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Title

Incidental Findings Associated with Magnetic Resonance Imaging of the Brachial Plexus

Short title

Incidental findings on brachial plexus MRI

Abstract

Objectives: The identification and management of incidentalomas is becoming increasingly problematic, particularly in relation to brachial plexus imaging because the prevalence of incidental findings is unknown. Therefore, we aimed to estimate the prevalence of incidental findings in symptomatic patients undergoing MRI of the brachial plexus.

Methods: This retrospective cohort study included all children and adults who underwent MRI over a 12-year period, in a tertiary care centre in the UK. An incidental finding was any abnormality which was not a direct injury to or disease-process of the brachial plexus. An 'incidentaloma' was defined by the need for further investigation or treatment. Multivariable logistic regression was used to estimate the odds ratio (OR) of an 'incidentaloma'. To estimate which factors were associated with the number of incidental findings, multivariable Poisson regression was used.

Results: Overall, 502 scans (72%) reported incidental anomalies. Although the number of MRIs performed per annum increased by 23%, the prevalence of 'incidentalomas' remained static (p=0.766). Musculoskeletal incidental findings were the most prevalent (63%) and when identified, there were a median of 3 incidental anomalies per patient. Overall, 125 (18%) anomalies were 'incidentalomas' which required further investigation or treatment. The odds of having further investigation or treatment was strongly related to the frequency of incidental findings (adjusted OR 1.16 [95% CI 1.08, 1.24]) and when a tumour was identified (adjusted OR 2.86 [95% CI 1.81, 4.53]). The number of incidental findings recorded per scan increased when trainees co-reported with consultants (adjusted IRR 0.36 [95% CI 0.05, 0.67]) and in the presence of a tumour (adjusted IRR 0.39 (95% CI 0.28, 0.49))

Conclusions: The prevalence of clinically important incidental findings on brachial plexus MRI is lower than organ-specific imaging, but still 18% of scans identified an 'incidentaloma' which required further investigation or treatment.

Advances in knowledge

This cohort study shows that approximately 1 in 5 symptomatic patients undergoing a brachial plexus MRI had a clinically important incidental findings, which required further investigation or treatment. This information can be used to inform patients consenting to clinical or research imaging.

Abbreviations

CI Confidence interval

IQR interquartile range

IRR incident rate ratio

OR odds ratio

SD standard deviation

Key words

Brachial plexus; magnetic resonance imaging; peripheral nerve; incidental; incidentaloma;

Introduction

As the utilisation and fidelity of magnetic resonance imaging (MRI) improves[1], the identification and management of incidental findings is a growing problem[2,3]. In a small number of cases, incidental anomalies warrant additional investigations or treatment and we term these 'incidentalomas'. Incidentalomas may cause patient anxiety, and increase burden to the health and legal services[4]. Clearly the early detection of truly sinister incidentalomas allows earlier treatment and this benefits patients[5]. Consequently, there have been widespread calls for clinicians and researchers to counsel individuals about the potential for anxiety, health and financial risk should an incidentaloma be detected on imaging[2,6].

The reported prevalence of incidentalomas depends on many factors, including the imaging modality used, age and sex of the patient and the body region[5,7,8]. From the available MRI literature, the prevalence of incidentalomas are as follows: cardiac 24%[7], brain and spine 22%[4,7,9,10], breast 29%[11], liver 12%[12], lungs 6%[13,14], thyroid 4%[15] and when whole-body is employed, the mean prevalence rises to 32% (95% CI 18%, 50%)[16]. MRI is the best non-invasive imaging modality for diagnosing various pathologies affecting the brachial plexus and its terminal branches[17–19]. Consequently, MRI is widely used in clinical practice and research related to the brachial plexus. Clinicians obtaining consent for imaging should counsel individuals about the risk of incidental findings[20] but this is currently impossible for MRI studies of the brachial plexus because the prevalence of incidental findings and their ramifications remain unclear.

The aim of this study is to estimate the prevalence of incidental findings in symptomatic patients undergoing MRI of the brachial plexus.

Methods

Design and setting

This retrospective cohort study captured patients undergoing brachial plexus MRI between May 2007 and February 2019 in a single tertiary care centre in the UK. This study was conducted as an evaluation of service; the United Kingdom Health Research Authority states that Evaluations of Service do not require patient consent or ethical approval.

