

Myocardial perfusion SPECT 2015 in Germany

Results of the 7th survey

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Keywords

Myocardial perfusion scintigraphy, utilisation review, utilisation statistics, numerical data

Summary

Aim: The working group Cardiovascular Nuclear Medicine of the German Society of Nuclear Medicine presents the results of the 7th survey of myocardial perfusion SPECT (MPS) of the reporting year 2015. **Method:** 268 questionnaires (173 practices [PR], 67 hospitals [HO], 28 university hospitals [UH]) were evaluated. Results of the last survey from 2012 are set in squared brackets. **Results:** MPS of 121 939 [105 941] patients were reported. 98 % [95 %] of all MPS were performed with Tc-99m radiopharmaceuticals and 2 % [5 %] with Tl-201. 78 % [79 %] of all patients were studied in PR, 14 % [15 %] in HO, and 8 % [6 %] in UH. A pharmacological stress test was performed in 43 % [39 %] (22 % [24 %] adenosine, 20 % [9 %] regadenoson, 1 % [6 %] dipyridamole or dobutamine). Attenuation correction was applied in 25 % [2009: 10 %] of MPS. Gated SPECT was performed in 78 % [70 %] of all rest MPS, in 80 % [73 %] of all stress and in 76 % [67 %] of all stress and rest MPS. 53 % [33 %] of all nuclear medicine departments performed MPS

scoring by default, whereas 24 % [41 %] did not apply any quantification. 31 % [26 %] of all departments noticed an increase in their counted MPS and 29 % [29 %] no changes. Data from 89 departments which participated in all surveys showed an increase in MPS count of 11.1 % (PR: 12.2 %, HO: 4.8 %, UH: 18.4 %). 70 % [60 %] of the MPS were requested by ambulatory care cardiologists. **Conclusion:** The 2015 MPS survey reveals a high-grade adherence of routine MPS practice to current guidelines. The positive trend in MPS performance and number of MPS already observed in 2012 continues. Educational training remains necessary in the field of SPECT scoring.

Schlüsselwörter

Myokardszintigrafie, Leistungsbericht, Leistungsstatistik, Zahlenangaben

Zusammenfassung

Ziel: Die Arbeitsgemeinschaft „Kardiovaskuläre Nuklearmedizin“ der Deutschen Gesellschaft für Nuklearmedizin berichtet über die 7. Erhebung zur Myokard-Perfusions-SPECT (MPS) in Deutschland im Jahr 2015. **Methoden:** Es wurden 268 Fragebögen (173 Praxen

[PR], 67 Krankenhäuser [KH], 28 Universitätskliniken [UK]) ausgewertet. Die Daten der letzten Umfrage stehen in eckigen Klammern. **Ergebnisse:** Mit der Umfrage wurden MPS von 121 939 [105 941] Patienten erfasst. 98 % [95 %] der MPS wurden mit Tc-99m Perfusionradiopharmaka durchgeführt, 2 % [5 %] mit Tl-201. 78 % [79 %] der MPS wurden in PR, 14 % [15 %] in KH und 8 % [6 %] in UK erbracht. Die Belastung erfolgte zu 43 % [39 %] pharmakologisch (22 % [24 %] mit Adenosin, 20 % [9 %] mit Regadenoson, 1 % [6 %] Dipyridamol oder Dobutamin). Eine Schwächungskorrektur wurde in 25 % [2009: 10 %] der MPS durchgeführt. 78 % [70 %] der Ruhe-, 80 % [73 %] der Belastungs- sowie 76 % [67 %] der Ruhe- und der Belastungsaufnahmen wurden als „gated SPECT“ aufgenommen. 53 % [33 %] der Teilnehmer verwendeten standardmäßig Perfusionscores bei der Befundung, 24 % [41 %] erhoben den Befund ohne Scores. 31 % [26 %] der Teilnehmer verzeichneten eine Zunahme ihrer Untersuchungszahlen, 29 % [29 %] keine Änderungen. 89 Einrichtungen nahmen an allen 7 Erhebungen teil. Bei diesen ergab sich eine Zunahme der Untersuchungszahlen um 11,1 % (PP: 12,2 %, KH: 4,8 %, UK: 18,4 %). Die größte Zuweisergruppe waren Kardiologen (70 % [60 %] der MPS). **Schlussfolgerung:** Anhand der aktuellen Erhebung zur MPS in Deutschland zeigt sich eine gute Leitlinienkonformität bei der Untersuchung. Der sich schon 2012 abzeichnende positive Trend bei den MPS-Qualitätsparametern und den Untersuchungszahlen hält an. Nachbesserungsbedarf besteht weiterhin bei der quantitativen Auswertung mit Perfusionscores.

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Myokard-Perfusions-Szintigraphie 2015 in Deutschland

Ergebnisse der 7. Erhebung Nuklearmedizin 2017; 56: 31–38
<https://doi.org/10.3413/Nukmed-0858-16-10>
received: October 26, 2016
accepted in revised form: November 17, 2016
epub ahead of print: December 2, 2016

Since 2006 the working group Cardiovascular Nuclear Medicine of the German Society of Nuclear Medicine performs regular surveys to obtain information on technique, utilisation and development of myocardial perfusion SPECT (MPS). The last survey 3 years ago delivered data for the year 2012. With the current 2015 project, data from a total of 7 surveys are available (7–12).

