Eur J Vasc Endovasc Surg (2017) 53, 837–843

Editor's Choice – Inequalities in Abdominal Aortic Aneurysm Screening in England: Effects of Social Deprivation and Ethnicity

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WHAT THIS PAPER ADDS

This paper adds to existing literature, and confirms the adverse effects of social deprivation on uptake of AAA screening, and the decline rate in a population screening programme. It also confirms the increase in prevalence of AAA in deprived men, and the variation among different ethnic groups. Any efforts to improve uptake will require local action, taking into account local factors.

Objective: Population screening for abdominal aortic aneurysm (AAA) in men is currently ongoing in several countries. The aim was to examine the effects of deprivation and ethnicity on uptake of screening for abdominal aortic aneurysm (AAA) and prevalence of AAA.

Methods: This was a review of outcomes from a population screening programme using data collected contemporaneously on a bespoke national database. Men aged 65 in two annual cohorts (2013/14 and 2014/15) were invited for AAA screening. Attendance and prevalence of AAA (aortic diameter >2.9 cm) were recorded. Results were compared according to measures of social deprivation and recorded ethnicity.

Results: Some 593,032 men were invited and 461,898 attended for ultrasound screening; uptake 77.9%. Uptake was related to social deprivation: 65.1% in the most deprived decile, 84.1% in the least deprived: OR for least deprived 2.84, 95% CI 2.76-2.92, $p<.0001$. Men in deprived areas were more likely to actively decline screening: 6% versus 3.8% in the least deprived decile. AAA were twice as common in the most deprived compared with the least deprived decile: OR 2.1, 95% CI 1.77-2.27, $p<.0001$. AAA were more common in white British men than in black (OR 0.46, 95% CI 0.31-0.71) or Asian (OR 0.18, 95% CI 0.13-0.26) men. There was considerable local variation in all findings.

Conclusions: Social deprivation affects uptake of AAA screening in 65 year old men. Local factors are the most important determinants of uptake, so solutions to improve uptake must be designed at local, not national level.

Article history: Received 31 August 2016, Accepted 7 March 2017, Available online 14 April 2017

Keywords: Aortic aneurysm, Aneurysm screening, Social deprivation, Ethnicity

INTRODUCTION

The aim of the NHS Abdominal Aortic Aneurysm Screening Programme (NAAASP) is to reduce the risk of death from ruptured abdominal aortic aneurysm (AAA) in men. Approximately 3,000 to 4,000 people die from the condition annually in England and Wales, concentrated mainly in men over 65 years of age.[1] Population screening of men in their 65th year commenced in April 2009, and was fully implemented in England in April 2013.[2] Similar programmes have also been implemented in Wales, Scotland, and Northern Ireland. Men aged 65 are invited by standard letter to attend for a portable abdominal ultrasound scan as close as possible to their homes. Those with an abdominal aorta less than 3.0 cm in inner diameter are reassured and discharged; men with an aortic diameter 3.0–5.4 cm are offered regular ultrasound surveillance; men whose initial aortic diameter is greater than 5.4 cm, or whose aneurysms grow to that diameter during surveillance are referred to a vascular service for possible intervention. Men over 65 are not invited, but can refer themselves for screening at their local programme.

The beneficial effects of screening are maximised when uptake is high, and the test is acceptable to invitees. Screening programmes have a responsibility to ensure that information about the programme is easily and widely available to all the target population.[3] Using available data to ensure equity of access and uptake is a fundamental part of the screening process.

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1078-5884/

http://dx.doi.org/10.1016/j.ejvs.2017.03.006

Social deprivation impacts on many aspects of health and access to healthcare services. There has been little research on the influence of social deprivation on the uptake of AAA screening.[4,5] With the recent availability of the NHS postcode directory to NAAASP it is possible to assign men to lower super output areas (LSOA) and local authority (LA) geographies and therefore link them to a deprivation score. LSOA is a means of dividing local populations into small cohorts containing from 1,000 to 3,000 people. This means outcomes of screening can be linked to deprivation at local population level.