Participants

We included consecutive symptomatic patients (children and adults) who underwent a brachial plexus MRI, on any system. We excluded repeat scans in the same individual (i.e. this study considers patients' first brachial plexus MRI and no subsequent imaging, so as to avoid the potential for duplication), scans of patients who failed to complete the planned protocol (i.e. those who terminated their scan early owing to claustrophobia or pain), and scans which could not be reported owing to artefact.

Variables

To minimise investigator bias, all findings were extracted from radiologist reports verbatim by three independent authors (ARP, UAA and RKB). An 'incidental finding' was defined as any abnormality which was not a direct injury to or disease-process of the brachial plexus[21]. An 'incidentaloma' was defined as an incidental anomaly which required further action of any sort, such as further imaging, blood tests, biopsy or treatments. The decision to undertake further investigation or treatment was made by the treating team; defining a threshold for this decision was difficult and is clearly based upon numerous factors. Therefore, we took a pragmatic approach and classified this outcome as binary so that any/all actions were captured. Subsequent actions were not mutually exclusive and where multiple further actions were undertaken (e.g. a blood test, further imaging and an operation) all these events were captured discretely. We defined an incidental tumour as any unexpected space-occupying lesion whether it appeared to be benign or malignant and regardless

of the tissue of origin. Scans were reported by either consultant radiologists or by trainee radiologists with addendums and/or corrections by the supervising consultant. When some scans were transferred from a referring hospital, information contained within the DICOM header was lost and thus the make, model and field strength of the scanner was unclear.

Data analysis

Data were analysed using Stata/MP v15. Proportions were compared using the chi-squared test. Count data were summarised by the median and interquartile range (IQR). Age was normally distributed so was summarised by the mean (and standard deviation, SD). To estimate which factors were associated with the need for further investigations or treatment, multivariable logistic regression was used. To estimate which factors were associated with the number of incidental findings, Poisson regression was used. The covariables for both models were: age and the frequency of incidental findings as continuous co-variables, and the indication for scanning, sex, field strength, radiologist reporting (consultant only versus consultant and trainee co-reporting) and whether intravenous contrast was used as categorical co-variables. Confidence intervals (CIs) were generated to the 95% level.

Results

Overall, we retrieved 749 reports from patients who underwent MRI of their brachial plexus. We excluded the reports from 38 patients who did not complete their scans (n=36 due to claustrophobia and n=2 due to safety concerns), 9 research scans of asymptomatic adults, and a further 7 records of patients whose images were degraded by motion artefact such that interpretation was impossible. Ultimately, the reports from 695 patients were included.

A total of 502 scans (72%) reported incidental findings, of which 125 (18%) were incidentalomas i.e. unexpected anomalies which required further investigation or treatment (Figure 1). The number of scans increased over time by a mean of 23% per annum (Figure 2) but the proportion of scans with incidentalomas remained static (p=0.766). Patients with incidentalomas were 5.1 years older (95% CI 1.5, 8.8) than others (Table 1). Protocols using steady-state sequences were associated with significantly fewer incidentalomas (OR 0.45 [95% CI 0.27, 0.77]).

Table 2 shows that incidental findings were most commonly identified within the musculoskeletal system. When identified, the median count of musculoskeletal anomalies per patient was 3. Of these musculoskeletal anomalies, 30 were tumours of which, one-third required medical or surgical treatment. Table 3 shows that the odds of patients requiring further investigations or treatment for an incidental finding increased significantly when the anomaly was a suspected tumour and also in proportion to the frequency of incidental findings.

The cumulative number of incidental findings per scan (anomalies which both did and did not require further investigation or treatment) was strongly associated with several independent factors (Table 4), as follows. The identification of an incidental tumour was associated with a 39% increased rate of other co-reported anomalies. Co-reporting of scans by both a trainee and consultant radiologist increased the rate of reported incidental findings by 36% (Figure 3). Every year of life increased the incident rate ratio by 2% (Figure 4). Males had a 24% higher rate of

incidental findings than females. Conversely, scanning for a clinically suspected tumour and the use of a 3 Tesla system were associated with a lower rate of incidental findings.