Comparable European data have been collected by the European Council on Nuclear Cardiology (ECNC), a joint organisation of the EANM and the ESC. The last two reports cover the years 2005 and 2007 (16, 17). A comprehensive European survey of 2014 nuclear medicine practice and studies was initiated by the EANM in spring 2016 and is currently under evaluation.

Promoted by the IAEA, a worldwide study of nuclear cardiology practice and associated radiation doses was realised in 2013. A European subanalysis of 2381 patients undergoing nuclear cardiac imaging in 102 laboratories in 27 countries was pub-

lished in 2016 (13). However, only three German centres participated in this survey.

Methods

The updated database of the former surveys was used to address departments and physicians practicing nuclear medicine. A one-page questionnaire with a cover letter was sent by fax at the end of January 2016. In case of no response a first reminder was forwarded 4 weeks later and a second 4–6 weeks later. The survey was closed at the end of May 2016. The questionnaire comprised the following items:

- number of MPS patients,
- number of stress and rest MPS,
- type of stress,
- radiopharmaceuticals,
- protocols,
- gated SPECT,
- attenuation correction,
- semiquantitative scoring,
- type of camera,

- referrals, and
- potential causes of changes in referral.

In order to verify the representativeness of the survey and to reliably estimate the total or „true“ MPS numbers, the survey results were related to the data of the National Association of Statutory Health Insurance Physicians (NASHIP) (Kassenärztliche Bundesvereinigung [KBV]) (14). The NASHIP data represent the official number of ambulatory statutory health insurance patients.

The MPS counts were related to the invasive coronary angiography counts of the German report on cardiology (4). At the time of writing the manuscript, the most recent data of the cardiology report referred to the year 2014. Therefore, the 2014 data were related to the 2015 MPS data.

Results

Practices are abbreviated as PR, hospitals as HO and university hospitals as UH. The

federal state	no. of responding departments ^a	MPS (patients per 100 000 ^a)	CA ^b (per 100 000 ^c)	CA ^b /MPS (estimated ^c)
Baden-Württemberg	29 [38]	71 [54]	993 [939]	8.8 [6.9]
Bayern	42 [41]	152 [121]	1014 [999]	4.2 [4.5]
Berlin	10 [13]	91 [255]	1165 [1082]	8.0 [3.0]
Brandenburg	7 [8]	193 [202]	1192 [990]	3.9 [2.9]
Bremen	2 [3]	186 [246]	2865 [1428]	9.6 [3.9]
Hamburg	13 [10]	623 [462]	1643 [1719]	1.6 [3.3]
Hessen	16 [12]	195 [66]	1064 [1069]	3.4 [5.1]
Mecklenburg-Vorpommern	7 [6]	196 [186]	1266 [1183]	4.0 [3.5]
Niedersachsen	29 [28]	130 [114]	922 [966]	4.4 [5.2]
Nordrhein-Westfalen	64 [69]	173 [155]	1258 [1148]	4.5 [3.9]
Rheinland-Pfalz	17 [17]	92 [107]	881 [865]	6.0 [5.9]
Saarland	4 [3]	31 [49]	1186 [1192]	23.6 [19.7]
Sachsen	7 [8]	168 [137]	1111 [1009]	4.1 [3.9]
Sachsen-Anhalt	7 [6]	228 [206]	1048 [980]	2.9 [2.4]
Schleswig-Holstein	8 [8]	72 [40]	1155 [1052]	10.0 [10.2]
Thüringen	6 [8]	61 [69]	1234 [966]	12.7 [6.8]
Germany	268 [278]	150 [129]	1117 [1048]	4.6 [4.4]

^aData in square brackets refer to 2012.

^bCoronary angiography counts refer to 2014. At the time of writing the manuscript, 2015 data were not yet available.

^cData in square brackets refer to 2009 as corresponding 2012 data were not available. As explained in the results section, about 60 % of all MPS were recorded by the survey. Therefore, the MPS counts were multiplied by 1.6 to more precisely obtain the “real” regional and total angiography to MPS ratios.

Tab. 1
Myocardial perfusion SPECT (MPS) and invasive coronary angiographies (CA) per 100 000 inhabitants by federal states in 2015.

previous survey data (reporting year 2012) are placed for comparison in square brackets. Medical supply centers (Medizinische Untersuchungszentren) were categorised as practices because they are part of ambulatory medical care.

Questionnaires were sent to 765 nuclear medicine and radiology departments with potential activities in nuclear medicine. A feedback was given in 328 [361] cases. Of these, 60 [83] reported that no MPS were performed in 2015. Thus, questionnaires from 268 [278] departments were available:

- PR: 173 [177] – of these 23 [21] medical supply centers,
- HO: 67 [78], and
- UH: 28 [23].

65 [69] departments not participating in the last survey transmitted data this time, whereas 70 [76] departments once more failed to deliver data. A total of 89 departments (50 PR, 24 HO, 14 UH) contributed questionnaires to all 7 surveys.