Likewise, it is well documented that there are inequalities in the health status of different ethnic groups in England. This may result from various factors such as lifestyle (physical activity, smoking, and obesity), environment (jobs, housing, and transport), access to health services, and, to a certain extent, genetics. Internationally there is little research on ethnicity, uptake of screening, and the prevalence of AAA. Ethnicity of men who attend AAA screening can be recorded; it is unknown for men who do not attend. It is possible therefore to estimate AAA incidence according to ethnicity using AAA SMaRT (Screening Management and Referral Tracker). It is not possible to link the information from the screening programme with other national datasets such as national ethnic population estimates, as screening data were not available by residency geography. However, using the local authority coding it is possible to estimate whether the percentage of men tested in each ethnic group is similar to the resident ethnic groups using the nationally available census population estimates.

The aim of the present analysis was to look at the effects of deprivation and ethnicity on the uptake of AAA screening and incidence of AAA detected in the first 2 full year cohorts of men from NAAASP.

METHODS

Data from NAAASP are stored on a bespoke AAA screening database: SMaRT. The first full year of the screening programme was 2013/14; all men in England aged 65 in the calendar year from April 1, 2013 were invited for AAA screening. The data used for this analysis were extracted from the national database, SMaRT, using Business Objects software. The data were extracted for the first 2 full years of screening in England (2013/14 and 2014/15) on May 14, 2015. Four queries were used:

- total number of men offered an appointment within the screening year plus 3 months (to allow completion of cohort screening) by LSOA and LA
- total number of men who declined the screen by LSOA and LA
- individual records for men conclusively tested within the screening year plus 3 months (ditto above) by ethnic group, LSOA, and LA
- individual records for men conclusively tested within the screening year plus 3 months (ditto above) by aortic diameter at initial screen, ethnic group, LSOA, and LA.

The cohort of men eligible for screening in the programme is provided in an extract from NHAIS (National Health Applications and Infrastructure services) each October for the following financial year. Men are included if they turn 65 during the following financial year (from April 1). Men who are not registered with a general practitioner are not included in the cohort and are not eligible for screening. As the clinical characteristics of men who self refer will be different from those in the invited cohort, they were excluded from the present analysis.

The extracted data on screened men were merged in Stata with the adjusted Index of Multiple Deprivation (IMD) 2010 scores adjusted for the 2011 LSOA boundaries.[6] The IMD2010 scores are based on seven domains of deprivation using data from a variety of sources that include finance, employment, education, housing, environment, crime, and health.[7] A combined score across these domains is calculated for each LSOA in the county, although, even at LSOA level there will still be variation of the level of deprivation experienced. The summary scores can then be used to group each of the LSOAs into 10 groups, deciles, with increasing scores representing increasing levels of deprivation. The national LSOA deciles were obtained.

When a man attends for his screening appointment he is asked to confirm his Office of National Statistics ethnic group. A man can choose to not give his ethnicity, this is marked as “not stated.” This information is not available through the extract received by the screening programme and so all men have their ethnic group set to not stated, by default. It is therefore not possible to calculate how many men have declined to record their ethnicity and how many were not asked. Thus uptake cannot be calculated by ethnic group, but it is possible to make comparisons where ethnic group is stated. The estimates of population by ethnic group were obtained from NOMIS.[8] NOMIS is the official source of labour market statistic and provides a web based tool to query the 2011 Census data. The 2011 Census data is the most recent available source of the population by ethnicity as the Office for National Statistics no longer produces mid year population estimates. Also, it was not possible to obtain the figures by single year of age and so the population figures used may vary from the actual demographic structure. The population by ethnic group for men aged 65 years and over by local authority was queried on May 14, 2015.

The 95% CI for proportions were calculated using the Wilson Score method.[9] This is the preferred method within Public Health England as it has been evaluated and recommended by Newcombe and Altman.[10,11]

Logistic regression was used to examine the association of an outcome with each of the IMD2010 levels of deprivation. The outcomes were being conclusively tested, declining screening and detecting an aneurysm. Men were categorised into either having the outcome (e.g. declined screen) or not having the outcome (did not decline the screen). Decile 10, the least deprived decile, was chosen as the reference exposure level as they had the lowest levels of declining screening and detection of aneurysms. The

association between ethnic group and detection of aneurysms was also examined using logistic regression. The white ethnic group was chosen as the reference group as it had the largest population size. The analyses were undertaken in Stata.