Of the 125 incidentalomas (unexpected anomalies which were further investigated or treated), the majority transpired to be benign/innocent (n=81, 65%). Importantly, MRI identified a minority of patients with new metastatic deposits from breast cancers (n=18, 14%), lung and mesothelial carcinomas (n=7, 6%), prostate carcinomas (n=4, 3%), thyroid cancer (n=1, 0.8%), renal cell carcinoma (n=1, 0.8%) and cutaneous squamous cell carcinoma (n=1, 0.8%). Recurrent sarcomas were also identified in 2 patients (1.6%) and new pathological fractures in 2 patients with known localised breast cancer.

Discussion

We have shown that 72% of brachial plexus MRI scans were associated with an incidental finding. Importantly, 18% of scans described an incidental anomaly which required further investigation or treatment. These risks should be adequately conveyed to patients undergoing imaging of the brachial plexus. Furthermore, the resultant burden on health services to further investigate and treat these incidental anomalies must be factored into the design and funding for both clinical services and research activities.

The prevalence of clinically important incidental findings associated with brachial plexus MRI is lower than the comparative literature on organ-specific imaging. Overall, we show that 18% of brachial plexus MRIs yielded at least one unexpected anomalous finding which required further investigation or treatment. This estimate is lower than the incidentaloma rate in whole-body (32%)[16], breast (29%)[11], heart (24%)[7], brain and spine 22%[4,7,9,10] MRI, which might be related to several factors. Patients undergoing brachial plexus MRI are typically much younger than those undergoing organ-specific imaging and because age is strongly associated with the incidence of cancer[8] and non-cancerous incidental findings on imaging[5,7], the prevalence is expected to be lower. Furthermore, the patients undergoing brachial plexus MRI broadly fall into two categories – those with acute traumatic injuries and those with chronic compressive pathologies (e.g. tumours) – and there are important distinctions in the protocols which are typically used. The mainstay of imaging in patients with traumatic brachial plexus injuries is a combination of MRI myelography and fat-suppressed T2-weighted imaging. Magnetic resonance myelography is typically acquired with heavy T2-weighting (often in the form of a steady-state sequence), in a thin coronal slab and at very high-resolution (often less than $1mm^3$). Consequently, the limited field and poor contrast outside the thecal sac leaves little opportunity for identifying other anomalies. Equally, protocols designed to image those with suspected tumours or uncertain pathologies often deploy large field-of-view T1 (with or without contrast) and fat-suppressed T2-weighted protocols, which come at the expense of resolution and various artefacts related to movement, flow and susceptibility, all of which may contribute to lower counts of incidental findings which we observed.

We have shown that several factors were statistically associated with higher counts of incidental findings per scan (Table 4). Of foremost effect was the identification of an unexpected tumour which increased the rate ratio of incidental findings by 39%. We speculate that this represents efforts to identify other anomalies (such as metastases, lymphadenopathy and paraneoplastic changes) which may be relevant to a potential diagnosis of cancer. Scans reported by both a trainee and consultant radiologist yielded significantly more incidental findings than scans reported by a consultant alone, which agrees with prior work showing that co-reporting of musculoskeletal imaging (a trainee supervised by a consultant) increased the probability that further imaging was recommended[22]. Although the underlying reason(s) for this outcome remain unclear, our experience suggests that consultants selectively omit incidental anomalies which are clinically irrelevant or highly likely to be innocent. Age and sex are well known determinants of cancer risk, with older males having the highest incidence of cancer[8]. Our findings are in keeping with the literature and show that increasing age and male sex increase the probability of incidental findings in brachial plexus MRI[5,7]. Conversely, when MRI was requested for a clinically suspected tumour, the prevalence of incidental findings approximately halved (IRR -0.57) which suggests that the radiologist's attention was rightly focussed on the tumour-draining nodal basins and potential sites of metastasis. Our data shows that the use of higher field strength scanners (3T versus 1.5T) was associated with fewer incidental anomalies. This is in contrast to the literature on brain MRI where increasing field strength (enabling increased spatial resolution) is associated with more incidental findings[23]. This discrepancy might be explained by the fact that only 1% of scans were performed on a 3T system (of the same brand) at a neighbouring site where the patients may have been subtly different (i.e. able to travel to another site) and the sequences may not have been optimised.