MPS numbers and regional distribution

MPS data from a total of 121939 [105941] patients with 120302 [103893] stress and 97229 [88883] rest MPS were recorded. In case of TI-201 use, the stress and corresponding rest study were registered as one single stress and one single rest study.

78% [79%] of all patients were studied in PR, 14% [15%] in HO and 8% [6%] in UH. On average, 455 [381] MPS patients were examined in each department (PR 535 [508], HO 255 [200], UH 343 [270]).

The median MPS count was 243.5 [179], in PR 291 [216], in HO 142 [97] and in UH 258.5 [165.5]. In all kinds of departments the median was clearly below the mean value, indicating a greater proportion of departments with low MPS numbers. The MPS patient count ranged from 2–4577 [2–4082] in PR, from 1–2200 [2–1950] in HO, and from 11–1149 [11–1150] in UH.

The number of patients by federal state is listed in ►Tab. 1 and depicted in ►Fig. 1. Regional coronary angiography counts and the ratios of angiography to MPS are also listed in ►Tab. 1.

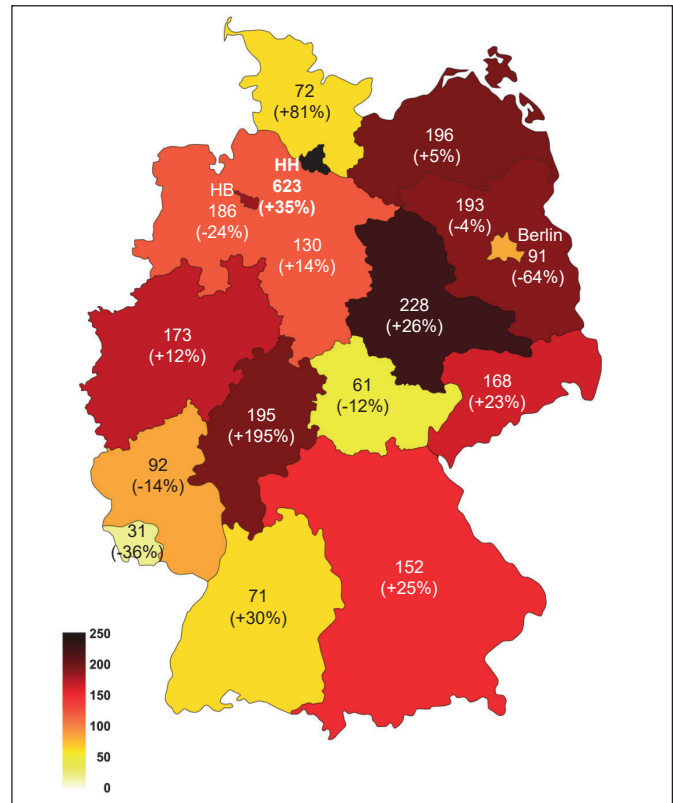


Fig. 1 Myocardial perfusion SPECT per 100,000 inhabitants by federal states in 2015. In brackets: changes to 2012. Scaling as in the previous publications.

NASHIP count

The data of the NASHIP reported a frequency of 144681 [132813] for the fee schedule item 17330 (stress MPS), and of

119831 [112237] for the item 17331 (rest MPS) for the year 2015. The time course of the fee schedule items 17330 and 17331 from 2006–2015 is shown in ►Fig. 2.

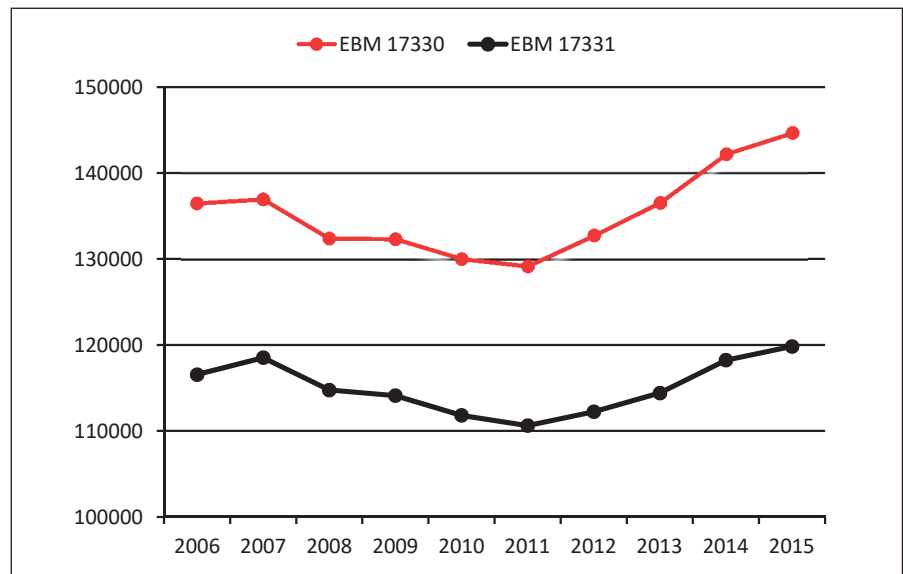


Fig. 2 MPS counts of the National Association of Statutory Health Insurance Physicians (Kassenärztliche Bundesvereinigung) for the fee scale items EBM 17330 (stress) and EBM 17331 (rest) from 2006–2015.

