TITLE

Australian Students' Perspective on Interventional Radiology Education (ASPIRE): A Prospective Cross-Institutional Study

RUNNING TITLE

ASPIRE

AUTHORS AND INSTITUTIONS

Ms Michelle Foo¹

Dr Julian Maingard^{2,3,4}

Dr Kevin Phan⁵

Dr Reuben Lim⁶

A/Prof Ronil Chandra⁷

Prof Michael Lee^{8,9}

A/Prof Hamed Asadi^{2,3,4,7,10}

Dr Hong Kuan Kok¹¹

A/Prof Mark Brooks^{2,3,10,12}

¹Monash School of Medicine, Monash University, Clayton VIC, Australia

²Interventional Radiology Service, Department of Radiology, Austin Hospital, Heidelberg VIC, Australia

³Interventional Neuroradiology Service, Department of Radiology, Austin Hospital, Heidelberg, VIC, Australia

⁴School of Medicine, Faculty of Health, Deakin University, Waurn Ponds VIC, Australia

⁵Liverpool Hospital, Liverpool NSW, Australia

⁶Ballarat Health Services, Ballarat Central VIC, Australia

⁷Interventional Neuroradiology Service, Monash Imaging, Monash Medical Centre, Clayton VIC, Australia

⁸Department of Radiology, Royal College of Surgeons in Ireland, Dublin, Ireland

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⁹Interventional Radiology Service, Department of Radiology, Beaumont Hospital,
Dublin, Ireland

¹⁰The Florey Institute of Neuroscience and Mental Health, University of Melbourne,
Parkville, Australia

¹¹Interventional Radiology Service, Department of Radiology, Northern Health, Epping
VIC, Australia

¹²St Vincent's Private Radiology, St Vincent's Hospital, Fitzroy VIC, Australia

CORRESPONDING AUTHOR

Ms Michelle Foo

8 Webb St

Glen Iris 3146

VIC, Australia

Mobile: 0415664204

Email: mfoo4@student.monash.edu

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MS. MICHELLE FOO (Orcid ID : 0000-0001-8056-1163)

DR. JULIAN MAINGARD (Orcid ID : 0000-0001-8958-2411)

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ABSTRACT

Introduction

As interventional radiology (IR) adopts an increasingly pivotal role within therapeutic medicine, it is essential that medical students gain exposure to IR so as future doctors, they can fulfil the growing demand for interventional radiologists (IRs) and make appropriate referrals to IRs. Nonetheless, several international studies have reported no or little representation of IR in medical school. Our study aims to assess the current awareness, exposure, knowledge and attitudes about IR amongst Australian medical students, as to provide preliminary data on whether IR teaching in Australian medical schools needs improvement.

Methods

A prospective cross-sectional study was conducted via web-based and in-person distribution of a voluntary, anonymous questionnaire.

Results

237 complete responses were received from approximately 1400 clinical-based students (17% response rate). 38% of respondents had never witnessed an IR procedure, 39% witnessed 1-2, and the remainder 3-5. Few students reported adequate teaching or knowledge in IR (7% and 5% respectively). Of the 32% of students considering a career in IR, males predominated (25% of females vs 59% of males, OR=0.48, 95%CI=0.27-0.83,p=0.008). Most students agree IR should be in the university curriculum (59%) and is key to improving healthcare (74%). Senior students were more likely to report adequate teaching (p<0.001) and believe IR teaching is important (p=0.001).

Conclusions

Australian medical students have a strong appreciation for IR despite having suboptimal teaching, exposure and knowledge in IR. In order to complement and sustain the rapid uptake of IR techniques in modern medicine, university curricula require a greater focus on IR.

KEY WORDS

intervention, neurointerventional radiology, non-vascular interventional radiology, vascular interventional radiology, quality assurance

MAIN TEXT

Introduction

Interventional radiology (IR) is a rapidly growing medical specialty that utilises image-guided, minimally invasive therapy to treat an expansive variety of diseases across all anatomic sites of the body. Apart from offering a variety of innovative treatment options for important conditions such as stroke, trauma, and oncologic diseases, IR offers substantial additional benefits, such as improved efficiency, cost-effectiveness, survival and length of hospital stay, due to its minimally invasive nature.[1] As the world of therapeutic medicine shifts inexorably toward the minimally invasive sphere, IR is positioned at the centre of this change and leading the way forward.