The issue of incidental anomalies is particularly important in brachial plexus imaging because the current clinical protocols are not fit for purpose[19] and there is a rapidly growing interest in imaging research[24–28]. At least 40% of imaging research is performed by non-medically trained scientists[29–31] and whilst doctors may be in a comparatively better position to identify anomalies, and have a

duty of care and candour to disclose clinically relevant findings to research subjects, the guidance around reporting images and handling incidental findings are less clear for non-medical professionals. Therefore, in the absence of a legal "test case" in the UK[4], we echo calls for clear standards, guidance on image-centric reporting[32] and the development of a national framework[31] for the management of research images and incidental findings[30].

Limitations

The main weakness of this study is the inability to define what made clinicians elect to investigate or treat some incidental findings and not others; the absence of a diagnostic threshold for this outcome limits the translation. In the absence of any data on this topic we chose a pragmatic approach in the form of a retrospective study; hereafter, the topic should be explored in a prospective study. The variability of when and how radiologists report incidental findings may affect both the prevalence and recommended actions from an imaging study[33]. For example, one radiologist may report signal anomalies which they judge to appear innocent and warrant no further action, whilst another may choose to omit specific findings meaning that assessment bias may be present in our study. Capturing if and how many trainees radiologists had input on a given report was difficult in some instances; all reports automatically have a consultant name assigned although a trainee's name only appears on the report if he/she manually signs it; furthermore, if the report is incorrect and warrants re-writing, it is possible that the trainees name was removed from the report, meaning that we might have failed to capture some instances of co-reporting. This dataset is derived from a large teaching hospital which provides tertiary cancer and major trauma care, so the findings may not be transferrable to centres with a different caseload. The pulse sequences used in our centre may differ to hospitals elsewhere, thus it is plausible that the prevalence of incidental anomalies will differ too. For patients who had multiple scans, we included only their 1st scan to a) avoid potential double-counting of incidental findings, and given that b) innocent incidental anomalies are likely to be omitted from subsequent reports and c) sinister anomalies are likely to have been resolved. However, this means that we were unable to quantify how many

clinically important incidental anomalies were missed in patients 1st scans but correctly identified in follow-up imaging.

Conclusions

The prevalence of incidental findings on brachial plexus MRI is moderate and 18% of scans identified an incidentaloma which required further investigations or treatment. Doctors requesting clinical scans and researchers who obtain consent from volunteers should provide information on the prevalence of incidental findings and their potential ramifications.

Data availability

The raw dataset and statistical syntax are available from the last author (RGW) upon request.

References

1. Smith-Bindman R, Miglioretti DL, Larson EB. Rising Use Of Diagnostic Medical Imaging In A Large Integrated Health System. *Health Aff.* 2008;27(6):1491–1502.
2. Stone JH. Incidentalomas — Clinical Correlation and Translational Science Required. *N. Engl. J. Med.* 2006;354(26):2748–2749.
3. Weiner C. Anticipate and Communicate: Ethical Management of Incidental and Secondary Findings in the Clinical, Research, and Direct-to-Consumer Contexts (December 2013 Report of the Presidential Commission for the Study of Bioethical Issues). *Am. J. Epidemiol.* 2014;180(6):562–564.
4. Wardlaw JM, Davies H, Booth TC, et al. Acting on incidental findings in research imaging. *BMJ*. 2015;351(nov10 1):h5190–h5190.
5. Orme NM, Fletcher JG, Siddiki HA, et al. Incidental Findings in Imaging Research. *Arch. Intern. Med.* 2010;170(17):2145–2156.
6. Powell DK. Patient Explanation Guidelines for Incidentalomas: Helping Patients Not to Fear the Delayed Surveillance. *Am. J. Roentgenol.* 2014;202(6):W602–W602.
7. O'Sullivan JW, Muntinga T, Grigg S, et al. Prevalence and outcomes of incidental imaging findings: umbrella review. *BMJ*. 2018:k2387.
8. UK CR. Cancer incidence by age. 2020.
9. Hegenscheid K, Seipel R, Schmidt CO, et al. Potentially relevant incidental findings on research whole-body MRI in the general adult population: Frequencies and management. *Eur. Radiol.* 2013;23(3):816–826.
10. Weber F, Lee Y-C, Tsushima Y, et al. Incidental findings on brain magnetic resonance imaging : systematic review and meta-analysis. *BMJ*. 2000;339:b3016.
11. Liberman L, Morris EA, Dershaw DD, et al. Ductal enhancement on MR imaging of the breast. *Breast Dis.* 2004;15(3):263–266.
12. Knox M, Slanetz P, Phillips J, et al. Incidental liver lesions seen on Breast MRI: When is additional imaging warranted? *Eur. J. Radiol.* 2017;95(February):319–324.
13. Morin SHX, Cobbold JFL, Lim AKP, et al. Incidental findings in healthy control research