Tab. 2 Percentages of study protocols in 2015 by institution. The figures refer to the total number of myocardial perfusion SPECT in the respective type of institution. In square brackets: figures from the 2012 survey.

protocol	total (%)	practices (%)	hospitals (%)	university hospitals (%)
Tc-99m MIBI/tetrofosmin stress and rest (1-day protocol)	27 [26]	22 [22]	36 [37]	61 [46]
Tc-99m MIBI/tetrofosmin stress and rest (2-day protocol)	50 [51]	53 [55]	36 [37]	20 [26]
Tl-201 stress-redistribution	2 [5]	2 [6]	1 [1]	0 [3]
Tc-99m MIBI/tetrofosmin stress only	20 [16]	22 [16]	16 [14]	16 [19]
Tc-99m MIBI/tetrofosmin rest only	1 [2]	1 [1]	2 [4]	3 [6]

MIBI: methoxyisobutylisonitrile

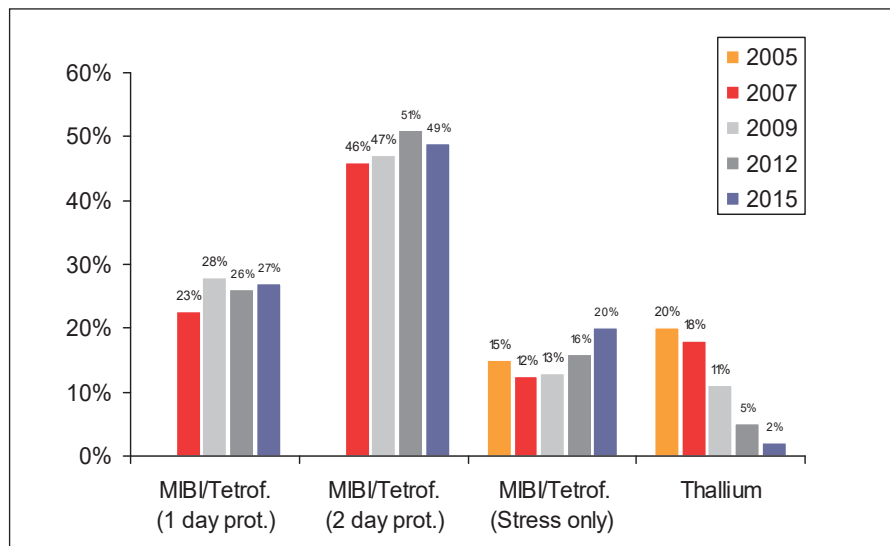


Fig. 3 Utilisation of protocols for myocardial perfusion SPECT from 2005–2015.

Tab. 3 Type of stress test in 2015 by institution. In square brackets: figures from the 2012 survey.

stress test	total (%)	practice (%)	hospitals (%)	university hospitals (%)
ergometry	57 [61]	63 [65]	41 [44]	34 [39]
adenosine	22 [24]	19 [20]	34 [40]	34 [43]
regadenoson	20 [9]	17 [8]	22 [8]	31 [14]
dipyridamole	1 [5]	1 [6]	2 [7]	0* [2]
dobutamine	0* [1]	0* [1]	1 [1]	1 [2]

*numbers <0.5 and thus rounded to 0

Based on a 10–15% proportion of privately insured patients and the referral structure, about 60% of all MPS were recorded through the survey.

Changes in MPS counts from 2005–2015 and 2009–2015

89 departments (50 PR, 24 HO, 15 UH) participated in all seven surveys from 2005–2015. In this group the total MPS count increased by 11.1% (PP 12.2%, HO 4.8%, UH 18.4%).

163 departments (97 PP, 46 HO, 20 UH) participated in the three surveys from 2009 to 2015. In this group, the MPS count increased by 23.6% (PP 24.6%, HO –21.8%, UH –3.9%).

Protocols

The utilisation frequency of the different MPS study protocols is given in ► Tab. 2 and ► Fig. 3. In 2015, about 98% [95%] of all MPS were performed with Tc-99m radiopharmaceuticals. On average, 2-day protocols were used twice as often as 1-day protocols (50 vs. 27%, [51 vs. 26%]). However, HO and UH had a higher 1-day protocol proportion, most likely due to a higher time pressure in inpatient care.

Stress-only protocols experienced a mild increase (20% [16%]) whereas rest-only protocols were used very rarely (1% [2%]).

The number of Tl-201 studies further decreased to 2% [5%]. 17 [31] institutions applied Tl-201, and only 2 [4] of them used exclusively Tl-201 for MPS imaging.

Stress tests

► Tab. 3 lists and ► Fig. 4 shows the utilisation of the different forms of stress for MPS. Exercise stress was most common, but its share further declined (57% [61%]). Adenosine represented the most common pharmacological stress agent. However, the proportion mildly diminished (22% [24%]) for the first time. In Germany, regadenoson was licensed in Autumn 2011. Its proportion reached 20% [9%] in 2015.

Dipyridamole diminished to 1% [5%]. Likewise, dobutamine was used to a very low extent <1% [1%].