However, because IR is a young specialty housed within diagnostic radiology (DR), IR has not yet been recognised in many medical school curricula. We believe that it is essential that current and future medical students are exposed and attracted to the specialty of IR to fulfil the future demand for interventional radiologists (IRs).[2] Additionally, medical specialists should be familiar with the increasing range of minimally invasive treatments available in their respective fields and be able to work collaboratively with IRs as part of a holistic, longitudinal and multidisciplinary approach to patient care. Nevertheless, it has been recognised within many European, North American and Asian countries that IR is underrepresented in the medical school curriculum and basic IR knowledge is lacking amongst medical students.[2-7] To date, no similar studies have examined the standard of IR teaching and knowledge in Australian medical schools. We hypothesise that, in line with

international studies, Australian students are not adequately equipped with the knowledge and experience in IR to enable effective clinical practice into the future.

The aim of this study was to assess the current level of awareness, knowledge, exposure and attitudes about IR amongst Australian medical students. In turn, such information could provide a basis as to whether IR teaching should receive greater focus within Australian medical school curricula.

Methods

A prospective cross-sectional study was conducted via web-based and in-person distribution of an anonymous questionnaire to clinical-based medical students across two large medical schools in one Australian city, henceforth referred to as “University A” and “University B”. The questionnaire was distributed by a medical student at each university. Participants were informed that the questionnaire was voluntary and not related to the coursework at their respective universities. Ethics approval was granted from the study institutions ethics review board.

University A has both undergraduate and postgraduate medical students, whereas University B offers a postgraduate course. The current curricula at University A and B includes the core components of DR but lacks IR. At each university, students are allocated to clinical placement at a certain hospital or group of hospitals, with the format of radiology teaching and exposure varying between hospitals. The main methods of teaching include tutorials, lectures, clinical placements, and incidental learning as part of other specialties. This is often supplemented by self-study via textbooks and online resources. As for exposure to IR, students placed at tertiary hospitals may have the opportunity to witness IR procedures through self-directed learning and may have limited IR content included in DR-focussed tutorials by radiologists.

The questionnaire comprised of 19 questions, 11 of which were subjective questions asking students to rate their own level of knowledge, exposure and attitudes about IR on a visual analogue scale. There were 5 response options: “strongly disagree”, “disagree”, “neutral”, “agree”, and “strongly agree”. The remaining 8 questions were objective questions testing students’ knowledge about IR, which required “true” or “false” answers. Additionally, basic demographic data was also recorded, including age, gender, university, year level and level of

101 qualification. Students had access to the online questionnaire for one month, with electronic
102 reminders sent to participants in the final week.

103 Statistical analysis was performed with SPSS (IBM, Armonk, NY). Associations between
104 categorical data were assessed using Pearson's χ^2 test, and where appropriate, Fischer's exact
105 test. Continuous variables were examined using 1-way ANOVA tests. A p-value of <0.05
106 was taken to represent statistical significance.

107 **Results**

108 A total of 237 complete responses were received from a target audience of approximately
109 1400 students (17% response rate). University A had 115 respondents while University B had
110 122. Students ranged from their 2nd to 5th year of studying medicine (Table 1).

111 <insert Table 1>

112
113 Exposure to IR was minimal, with 38% of respondents having never witnessed an IR
114 procedure and 39% having witnessed 1-2 procedures (Figure 1). This was not significantly
115 associated with age, gender, university, year level or site. However, undergraduate students
116 were significantly less likely to have seen at least 1 procedure, compared to postgraduate
117 students, with an odds ratio (OR) of 0.56 ($p=0.035$, 95% confidence interval (CI)=0.36-0.96).