RESULTS

Between April 1, 2013 and March 31, 2015, a total of 593,032 men in their 65th year were invited for AAA screening. A total of 461,898 attended and had a conclusive test result; 27,408 declined the offer and 103,726 did not attend (despite a second invitation letter). Uptake was 77.9%, varying between 46.3% in St Helens Local Authority (Cheshire and Merseyside screening programme) and 88.6% in Test Valley (Hampshire). Of those with a conclusive test result, 456,336 had aortic diameter <3.0 cm and were reassured and discharged; 5,132 had an aortic diameter from 3.0 to 5.4 cm and were entered into an ultrasound surveillance programme; and 430 had an initial aortic diameter of 5.5 cm or more, and were referred to the local vascular service for consideration of elective AAA repair. The overall prevalence of AAA at age 65 was 1.2%.

Deprivation and uptake

When uptake by LSOA (lowest super output area) was aggregated by national IMD2010 decile, there was a clear relationship between deprivation and uptake of screening (Table 1). As deprivation decreases, the uptake increases, with the greatest differences between the most deprived five classes. The odds ratio for being tested in the least deprived tenth of LSOAs in the country was 2.84 compared with the most deprived tenth (95% CI 2.76-2.92, $p<.0001$). However, there was significant within area variation. When uptake for each LSOA was examined there were LSOAs with 100% and 0% uptake in each decile. There was a clear trend of increasing uptake of AAA screening as deprivation decreased (Fig. 1). There was also a narrowing of the interquartile range from the most deprived decile (55—75%) to the least deprived decile (78—91%) (Fig. 1).

Table 1. Uptake and declines of screening and detection of aneurysms by IMD 2010 decile (1 is the most deprived decile and 10 is the least deprived decile).

IMD 2010 decile	Number eligible	Number offered	Number tested	Number declining	Number aneurysms
1	45,818	45,413	29,552	2,735	497
2	46,670	46,312	32,230	2,481	531
3	50,957	50,552	36,614	2,661	530
4	55,905	55,458	41,869	2,709	563
5	61,020	60,563	47,473	2,721	595
6	65,228	64,779	51,480	2,972	614
7	68,351	67,746	54,938	2,992	596
8	68,787	68,225	55,978	2,796	600
9	68,483	67,794	56,111	2,851	568
10	66,765	66,190	55,653	2,490	468
Total	597,984	593,032	461,898	27,408	5,562

Deprivation and declines

Men have the option of actively declining their invite to screening by calling or writing to the screening programme. This number is smaller than those who are not screened, as a larger number simply do not turn up to their appointment. Nationally 4.6% of men declined their screen in 2013/14 and 2014/15. This ranged from 0.9% in Haringey to 12.3% in Leicester. There was a marked geographical variation in the percentage of men declining across the country.

Regionally, the rates of men declining ranged from 2.8% in London to 8.8% in the North East. While uptake in the North East was approximately 76.0%, it was 72.6% in London. London has a much higher proportion of men who did not attend their appointment, without explanation (Fig. 2).

There was also an association between invitation decline and deprivation. Six per cent of men in the most deprived tenth of the country declined screening compared with 3.8% in the least deprived tenth (Table 2). When entered into a linear regression model men in the most deprived tenth were 1.66 times more likely to decline than the men in the least deprived tenth (95% CI 1.57—1.76, $p<.0001$).

Deprivation and detection of AAA

The overall incidence of AAA (>2.9 cm aortic diameter) was 1.2%. This varied from 0.12% in Gravesham to 2.38% in Forest Heath. The percentage of aneurysms detected has decreased each year from 2009/10 when the screening programme started.

Nationally there was a higher percentage of aneurysms detected in the most deprived tenth of the country (1.68%) compared with the least deprived tenth (0.84%) (Fig. 3). Men in the most deprived tenth were twice as likely to have an aneurysm detected compared with the least deprived tenth (OR 2.01, $p<.0001$, 95% CI 1.77—2.27).