Camera systems

For MPS imaging, 4% of the departments used a one-head camera, 74% a multi-head camera, 13% a SPECT-CT system, 4% a dedicated heart camera, and 4% more than one system in MPS imaging. 19% of all patients (i.e. 23 110 patients) were investigated with a dedicated heart camera.

Attenuation correction

Attenuation correction features were last requested in 2009. Thus, the data in squared brackets refer to that year. In 2015, attenuation correction was performed in 25% [10%] of all MPS (18% PR, 43% HO, 56% UH). 27 [32] departments applied supine/prone imaging for attenuation correction, 13 [17] used transmission sources and 28 [12] CT-based systems. 3 [3] departments had more than one system available.

Gated SPECT and segmental scoring

Data are given in ►Tab. 4 and depicted in ►Fig. 5. Gated SPECT as the functional adjunct to myocardial perfusion SPECT showed a further increase of about 7%. In 2015, 80% [73%] of all stress, 78% [70%] of all rest and 76% [67%] of all stress and rest MPS were realised with this technique. The highest proportion was found in UH, followed by HO. The percentages of departments performing a regular, an intermediate, or no quantification with scores are listed in ►Tab. 5. In 2015, 53% [36%] of all departments performed MPS scoring by default. Correspondingly, the amount of departments without scoring decreased to 24 [41]. The intermediate fraction remained constant (23% [23%]).

MPS referrer

►Tab. 6 and ►Fig. 6 show the referrer structure to MPS. Ambulatory care cardiologists continued to represent the major referral group and further increased their proportion (70% [60%]). Primary care physicians and others showed mild increases. The amount of inpatients remained low at 11% [13%].

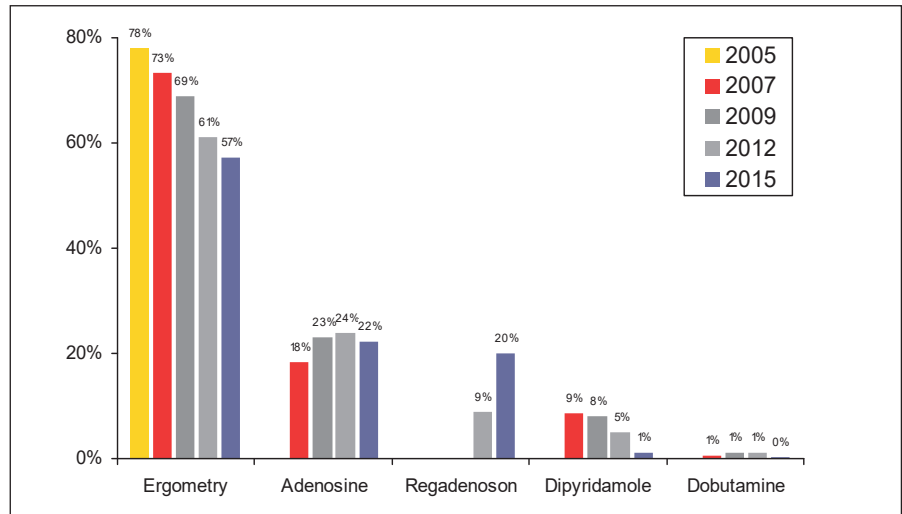


Fig. 4 Type of stress for myocardial perfusion SPECT from 2005–2015.

Tab. 4 Myocardial perfusion SPECT performed as gated SPECT in 2015 by institution. In square brackets: figures from the 2012 survey.

	total (%)	practice (%)	hospitals (%)	university hospitals (%)
stress study as gated SPECT	80 [73]	77 [70]	93 [85]	92 [76]
rest study as gated SPECT	78 [70]	75 [68]	85 [81]	95 [73]
stress and rest study as gated SPECT	76 [67]	73 [63]	84 [83]	92 [77]

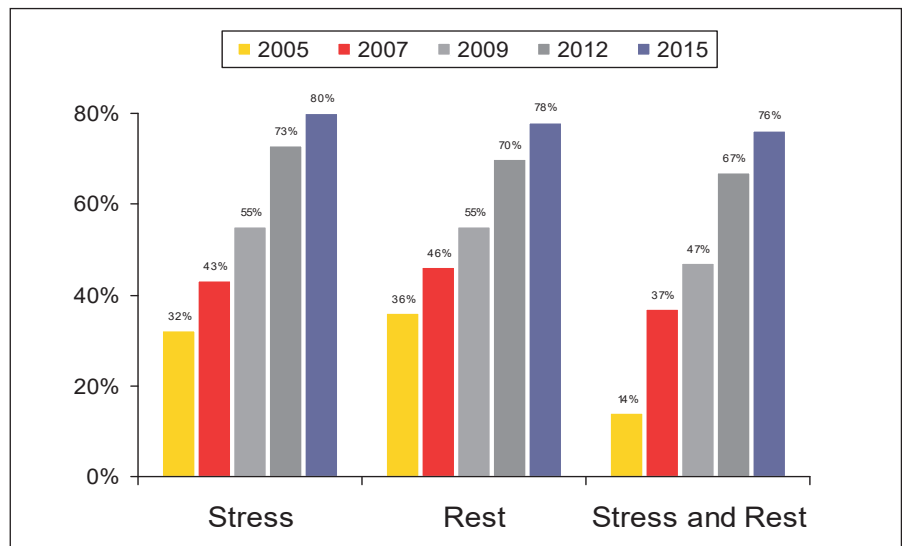


Fig. 5 Use of gated SPECT in myocardial perfusion SPECT from 2005–2015.