118
119 <insert Figure 1>

120
121 Reported teaching and knowledge of IR was generally poor – only 16 students (7%) agreed
122 they had received adequate teaching (Figure 2) and 11 students (5%) agreed they had
123 adequate knowledge (Figure 3). IR teaching was significantly associated with year level
124 ($p<0.001$), with final year students most likely to report having received “adequate” IR
125 teaching (Table 2). Correspondingly, higher year level was also significantly associated with
126 higher self-rated knowledge in IR ($p=0.05$). When asked to compare their IR knowledge to
127 that of other areas of medicine, 93% claimed it was either worse (49%) or significantly worse
128 (44%).

129
130 <insert Figure 2, Figure 3, Table 2>

Objective tests of knowledge yielded variable results. Most students knew that endovascular thrombectomy (EVT) was the reference standard for the treatment of large vessel acute ischaemic stroke, and common indications for IR procedures, such as gastrointestinal (GI) bleeding and deep venous thrombosis (DVT), were well recognized (Figure 4, Table 3). Conversely, students were unaware of the full extent of IR's versatility, with only 6 respondents correctly identifying all of the given conditions where IR has a role to play in management.

<insert Table 3>

Awareness about the practice of IR was also variable. Only 14% of students knew the duties of IRs and only 49.8% knew that IR services were offered 24/7 in their teaching hospitals. However, 87.8% of students understood that most IR procedures can be performed without general anaesthesia (Figure 4). Regarding career pathways into IR, 65% of respondents knew that IR requires subspecialty fellowship training, especially students from University B ($p=0.017$). When presented with 4 specialties as potential pathways into a career in IR – DR, neurology, cardiology and vascular surgery – only 30% of respondents recognised that DR was the only feasible option to a career which allowed training in the full breadth of IR procedures.

<insert Figure 4>

In terms of interest in IR, 43% of students agreed or strongly agreed that they enjoyed learning IR, whilst a further 43% responded neutrally. Forty percent of students agreed or strongly agreed that they would opt for an elective in IR. Both these measures were associated with year level, as senior students were more likely to enjoy IR ($p=0.017$) and consider an elective in IR ($p=0.011$). Furthermore, 32% of students agreed or strongly agreed that they would consider a career in IR. This was significantly less likely amongst female respondents ($p=0.008$), with only 25% of females agreeing, as opposed to 59% of males ($OR=0.48$, $95\%CI=0.27-0.83$).

<insert Table 4>

Most students (64%) agreed that informal teaching, such as ward rounds and watching procedures, would be preferred over formal teaching, such as lectures and tutorials. This was significantly associated with postgraduate status ($p=0.016$) and University B ($p=0.036$). There is strong appreciation of IR as an important subject with 74% of students agreeing that IR is essential to improving future health care, especially students from university B ($p=0.008$) and postgraduate students ($p=0.043$). Furthermore, 59% of students agreed that IR should be mandatory within the medical school curriculum. This was strongly associated with being more senior ($p=0.001$) or from University B ($p=0.026$).

<insert Figure 5>

Discussion

This study shows that IR knowledge in Australian medical schools is relatively poor and mirrors trends reported in the international literature.[2-7] Our results show considerable demand from students to improve this level of knowledge. Demand can be inferred by: 74% of students agreeing that IR is essential for improving future healthcare; 59% of students believing IR should be compulsory within the curriculum; 40% of students opting for an elective in IR; and 32% of students considering a career in IR. Such motivation and interest from the students themselves provides a suitable substrate and worthy indication to increase the amount of IR teaching. This is supported by the self-determination theory, which suggests that intrinsic motivation enables more successful and enjoyable learning of IR.[8,9]

From a wider perspective, there is also an extrinsic demand for increasing IR knowledge amongst medical graduates. That is, to sustain rapid advancement of IR and enable wider access to 24/7 IR services, there must be a steady influx of medical students and junior doctors interested in becoming IRs.[2,3] Previous studies indicate that exposure and teaching of a certain specialty in medical school increases the likelihood of a student pursuing that career.[10,11] Moreover, irrespective of the eventual specialty of practice, all doctors should have an understanding of the role of IR such that they can integrate such procedures into the optimal management of patients and have the knowledge to refer appropriately. From diagnosis (e.g. biopsy, diagnostic angiography) to treatment (e.g. angioplasty, embolization and ablation of tumours) to palliation (e.g. vertebroplasty for pain), minimally invasive procedures are important in holistic longitudinal patient care and can ultimately confer a cost-effective improvement in quality-adjusted life-years (e.g. EVT for acute ischemic stroke,

sclerotherapy for vascular malformations).[12,13] Having ‘core’ IR knowledge to deliver such care may be potentiated by the introduction of IR in medical school.[1,14]