Ethnicity

Overall ethnic group was recorded in 80.5% of records. This varied among local programmes. The South West London screening programme had less than 1% of their men with ethnic group not stated. However, there were four local screening programmes which had close to 100% not stated, suggesting that their screeners were not asking for the information.

Where ethnicity was recorded, the percentage of aneurysms detected varied between groups but because of the small numbers in the non-white groups, the estimates are less precise. Asian/Asian British men had the lowest percentage of aneurysms detected: 0.23%. White men were the most likely to have an aneurysm at 1.3% (Table 3). Men in each non-white ethnic group were less likely to have an aneurysm detected compared with men in the white ethnic group (Table 4). When the white ethnic group is broken down further, 1.86% (95% CI 1.25—1.33%) of white Irish had an aneurysm compared with 1.29% (95% CI 1.43—2.40%) of white British men.

If the number of aneurysms detected is broken down by IMD2010 decile for each ethnic group, there was no

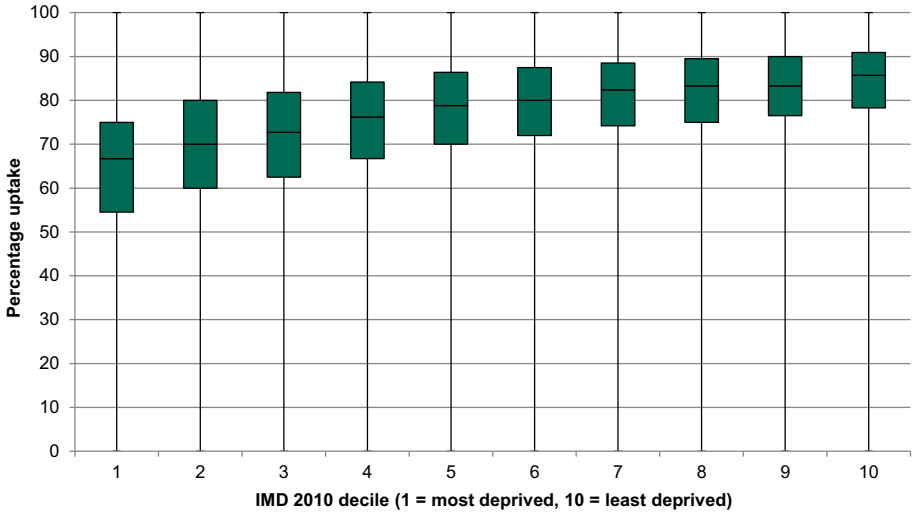

Figure 1. Box and whisker plot of the percentage uptake of screening by deprivation index (LSOA IMD2010 decile).

