that specific chemical markers may suggest warrant further investigation.

Conclusion

Guidelines exist on further diagnostic investigation.

10. There should be an effective treatment or intervention for patients identified through early detection, with evidence of early treatment leading to better outcomes than late treatment

There are no UK consensus guidelines for treatment of hypertension in children. The US Fourth Report (2004) and the European guidelines (2009) provide clear treatment guidelines. Two major UK medical institutions contributed (Manchester Royal Infirmary, Cardiovascular Research Group and the Nephro-Urology Unit, UCL, Institute of Child Health) to the European guidelines.

Where secondary hypertension is diagnosed the treatment of choice depends on the underlying condition or cause and is based on the clinical circumstances of each case. The majority of children with secondary hypertension will have renal or renovascular causes for the BP elevation.

The majority of cases will, however, be primary hypertension for which both guidelines suggest lifestyle modifications should be applied. Obesity is the most important condition to be treated and weight reduction is the primary therapy with physical activity and dietary modification associated with family-based intervention (Fourth Report 2004). This is in line with the UK DH recommendation for childhood obesity (Nice Guidance 43 2006, Department of Health website 2010). The European guidelines (Lurbe 2008) point out that that despite the paucity of data from randomised trials looking at obesity reduction this is the best option and the treatment of choice. The international increase in childhood obesity suggests that to date there are not consistently effective measures for treating childhood obesity.
Drugs are indicated in patients who fail to respond to lifestyle measures although this treatment should be based on a range of indicators and not BP alone. Both reports acknowledged that the long-term consequences of not treating hypertension are unknown, as are the long term effects of antihypertensive drugs on growth and development.

Conclusion

There are guidelines on treatments although these are not all fully evidence based.

11. There should be agreed evidence-based policies covering which individuals should be offered treatment and the appropriate treatment to be offered

The Fourth Report (2004) and European guidelines (2008) provide treatment protocols for which there is limited trial evidence and, as is common in the care of paediatrics, some of the treatments are not licensed for paediatric use.

12. Clinical management of the condition and patient outcomes should be optimised in all healthcare providers prior to participation in a screening programme

Children with high blood pressure will generally be seen by cardiac or renal paediatricians as according to Professor David Hall, former President of the College of Paediatrics and Child Health, “there is not really a speciality of childhood hypertension”.

13. There should be evidence from high-quality Randomised Controlled Trials that the screening programme is effective in reducing mortality or morbidity. Where screening is aimed solely at providing information to allow the person being screened to make an "informed choice" (eg. Down's syndrome, cystic fibrosis carrier screening), there must be evidence from high-quality trials that the test accurately measures risk. The information that is provided about the test and its outcome must be of value and readily understood by the individual being screened

There have been no UK studies on the effectiveness of a childhood hypertension screening programme. The Department of Health care pathway for childhood obesity does not identify taking blood pressure as a key part of the childhood obesity care pathway. There is nothing stated in the literature that the complete screening programme is acceptable to either health professionals or the public. There is no UK or international economic evidence for or against such a screening programme either in terms of cost benefit or opportunity costs.

Screening in the US

The US Preventive Services Task Force (2003), following a systematic review of hypertension, considered that there is insufficient evidence to recommend for or against routine screening for high blood pressure in children and adolescents to reduce the risk of cardiovascular disease. They found poor evidence that routine BP measurement accurately identifies children and adolescents of increased risk for cardiovascular disease, and poor evidence to determine whether treatment of elevated BP in children or adolescents decreases the incidence of cardiovascular disease. They therefore could not determine the balance of benefits and harms of routine screening for high BP in children and adults.

This decision is contrary to the expert advice of the American Academy of Paediatrics, American Heart Association and American Medical Association which recommends routine screening of asymptomatic adolescents and children during preventive care visits. The US Fourth Report (2004) recommended that all children over the age of three should have their blood pressure taken when they are seen in a medical setting.

Friedman (2008) in an editorial in the Journal of Pediatrics explored the recommendation of the Fourth Report in the US context. He considered that the test is not specific enough and that there is not enough evidence on the automated BP machines to accept that they are sufficiently specific. He also questioned the assumption that it is relatively cheap test as it is not just a single BP measurement. He said that overall costs, including the cost of screening of early positives, many of which will be negative, have not been well studied. He suggests the Fourth Report recommendation is not evidence based and that screening children with at-risk parents would be a better strategy suggesting that the approach of the "Fourth Report" should be reconsidered.

Commentary on screening in the UK

The UK Health for All Children revised fourth edition (2006) provides two reasons for screening: detection of secondary hypertension and detection of increased risk of essential hypertension in

adult life. The authors then go on to clarify why they do not support a screening programme in the UK.

In relation to early detection of secondary hypertension due to an underlying disease and to enable diagnosis before serious symptoms present they consider that incidence is very low at less than 0.1 percent and thus the condition is not common enough.

Regarding screening for increased risk of developing essential hypertension in adult life, their arguments against are: lack of evidence that lifestyle advice works, lack of a clear distinction between normal and elevated readings, resulting in an arbitrary cut-off point for referral, and resulting in many children with mild hypertension being identified and investigated.

Bird and Michie (2008) reflect on the lack of BP measurement in children in the UK. They acknowledge that the process is more difficult in children than adults and that the UK does not have a clear definition of what is abnormal for children. They propose, because it is an easy test and because of the rising obesity levels, there should be a pilot screening programme for obese children and that healthcare workers should be reminded to perform sphygomanometry on children and ensure services and systems are in place to manage this. One GP response published in the BMJ on line (Davis 2008) considered the proposal "a leap of faith "and that Bird fails to justify their proposal. "Obese kids should lose weight; knowing their BP would make no difference." Julian Tudor Hart (2008) responds saying, "Clinical alertness will not be improved by adding yet another poorly performed measurement to unimaginative thoughtless routines searching for a clinical problem which for practical purposes does not exist."

Present policy

UK The present policy is not to support childhood screening for childhood hypertension.

Conclusions

Screening for hypertension in children is not recommended due to the lack of: understanding of the condition, an agreed definition of the condition, a simple valid test, acceptance of BP-taking in children by professionals and trial data of a screening programme.

Implications for policy

The present policy of the NSC is endorsed by this review.

The importance of the UK policy on childhood obesity is endorsed by this review.

Implications for research

Further research is required to increase understanding of essential hypertension and its treatment in children and to consider if screening of children with risk factors is effective.

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