subjects using whole-body MRI. *Eur. J. Radiol.* 2009;72(3):529–533.

14. Lo GG, Ai V, Au-Yeung KM, et al. Magnetic resonance whole body imaging at 3 Tesla: Feasibility and findings in a cohort of asymptomatic medical doctors. *Hong Kong Med. J.* 2008;14(2):90–96.
15. Drake T, Gravely A, Westanmo A, et al. Prevalence of Thyroid Incidentalomas from 1995 to 2016: A Single-Center, Retrospective Cohort Study. *J. Endocr. Soc.* 2020;4(1):1–8.
16. Kwee RM, Kwee TC. Whole-body MRI for preventive health screening: A systematic review of the literature. *J. Magn. Reson. Imaging*. 2019;50(5):1489–1503.
17. Vargas MI, Viallon M, Nguyen D, et al. New approaches in imaging of the brachial plexus. *Eur. J. Radiol.* 2010;74(2):403–410.
18. Sureka J, Cherian RA, Alexander M, et al. MRI of brachial plexopathies. *Clin. Radiol.* 2009;64(2):208–218.
19. Wade RG, Takwoingi Y, Wormald JCR, et al. MRI for Detecting Root Avulsions in Traumatic Adult Brachial Plexus Injuries: A Systematic Review and Meta-Analysis of Diagnostic Accuracy. *Radiology*. 2019;293(1):125–133.
20. Kole J, Fiester A. Incidental Findings and the Need for a Revised Informed Consent Process. *Am. J. Roentgenol.* 2013;201(5):1064–1068.
21. Lumbreras B, Donat L, Hernández-Aguado I. Incidental findings in imaging diagnostic tests: a systematic review. *Br. J. Radiol.* 2010;83(988):276–289.
22. Cochon LR, Kapoor N, Carrodeguas E, et al. Variation in Follow-up Imaging Recommendations in Radiology Reports: Patient, Modality, and Radiologist Predictors. *Radiology*. 2019;291(3):700–707.
23. Morris Z, Whiteley WN, Longstreth WT, et al. Incidental findings on brain magnetic resonance imaging: systematic review and meta-analysis. *BMJ*. 2009;339(aug17 1):b3016–b3016.
24. Wade RG, Tanner SF, Teh I, et al. Diffusion Tensor Imaging for Diagnosing Root Avulsions in Traumatic Adult Brachial Plexus Injuries: A Proof-of-Concept Study. *Front. Surg.* 2020;7:Article 19.
25. Ho MJ, Ciritsis A, Manoliu A, et al. Diffusion Tensor Imaging of the Brachial Plexus: A

Comparison between Readout-segmented and Conventional Single-shot Echo-planar Imaging. *Magn. Reson. Med. Sci.* 2019;18(2):150–157.