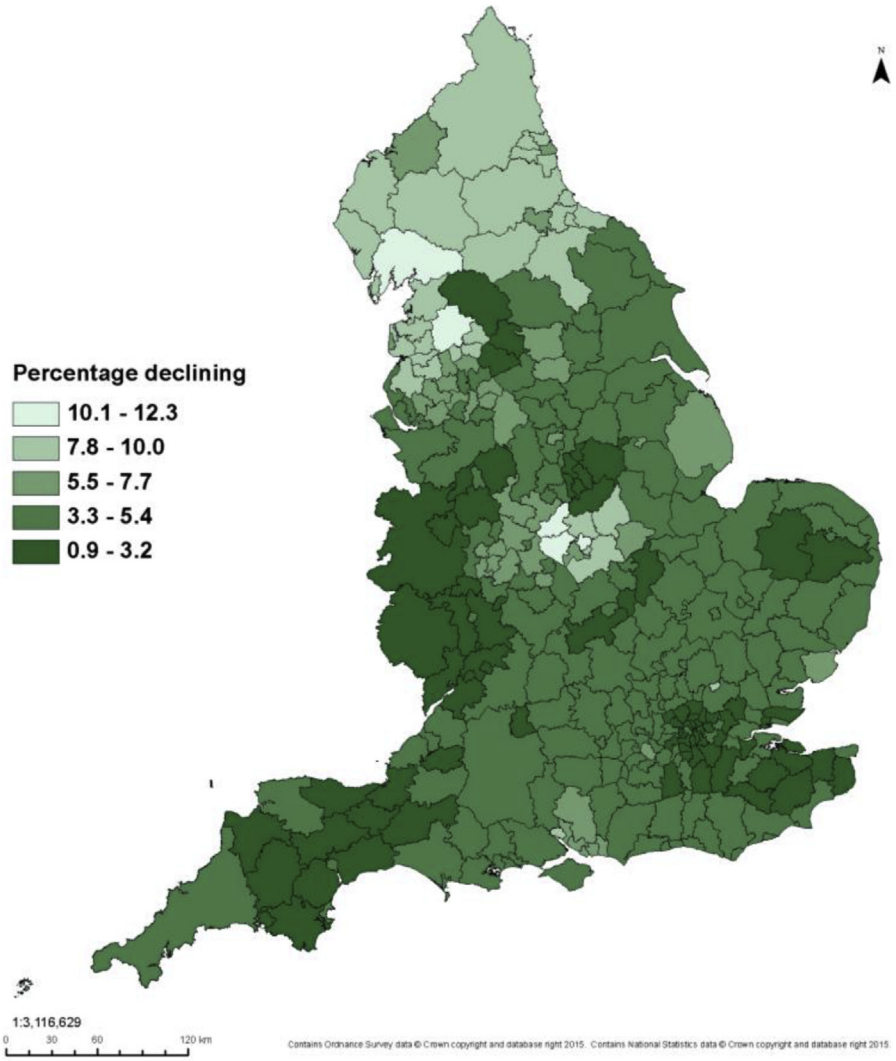

Figure 2. Percentage of men actively declining AAA screening by area (local authority).

Table 2. Men declining AAA screening related to social deprivation as measured by IMD 2010 decile (1 is the most deprived decile and 10 is the least deprived decile).

IMD 2010 decile	Number offered	Number declining	Odds ratio	p value	95% CI
1	45,413	2,735	1.66	0.000	1.57—1.76
2	46,312	2,481	1.46	0.000	1.38—1.54
3	50,552	2,661	1.43	0.000	1.35—1.51
4	55,458	2,709	1.33	0.000	1.26—1.40
5	60,563	2,721	1.22	0.000	1.15—1.29
6	64,779	2,972	1.23	0.000	1.17—1.30
7	67,746	2,992	1.18	0.000	1.12—1.25
8	68,225	2,796	1.10	0.001	1.04—1.16
9	67,794	2,851	1.13	0.000	1.07—1.20
10	66,190	2,490	-	-	-

relationship between deprivation and number of aneurysms detected for Asian, black, or men of mixed or other ethnicities. However, for white men and those with an unstated ethnicity there was a strong decline in the detection of aneurysms as deprivation decreased. When entered into a regression model, white men in the most deprived tenth of the country were twice as likely to have an aneurysm compared with the least deprived tenth: OR 2.10, 95% CI 1.83-2.42, p value $\leq$.0001.

DISCUSSION

The present study makes a number of observations concerning deprivation and AAA screening outcomes from a national programme. First, screening uptake varies with local deprivation: attendance is reduced in deprived areas. This is quite variable, however, and local factors, such as access to screening centres and local publicity can make a difference.[12] Second, men in deprived areas are more likely to decline to be screened. It is generally believed that the prevalence of AAA is higher in men who do not attend for AAA screening, possibly as a result of their attitude to their own health. Third, there may be a higher prevalence of AAA in men from deprived areas. This might be a consequence of their attitude to their health, such as a higher rate of smoking,[13,14] or it may be an effect of the current analysis. Further exploration of even larger datasets will be needed to obtain definitive conclusions. Finally, there are clearly problems with the reporting of ethnicity within NAAASP, but analysis of the current data suggests AAA are much more common in white British (and particularly white Irish) men compared with black or Asian men.

In the largest randomised trial of AAA screening (Multicentre Aneurysm Screening Study), it was noted that social deprivation affected attendance.[4] Similar studies have been reported from Sweden[15] and Scotland.[12] The links among

Table 3. Incidence of aneurysms in screened men by ethnic group.