Having established that there is an intrinsic and extrinsic demand for improved IR knowledge amongst medical students, it is pertinent to next consider whether it is effective to teach IR at a medical school level. Our results show that knowledge and interest in IR are highly amenable to increased exposure and teaching in medical school. Senior students were more likely to have received adequate teaching in IR ($p<0.001$), and concomitantly, believe their level of knowledge in IR is adequate ($p=0.05$). Parallel to this, senior students were also more likely to enjoy learning IR ($p=0.017$), opt for an IR elective ($p=0.011$) and believe IR teaching should be mandatory ($p=0.001$). This suggests that students respond positively to learning about and being exposed to IR. Similarly, numerous pre-existing studies indicate that IR teaching in university is indeed effective in raising awareness, interest and knowledge in IR.[3,15,16]

Following logically, we must also determine what extent of IR-related competency graduating doctors should be expected to have. The Cardiovascular and Interventional Radiological Society of Europe (CIRSE) has published a medical school IR curriculum, stating that graduates should, in summary, understand the: basis of IR, role of image-guidance in interventional procedures, guidelines on radiation protection, and legislation relating to IR.[1] The validity and necessity of this curriculum is attested to by medical schools across numerous countries already adopting the curriculum, including Royal College of Surgeons in Ireland School of Medicine.[2] Furthermore, the delivery of this curriculum is supported by the increasing availability of undergraduate-dedicated IR textbooks, including recent publications; “Interventional Radiology for Medical Students” and “Demystifying Interventional Radiology”.[17, 18]

While it may be feasible to incorporate the above goals into university curricula, there remains no consensus about which form of teaching is most effective.[1] Our study revealed that most students (64%) preferred informal practical teaching over formal classes, however, existing evidence focuses on formal teaching. For instance, studied methods of teaching IR to medical students include a 1-hour lecture, 10-hour lecture program, and 1-day symposium, each of which have achieved significant improvements in IR knowledge and/or interest.[3,15,16] Newer, well-substantiated forms of teaching to explore include “peer-led

teaching”, in which residents teach medical students, and “flipped classroom”, in which students lead their own foundational learning outside class and dedicate class time for further consolidation.[19,20] Both of these methods have proven comparably effective to traditional tutorials or lectures, and in particular, peer-led teaching has successfully been trialled for DR.[21,22] However, IR, being more practical, may be more suited to clinically-based teaching. In this regard, IR electives are now increasingly offered to medical students worldwide, and have proven significantly effective in improving awareness and career interest in IR.[23]

The present study has several limitations. As a cross-sectional study, the results may not reflect a true temporal relationship and we cannot determine whether differences in self-reported knowledge are due to increased teaching, clinical exposure, or self-confidence related to being more senior. Another limitation of any survey-based study is response bias, and in particular, our study has a relatively low response rate of 17%. From this information, it is possible that the respondents were more likely to have participated since they were more interested or knowledgeable in IR. Reasons for the low response rate include the voluntary nature of the survey, generally poor awareness about IR, impersonal means of survey distribution, and distribution by medical students rather than authoritative personnel, such as university staff. This is an expected issue in medical student surveys, with similar IR-related studies also receiving responses from only a minority of their target population.[4,5,7,10,16] For example, in a major US study electronically surveying IR exposure in all medical schools nationwide, only 729 responses were returned.[10] Even with in-person surveys amongst smaller groups of medical students who registered for optional IR-dedicated events, published post-event response rates range from 21/119 (17.6%) to 157/309 (50.8%).[3,16]

Whilst a large proportion of respondents were senior students, this is not necessarily a limitation since IR content may not be relevant in early medical school. That is, the preclinical curriculum is already heavily condensed with the need to introduce core medical sciences, clinical skills, ethics and law before clinical placements, such that it may not be contextually appropriate nor logistically feasible to teach IR within this timeframe.