Tab. 5 Utilisation of perfusion scores in myocardial perfusion SPECT in 2015 by institution. In square brackets: figures from the 2012 survey.

frequency	total (%)	practice (%)	hospitals (%)	university hospitals (%)
regular	53 [36]	46 [29]	52 [41]	46 [44]
intermediate	23 [23]	28 [33]	23 [18]	25 [17]
never	24 [41]	26 [38]	25 [41]	29 [39]

Tab. 6 Referrals to myocardial perfusion SPECT in 2015. The figures refer to the total number of patients in the respective type of institution. In square brackets: figures from the 2012 survey.

referrer	total (%)	practice (%)	hospitals (%)	university hospitals (%)
primary care physician	13 [10]	14 [11]	13 [4]	15 [8]
ambulatory care physician*	– [14]	– [15]	– [11]	– [13]
ambulatory care cardiologist	70 [60]	77 [67]	46 [35]	45 [32]
others	6 [3]	6 [3]	4 [4]	7 [2]
hospital	11 [13]	3 [4]	37 [46]	33 [45]

*not asked in the 2015 survey

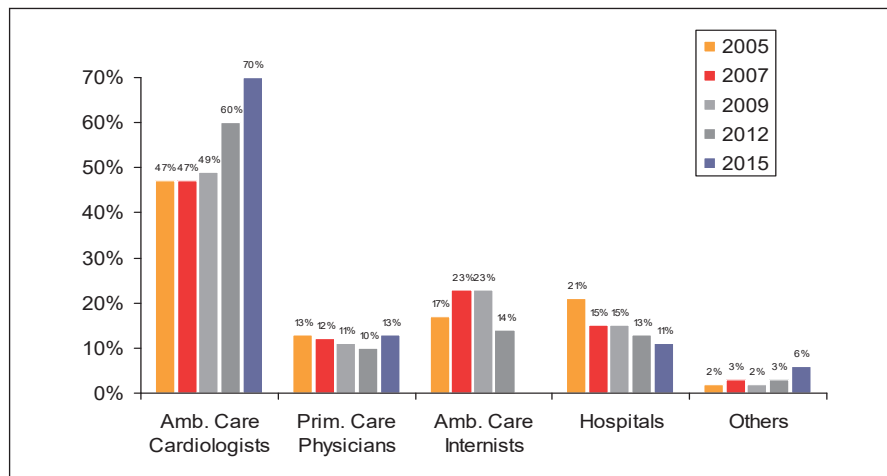


Fig. 6 Referrer structure to MPS from 2005–2015.

Tab. 7 Changes in referral to myocardial perfusion SPECT from 2012 to 2015. The percentages refer to the total number in the respective column. In square brackets: figures from the 2012 survey.

	total (%)	practice (%)	hospitals (%)	university hospitals (%)
increase	31 [26]	28 [28]	30 [17]	36 [35]
no change	29 [29]	36 [27]	31 [31]	25 [26]
decrease	16 [21]	14 [23]	13 [27]	25 [17]
unknown	24 [24]	22 [22]	26 [25]	14 [22]

Changes in MPS referral from 2012–2015

Data from 251 departments were available. 60% [55%] reported an increase or no changes in their MPS counts. The detailed data are compiled in ►Tab. 7.

16% [21%] observed a decrease in their MPS counts. This was related to stress echocardiography in 0% [12%], to CT in 8% [3%], to MRI in 13% [22%], to invasive angiography in 23% [15%], and to more than one modality in 25% [32%]. The rest provided no reasons for decline.

Discussion

The paper presents the results of the 7th German MPS survey. Herewith survey data from the reporting years 2005–2009, 2012, and 2015 are available (7–12).

A total of 268 departments contributed data to the survey. The number reached nearly the same level as in 2012. To estimate the representativeness of the survey, the data were related to the official counts of the NASHIP. The analysis revealed that about 60% of all MPS were included in this survey. Thus, the results can be regarded as representative. The estimated 60% value is slightly above the 50–55% level of the past surveys (11, 12).

The key statements of MPS imaging in its clinical and technical context 2015 in Germany can be summarised as follows:

1. The positive trend observed for the first time in 2012 is ongoing. This conclusion is based on data from 89 departments which participated in all surveys, on data from 163 departments which participated in the 2009, 2012, and 2015 survey, and the individual appraisal of 60% of departments which observed no change or an increase in their MPS counts. Additionally, the official NASHIP data (►Fig. 2) confirm the trend.
2. After a mild decrease in invasive coronary angiographies in 2012, the procedure counts increased in 2013 and 2014 (2–4). The estimated angiography to MPS (or non-invasive imaging) ratio remained constant. The numbers of alternative procedures like stress echocardiography, CTA or cardiac MRI are

unknown. Currently there is only limited reimbursement of these techniques in Germany. Thus, their counts are believed to be clearly lower than the MPS numbers and do not basically alter the angiography to non-invasive imaging ratio. In summary, non-invasive diagnosis before invasive angiography continues to be the exception rather than the rule, despite guidelines favoring non-invasive imaging in chronic CAD (1, 15).