Ethnic group	Number tested	Number aneurysms	Percentage aneurysms	95% CI
Asian or Asian British	12,767	30	0.23	0.16—0.34
Black or Black British	3,651	22	0.60	0.40—0.91
Mixed	703	5	0.71	0.30—1.65
Not stated	90,258	917	1.02	0.95—1.08
Other	2,318	20	0.86	0.56—1.33
White	352,257	4,568	1.30	1.26—1.33

Table 4. Odds of aneurysm being detected by ethnic group.

Ethnic group	Number tested	Number aneurysms	Odds ratio	p value	95% CI
Asian or Asian British	12,767	30	0.18	0.000	0.13—0.26
Black or Black British	3,651	22	0.46	0.000	0.31—0.71
Mixed	703	5	0.64	0.024	0.43—0.94
Not stated/ Other	92,576	937	0.77	0.000	0.72—0.83
White	352,257	4,568	-	-	-

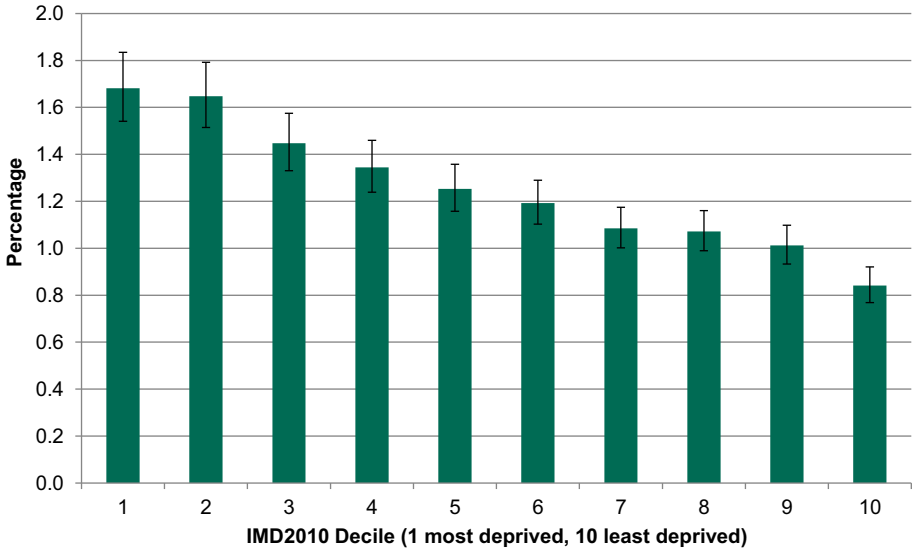

Figure 3. Prevalence of AAA in 65 year old men by deprivation index (LSOA IMD2010 decile).

age, social deprivation, and ethnicity are complex. Most recently, rurality (distance from the nearby city centre) has been shown to affect attendance for AAA screening,[12] but with complex local interaction. Less is known about ethnicity and uptake from AAA screening.[16] More accurate documentation of ethnicity variables in NAAASP, and larger number of men screened from smaller ethnic groups will enable more detail about variations in prevalence to be calculated in future.

Most of these findings are not necessarily novel, but the scale of the study (almost half a million men screened, with national coverage of England) renders the conclusions important. It can, however, be concluded that there is quite widespread variation in uptake between different areas, and the relationship of uptake, ethnicity, and deprivation is complex, which makes finding national solutions to improve uptake quite difficult. Solutions to reducing inequality will have to be local, and probably implemented by local screening teams.

There are a number of limitations to this study. Although NAAASP is fully implemented, there remain some programmes, particularly those at the tail end of the implementation process, that are not fully operational, and are still catching up. The addition of data from ensuing years will add value to the process. Second, the data on ethnicity remain incomplete. Some local programmes are better than others at completing this information. Finally, smoking is the main risk factor for AAA development, and it too is associated with social deprivation.[14] Data on smoking habits are not collected routinely from men screened in NAAASP.

Uptake for AAA screening in England is currently 78.1%.[17] The only other national programme is in Sweden and has a higher rate of 85%, despite men having to pay a small fee for their scan.[15] Maximising attendance is clearly the optimal way to realise the benefits of the programme. Understanding the challenge of ethnicity and deprivation, along with other local factors, enables action to ensure men receive all the information they need in a form which they can use. The current suggestion to mitigate variations in uptake is that NAAASP will feed back information to local screening programmes concerning their local diversity issues on a regular basis. This could be used by the programmes to maximise uptake by changing local arrangements: possibly altering venues for scanning, generating publicity, and other local proposals. It would be the responsibility of the national programme team to develop a suite of documents to facilitate local policy changes. Ongoing monitoring of the equality and diversity issues will ensure that equity is maximised in NAAASP. Local programmes should be encouraged to evaluate any interventions they employ.