Conclusion

This study highlights a clear disparity between the pivotal role of IR in current clinical practice and the relatively scarce amount of IR exposure, teaching and knowledge that medical students have in Australia. Encouragingly, however, students demonstrate strong appreciation and interest in IR, which provides a receptive population that may thrive if given more opportunities to learn about IR. Therefore, improvements to IR teaching within the medical school curriculum stand to not only benefit the wider public and the specialty of IR, but also the medical students themselves. If curriculum changes are to be implemented, this requires further studies evaluating the ideal method and amount of IR teaching, as well as cooperative input from medical school boards, curriculum advisors and IRs.

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CONFLICTS OF INTEREST

All authors have no conflict of interest to report.

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TABLES

Table 1: Characteristics of respondents.

		University A	University B	Total
Year level	2 nd year	7	20	27
	3 rd year	27	35	62
	4 th year	43	67	110
	5 th year	38	0	38
Gender	Male	42	58	100
	Female	73	64	137
	Other	0	0	0
Level of qualification	Undergraduate	93	0	93
	Postgraduate	22	122	144
Site of clinical placements	Urban	94	107	201
	Rural	21	15	36
Age	Mean	23.0	24.8	23.9

Table 2. Factors associated with belief in adequate teaching of IR.

Parameter	Adequate teaching	Inadequate teaching	P-value
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Mean age (years)	25 ± 4.95	23.8 ± 3.68	0.237
Females	11/16 (68.8) ^a	126/221 (57.0)	0.359
Males	5/16 (31.2)	95/126 (43.0)	
University A	10/16 (62.5)	105/221 (47.5)	0.247
University B	6/16 (37.5)	116/221 (52.5)	
Undergraduate	9/16 (56.25)	84/221 (38.0)	0.149
Postgraduate	7/16 (43.75)	137/221 (62.0)	
Year 2	4/16 (25.0)	23/221 (10.4)	<0.001
Year 3	0/16 (0)	62/221 (28.1)	
Year 4	4/16 (25.0)	106/221 (48.0)	
Year 5	8/16 (50.0)	30/221 (13.6)	

^a n/N (%) n=sample size. N=population size.

Table 3. Knowledge about applications of IR.

Application of IR	Students aware of the application
GI bleeding	81%
DVT	73%
Liver cancer	65%
Cholecystitis	50%
Bone tumours	42%
Colon cancer	38%
Prostatism	37%
Obesity	13%
Osteoporosis	9%

Table 4. Factors associated with enjoyment of learning IR.

Parameter	Enjoys learning IR	Does not enjoy learning IR	P-value
Age (years)	24.0 ± 2.7	23.8 ± 4.4	0.726
Females	55/101	82/136	0.368
Males	46/101	54/136	
University A	51/101	64/136	0.601
University B	50/101	72/136	

Undergraduate	41/101	52/136	0.713
Postgraduate	60/101	84/136	
Year 2	6/101	21/136	0.017
Year 3	22/101	40/136	
Year 4	51/101	59/136	
Year 5	22/101	16/136	
Rural	21/101	16/136	0.082
Urban	80/101	120/136	

352

353

354 FIGURES

355 Please see figures 1-5 attached as separate files.

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Figure 1: Number of IR procedures witnessed.

Figure 2: Reported adequacy of IR teaching.

Figure 3: Reported adequacy of knowledge in IR.

Response to *"I have adequate knowledge of IR"*

Figure 4: Objective Test of IR Knowledge.

Figure 5: Perceived importance of IR.

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Response to "IR is essential to improving the efficacy, safety and cost-effectiveness of healthcare in the future"

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Author/s:

Foo, M;Maingard, J;Phan, K;Lim, R;Chandra, RV;Lee, M;Asadi, H;Kok, HK;Brooks, M

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