3. As mentioned above, 60 % of the departments reported no change or an increase in their MPS counts, but 16 % a decreasing trend. In these cases invasive coronary angiography represented the main single cause. This observation confirms the conclusion mentioned above. MRI, which was regarded as the main MPS competitor in the past survey, is now in 2nd place, followed by CT. However, in the vast majority of cases a clear single competitor was not identifiable.
4. Considerable regional differences in the use of MPS and invasive angiography remain. Substantial regional changes could not be observed compared to the past survey.
5. Several indicators suggest an ongoing improvement in MPS quality:
 - The average MPS count increased in all type of departments and was on average nearly 20 % higher than in 2012. This is a favourable development as expertise parallels with the numbers of studies performed.
 - Camera technology for MPS improved. Only 4 % of the departments still acquired MPS with single-head cameras. The others used multiple-head cameras or dedicated systems, mostly CZT cameras. Those 4 % represent high-end users, who performed nearly one quarter of all MPS.
 - Attenuation correction has been shown to improve specificity of MPS. Its proportion ascended from 10 % in 2009 to 25 % in 2015 and certainly related to increasing numbers of SPECT-CT systems.
 - Gated SPECT acquisitions continued to increase and reached the 80 % level. Starting in 2005 with only

about 30 % of gated SPECT acquisitions, this is an encouraging result (►Fig. 5). Nevertheless, its proportion should further increase.

6. Several issues indicate a decline in procedural radiation dose of MPS:
 - 98 % of all MPS were performed with Tc-99m radiopharmaceuticals (sestamibi and tetrofosmin).
 - 2-day protocols requiring smaller amounts of radioactivity than 1-day protocols were preferred in case of stress and rest imaging.
 - The percentage of stress-only protocols, which have the lowest radiation dose, increased from 16 % in 2012 to 20 % in 2015.
 - The Tl-201 use declined from 5 % in 2012 to 2 % in 2015. Despite a new evaluation of effective Tl-201 dose with a reduction from 0.22 to 0.14 mSv/MBq, this agent is associated with the highest radiation dose in MPS imaging (5, 6).
 - Nearly 20 % of all MPS were performed with dedicated cardiac cameras which enable the use of time- and dose-saving protocols. Although the amount of radioactivity used in MPS imaging with such systems was not requested, it is assumed that they contribute to a reduction in average radiation dose.
7. Segmental scoring of perfusion defects experienced a further acceptance. However, only slightly more than half of all departments performed a regular scoring, so that this item remains underused. Guidelines clearly recommend scoring of myocardial perfusion SPECT (12, 18). Thus, it remains a target of future training and education in nuclear cardiology.
8. Exercise stress was the preferred form of MPS stress. Its proportion continued to decrease. Accordingly, pharmacological stress testing increased, mainly due to the strong rise of regadenoson, which is available in Germany since September 2011. Dipyridamole, which is not licenced in Germany, dropped to 1%. Dobutamine, as the 2nd choice pharmacological stress agent, is only applied in very particular settings, indicating that

nearly all patients can be managed with exercise or vasodilator stress testing.

9. Cardiologists represented the leading referrer group with a proportion of 70 %. The contribution of hospitals was further decreasing, indicating that CAD diagnosis is transferred out of hospitals or directly shifted to invasive angiography for reasons of DRG management.

Conclusion

The 2015 MPS survey reveals a high-grade adherence of routine MPS practice to current guidelines. The positive trend in MPS performance and number of MPS already observed in 2012 continues. Educational training remains necessary in the field of SPECT scoring.

Acknowledgements

The authors wish to thank all participating departments for their time and effort contributing to the surveys. They also thank the NASHIP for the delivery of MPS figures and Mrs. Sarah Kirkby and Mrs. Carola Thamar for revising the manuscript.