26. Oudeman J, Verhamme C, Engbersen MP, et al. Diffusion tensor MRI of the healthy brachial plexus. Gelderblom M, ed. *PLoS One*. 2018;13(5):e0196975.
27. Su X, Kong X, Liu D, et al. Multimodal magnetic resonance imaging of peripheral nerves: Establishment and validation of brachial and lumbosacral plexi measurements in 163 healthy subjects. *Eur. J. Radiol.* 2019;117(February):41–48.
28. Vargas MI, Viallon M, Nguyen D, et al. Diffusion tensor imaging (DTI) and tractography of the brachial plexus: feasibility and initial experience in neoplastic conditions. *Neuroradiology*. 2010;52(3):237–245.
29. Illes J, Kirschen MP, Karetsky K, et al. Discovery and disclosure of incidental findings in neuroimaging research. *J. Magn. Reson. Imaging*. 2004;20(5):743–747.
30. Booth TC, Jackson A, Wardlaw JM, et al. Incidental findings found in "healthy" volunteers during imaging performed for research: current legal and ethical implications. *Br. J. Radiol.* 2010;83(990):456–465.
31. Booth TC, Waldman AD, Wardlaw JM, et al. Management of incidental findings during imaging research in "healthy" volunteers: current UK practice. *Br. J. Radiol.* 2012;85(1009):11–21.
32. Reiner BI. Strategies for Radiology Reporting and Communication. Part 1: Challenges and Heightened Expectations. *J. Digit. Imaging*. 2013;26(4):610–613.
33. Dobranowski J, Sommer W. Structured Radiology Reporting: Addressing the Communication Quality Gap. *SN Compr. Clin. Med.* 2019;1(6):397–407.

Table 1. Patient characteristics

		Incidental findings which required further investigation(s) or treatment(s)		
		No (n=570)	**Yes (n=125)**	**P-value**
Sex (%)	**Males**	311 (55)	56 (45)	0.048
	Females	259 (45)	69 (55)	
	Mean age in years (SD)	41 (18)	46 (21)	0.005
Indications for MRI (%)	**Neurological deficit**	430 (76)	90 (72)	n/a*
	Suspected tumour +/- neurological symptoms	45 (8)	9 (7)	
	Postoperative surveillance	40 (7)	10 (8)	
	Supplement other (non-MRI) imaging	30 (5)	9 (7)	
	Connective tissue disease	4 (1)	1 (1)	
	Vascular symptoms	2 (0)	1 (1)	
	Operative planning	1 (0)	1 (1)	
	Unclear	17 (3)	4 (3)	
Field strength (%)	**1.5 Tesla**	546 (96)	122 (97)	0.633
	3 Tesla	9 (2)	1 (1)	
	Unclear	16 (3)	2 (2)	
Sequences (%)	**T1w**	555 (97)	123 (99)	0.220
	T1w with contrast	45 (8)	11 (9)	0.712
	T2w	502 (88)	111 (90)	0.649
	Steady state (e.g. CISS)	430 (88)	80 (76)	0.003
	Fat suppressed inversion recovery (e.g. STIR)	524 (92)	117 (94)	0.357
	Fluid suppressed inversion recovery (e.g. FLAIR)	25 (5)	5 (5)	0.883
Most senior reporting radiologist (%)	**Consultant only**	558 (98)	120 (96)	0.184
	Co-reporting trainee and consultant	6 (1)	4 (3)	
	Unclear	6 (1)	1 (1)	

CISS = constructive interference in steady state; STIR = short tau inversion recovery; T1w = T1-weighted; T2w = T2 weighted

*Arbitrary categories

Table 2. The distributions of incidental findings and the subsequent actions taken by clinicians

Locations of incidental anomalies	**Frequency of incidental findings (% of all 695 scans)**	**Median count of incidental findings (IQR; maximum)**	**Frequency of scans with incidentalomas* (% of all 695 scans)**	**Newly identified suspected tumour (% of all 695 scans)**	**Frequency of action(s) taken to address incidentalomas* (% of all 695 scans)**					
					Clinical observation only	**Further imaging**	**Blood tests**	**Nerve conduction studies**	**Biopsy**	**Medical and/or surgical treatment**
Musculoskeletal system and integument	444 (63.9)	3 (1, 4; 12)	102 (14.7)	30 (4.3)	7 (1.0)	39 (5.6)	21 (3.0)	7 (1.0)	17 (2.4)	30 (4.3)
Central nervous system	227 (32.7)	1 (1, 2; 8)	61 (8.8)	13 (1.9)	7 (1.0)	29 (4.2)	11 (1.6)	2 (0.3)	13 (1.9)	19 (2.7)
Upper aerodigestive track	80 (11.5)	1 (1, 2; 4)	23 (3.3)	7 (1.0)	2 (0.3)	10 (1.4)	8 (1.2)	0 (0)	6 (0.9)	6 (0.9)
Lower respiratory track & thoracic cavity	63 (9.1)	1 (1, 1; 4)	22 (3.2)	6 (0.9)	1 (0.1)	10 (1.4)	5 (0.7)	2 (0.3)	4 (0.6)	10 (1.4)
Breast	25 (3.5)	1 (1, 1; 2)	10 (1.4)	2 (0.3)	0 (0)	6 (0.9)	4 (0.6)	1 (0.1)	5 (0.7)	3 (0.4)
Thyroid	5 (0.7)	1 (1, 1; 1)	4 (0.6)	6 (0.9)	0 (0)	1 (0.1)	2 (0.3)	0 (0)	1 (0.1)	1 (0.1)
Vasculature	5 (0.7)	1 (1, 2; 3)	3 (0.4)	0 (0)	0 (0)	1 (0.1)	0 (0)	1 (0.1)	1 (0.1)	5 (0.7)
Non-brachial plexus peripheral nerves	1 (0.1)	1 (1, 1; 1)	1 (0.1)	1 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.1)