ACKNOWLEDGEMENTS

The authors are grateful for comments from Dr John Rodriquez and Dr Mike Crilly. The authors are also grateful for the continued support of the 41 local screening programme teams in England.

CONFLICT OF INTEREST

None.

FUNDING

The NHS AAA Screening Programme is funded by the Department of Health and provided through Public Health England.

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Eur J Vasc Endovasc Surg (2017) 53, 843

COUP D'OEIL

Endovascular Treatment of Symptomatic Renal Artery Aneurysm with Hostile Anatomy

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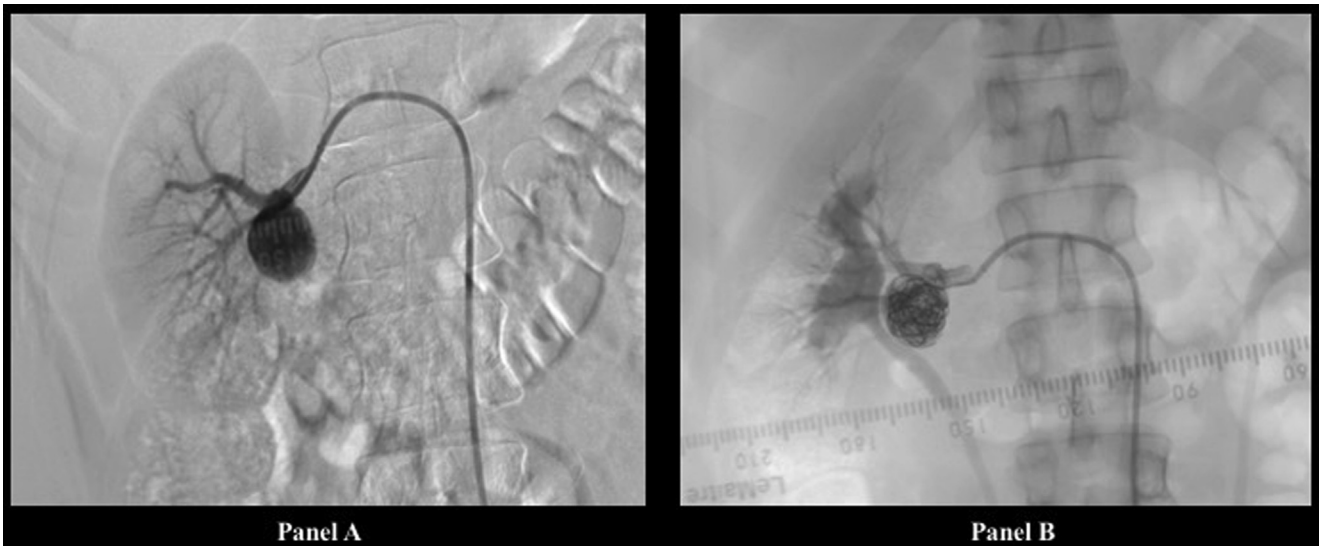

A 33 year old patient with no relevant medical history was admitted after the incidental finding of a right renal artery aneurysm on ultrasound performed for persistent flank pain. Computed tomography angiography confirmed a distal 21 mm saccular aneurysm, involving the artery's trifurcation and proximal inferior segmental artery (A). To preserve renal perfusion, a self expandable open-cell nitinol stent (Xpert, Abbott Vascular, Abbott Park, IL, USA) was deployed from the renal to the anterior segmental artery, after which microcatheter coil embolisation (AZUR, Terumo, Shibuya, Tokyo, Japan) of the sac was performed through the stent mesh. Completion angiography revealed total aneurysm exclusion (B) with full preservation of renal perfusion.

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http://dx.doi.org/10.1016/j.ejvs.2017.02.018