Conflict of interest

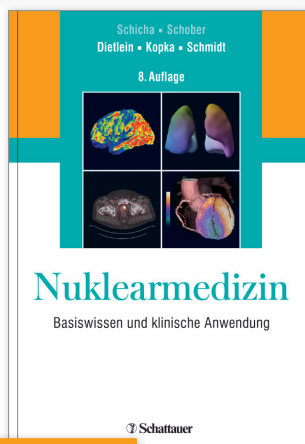
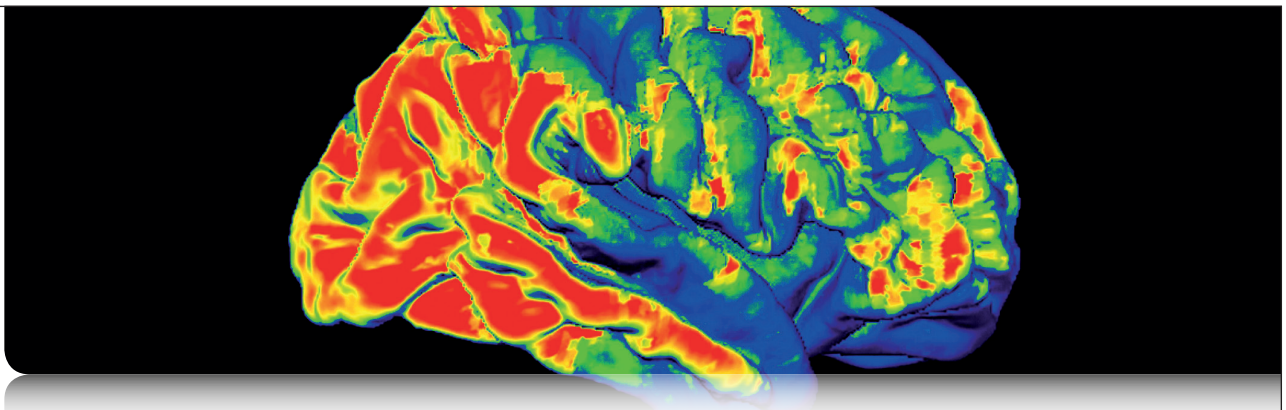
The authors declare that there is no conflict of interest.

References

1. Bundesärztekammer, Arbeitsgemeinschaft der wissenschaftlichen medizinischen Fachgesellschaften, Kassenärztliche Bundesvereinigung, Nationale Versorgungs-Leitlinie Chronische KHK (Langfassung), 4. Auflage, 2016. AWMF-Register-Nr.: nvl-004. <http://www.leitlinien.de/mdb/downloads/nvl/khk/khk-4aufl-vers1-lang.pdf>.
2. Deutsche Herzstiftung e.V. Deutscher Herzbericht 2013.
3. Deutsche Herzstiftung e.V. Deutscher Herzbericht 2014.
4. Deutsche Herzstiftung e.V. Deutscher Herzbericht 2015.
5. ICRP. Radiological protection in biomedical research. Ann ICRP 1992; 22(3).
6. ICRP. Radiation Dose to Patients from Radiopharmaceuticals: A Compendium of Current Information Related to Frequently Used Substances. Ann ICRP 2015; 44(2S).

7. Lindner O, Burchert W, Bengel FM et al. Myocardial perfusion scintigraphy in Germany. Results of the 2005 query and current status. *Nuklearmedizin* 2007; 46: 49–55.
8. Lindner O, Burchert W, Bengel FM et al. Myocardial perfusion scintigraphy 2006 in Germany. Results of the query and current status. *Nuklearmedizin* 2008; 47: 139–145.
9. Lindner O, Burchert W, Bengel FM et al. Myocardial perfusion scintigraphy 2007 in Germany – Results of the query and current status. *Nuklearmedizin* 2009; 48: 131–137.
10. Lindner O, Burchert W, Bengel FM et al. Myocardial perfusion scintigraphy 2008 in Germany – results of the fourth query. *Nuklearmedizin* 2010; 49: 65–72.
11. Lindner O, Burchert W, Bengel FM et al. Myocardial perfusion scintigraphy in Germany in 2009: utilization and state of the practice. *Eur J Nucl Med Mol Imaging* 2011; 38: 1485–1492.
12. Lindner O, Burchert W, Schaeffers M, Schaefer W. Myocardial perfusion scintigraphy 2012 in Germany. Results of the 6th Query. *Nuklearmedizin* 2014; 53: 13–18.
13. Lindner O, Pascual TN, Mercuri M et al. Nuclear cardiology practice and associated radiation doses in Europe: results of the IAEA Nuclear Cardiology Protocols Study (INCAPS) for the 27 European countries. *Eur J Nucl Med Mol Imaging* 2016; 43: 718–728.
14. Mitteilung der KBV (Communication of the NASHIP). KBV Abrechnungsstatistik (Statistics of the NASHIP) 2016.
15. Montalescot G, Sechtem U, Achenbach S et al. 2013 ESC guidelines on the management of stable coronary artery disease: the Task Force on the management of stable coronary artery disease of the European Society of Cardiology. *Eur Heart J* 2013; 34: 2949–3003.
16. Reyes E, Wiener S, Underwood SR. Myocardial perfusion scintigraphy in Europe 2007: a survey of the European Council of Nuclear Cardiology. *Eur J Nucl Med Mol Imaging* 2012; 39: 160–164.
17. Underwood SR, Wiener S. Myocardial perfusion scintigraphy in Europe 2005: A survey of the European Council on Nuclear Cardiology. *Eur J Nucl Med Mol Imaging* 2009; 36: 260–268.
18. Verberne HJ, Acampa W, Anagnostopoulos C et al. EANM procedural guidelines for radionuclide myocardial perfusion imaging with SPECT and SPECT/CT: 2015 revision. *Eur J Nucl Med Mol Imaging*. 2015; 42: 1929–1940.

Anzeige



NEU | 8. AUFLAGE

8., überarb. Aufl. 2017. Ca. 464 Seiten,
252 Abb., 72 Tab., geb.
Ca. € 79,99 (D) / € 82,30 (A)
ISBN 978-3-7945-3109-7

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