*Incidentaloma = an incidental finding which required further investigation or treatment

Table 3. Factors which influence whether further investigation or treatment is needed for an incidental finding

	Odds of an incidental finding which required further investigation or treatment			
	Univariable odds (95% CI)	**P-value**	**Adjusted odds (95% CI)**	**P-value**
Incidental tumour identified	3.59 (2.35, 5.12)	<0.001	2.86 (1.81, 4.53)	<0.001
Frequency of incidental findings (cumulative total, per scan)	1.19 (1.12, 1.26)	<0.001	1.16 (1.08, 1.24)	<0.001
Imaging for suspected tumour	0.85 (0.23, 3.12)	0.914	0.91 (0.41, 2.03)	0.816
Age in years	1.01 (1.00, 1.02)	0.006	1.01 (1.00, 1.02)	0.288
Female	1.48 (1.00, 2.18)	0.049	0.67 (0.44, 1.02)	0.064
3 Tesla system	0.49 (0.06, 3.96)	0.509	1.12 (0.14, 9.15)	0.916
Co-reporting trainee and consultant	3.10 (0.86, 11.2)	0.083	3.06 (0.76, 12.2)	0.114
Contrast enhanced scan	1.13 (0.57, 2.26)	0.726	1.06 (0.50, 2.23)	0.888

Table 4. Factors which effect the rate of incidental findings

	Incident Rates Ratio (IRR) for incidental findings			
	Univariable IRR (95% CI)	**P-value**	**Adjusted IRR (95% CI)**	**P-value**
Incidental tumour identified	0.44 (0.33, 0.53)	<0.001	0.39 (0.28, 0.49)	<0.001
Co-reporting trainee and consultant	0.39 (0.08, 0.69)	0.036	0.36 (0.05, 0.67)	0.021
Male	0.19 (0.11, 0.28)	<0.001	0.24 (0.14, 0.33)	<0.001
Age in years	0.02 (0.02, 0.02)	<0.001	0.02 (0.02, 0.02)	<0.001
Contrast enhanced scan	0.02 (-0.14, 0.18)	0.830	0 (-0.17, 0.16)	0.964
Imaging for suspected tumour	-0.58 (-0.79, -0.37)	<0.001	-0.60 (-0.81, -0.39)	<0.001
3 Tesla system	-2.66 (-4.10, -1.27)	<0.001	-2.94 (-4.33, -1.55)	<0.001

Figure Legends

Figure 1. Examples of incidental anomalies detected on MRI of the brachial plexus. Top left: A heterogenous right-sided thyroid mass. Top right: A mass arising from the chest wall, left of the midline, in a patient decades after bilateral mastectomy for breast cancer. Lower left: A parapharyngeal haematoma in a polytrauma patient. Lower middle: A nodule within the right parotid gland. Lower right: An aneurysmal descending thoracic aorta.

Figure 2. A stacked bar chart showing the number of times a patient underwent their first MRI of the brachial plexus increased annually by a mean 23%, but the prevalence of incidentalomas remained static.

Figure 3. Scans reported by a trainee and consultant jointly had significantly more incidental anomalies, in patients of all ages.

Figure 4. A scatter plot showing that the number of incidental findings per scan increases with age.