Online Submissions: wjg.wjgnet.com
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doi:10.3748/wjg.15.5953

World J Gastroenterol 2009 December 21; 15(47): 5953-5959
World Journal of Gastroenterology ISSN 1007-9327

BRIEF ARTICLE

Education-based approach to addressing non-evidence-based practice in preventing NSAID-associated gastrointestinal complications

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Supported by Unrestricted grant from AstraZeneca Spain
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Received: April 25, 2009 Revised: November 12, 2009
Accepted: November 19, 2009
Published online: December 21, 2009

Abstract

AIM: To evaluate an evidence-based educational program for improving strategies for prevention of non-steroidal anti-inflammatory drug (NSAID)-associated gastrointestinal (GI) complications.

METHODS: Four hundred and fifty-six specialists replied to a questionnaire that covered issues related to NSAID-induced adverse effects. They also collected data from their last five consecutive patients before and after they had attended an evidence-based seminar on GI prevention strategies.

RESULTS: Four hundred and forty-one of 456 specialists (96.7%) participated in the survey, and 382 (83.7%) in the education-based study that recorded data from 3728 patients. The specialists overestimated the risk of GI complications with NSAIDs, underestimated the GI safety profile of coxibs, but were aware of the risk factors and of the current prevention strategies. Proton pump inhibitors were co-prescribed with NSAIDs in > 80% of patients with and without risk factors. The educational program had little impact on prescribing habits.

CONCLUSION: Specialists are informed of advances in NSAID-associated adverse effects and have high rates of GI-prevention therapy. Our educational program did not alter these rates.

Key words: Nonsteroidal anti-inflammatory agents; Education; Gastrointestinal diseases; Adverse effects; Cyclooxygenase 2 inhibitors; Proton pump inhibitors

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Lanas A, Esplugues JV, Zapardiel J, Sobreviela E. Education-based approach to addressing non-evidence-based practice in preventing NSAID-associated gastrointestinal complications. *World J Gastroenterol* 2009; 15(47): 5953-5959 Available from: URL: http://www.wjgnet.com/1007-9327/15/5953.asp DOI: http://dx.doi.org/10.3748/wjg.15.5953

INTRODUCTION

Nonsteroidal anti-inflammatory drugs (NSAIDs) are prescribed extensively worldwide, with at least 20% of the adult population using them for at least 1 mo per year[1]. NSAID use is associated with a wide range of side effects, the most usual being those involving the gastrointestinal (GI) tract. Research in this field has progressed considerably, especially since the commercialization of cyclooxygenase 2 inhibitors (coxibs), and the amount of information published is impressive. Recent data derived from studies of the side effects associated with coxibs and traditional NSAIDs have received a good deal of attention in scientific and non-scientific

publications. Based on existing and new information, scientific organizations, regulatory agencies and influential journals have made recommendations regarding GI prevention strategies with NSAIDs[2-4]. These indicate that patients requiring NSAIDs should be evaluated for the presence of GI and cardiovascular (CV) risk factors, and should undergo prevention therapy when found to be at risk. Patients with a high risk of CV complications are to avoid coxibs and/or NSAIDs. Patients with GI risks should receive either a coxib, or concomitant therapy with misoprostol or a proton pump inhibitor (PPI). In all cases, the minimum effective dose and the shortest possible administration time should be a joint objective. In the light of all this knowledge, it remains unclear whether or not information has been translated into clinical practice.

Recent evidence indicates that prescribing patterns are far from appropriate; a trend that has become more pronounced since the withdrawal of rofecoxib from the market[5]. Reports suggest that, in Europe, up to 80% of patients with one or two risk factors for GI complications do not receive the appropriate prevention strategies[6,7] and that, in the United States, the lack of GI protection has grown since 2004[5]. In addition, some patients who are not at risk receive unnecessary therapy or receive inadequate and ineffective drugs that compromise their health and increase the cost of NSAID treatment[8,9]. The reasons for the lack of or inappropriate use of prevention strategies are unclear, but conflicting results or variations in their interpretation and divergences in the recommendations that they support[2-4,10,11] may have contributed to the confusion.

However, the aforementioned data and conclusions have been obtained at primary care level, therefore, the present study was designed firstly to evaluate the level of knowledge regarding NSAID-associated adverse effects among specialists treating patients with rheumatic diseases, and secondly, to evaluate whether an educational program based on a review of current evidence produced an improvement in the pattern of patient management.

MATERIALS AND METHODS

The study was approved by the Regional Institutional Review Board of Aragón and carried out during 2006 to 2007. First, we conducted a nationwide survey of 456 specialists distributed across the country, and among those who had previously participated in similar studies and had delivered good-quality data, and that represented the most frequently occurring specialties among patients suffering from musculoskeletal conditions. Physicians received a letter from one of the researchers (Lanas A) explaining the purpose of the study, voluntary nature of participation, the confidentiality of the information provided, and absence of commercial purposes of the study. Physicians were questioned about issues related to NSAIDs and their adverse effects, with a special focus on research over the previous 4-5 years that may have affected clinical practice directly. Table 1 summarizes the main questions.

The educational program was designed to answer the objective of the study, which was to evaluate the impact of an evidence-based seminar on clinical practice, and to describe current practice in the prevention of GI adverse effects in the specialized setting. Only physicians who participated in the initial survey were invited to participate in the educational program. Firstly, doctors sent data of their last five consecutive patients visited in the office (phase Ⅰ). These patients had to be at least 18 years old and taking or having been prescribed NSAIDs at the time of the visit. None of the data collected revealed the identity of the subjects. The responses were transmitted anonymously to one of the researchers (Sobreviela E), who entered the information into a database without including any data that could identify physicians or patients. Between 2 and 4 mo later, these specialists attended small group seminars that lasted approximately 2 h, and were based on current evidence in the field and received literature related to NSAID prevention strategies. These educational programs reviewed the main adverse affects associated with NSAIDs and coxibs, as well as risk factors, therapy-specific risks, the pros and cons of available prevention strategies, and treatment options for the cases most frequently encountered in clinical practice. The different therapeutic options, depending on the presence/absence of GI and CV risk factors[12,13], were also reviewed and discussed. All these seminars were given by the same two investigators (Lanas A and Esplugues JV). Between 3 and 4 mo after the seminar, the same physicians again sent data of their last five consecutive patients, with the same inclusion criteria as described above (phase Ⅱ of the educational program-based study).

Statistical analysis

Data were analyzed using SAS software v.8.02 for Windows (SAS Institute, Cary, NC, USA). For categorical variables, absolute frequencies and percentages were obtained; for continuous variables, mean ± SD, median, percentiles 25-75, maximal and minimum values and 95% CI were obtained. Significance related to categorical variables was obtained using the χ^2 test or Fisher's exact test. Comparisons reached statistical significance at $P < 0.05$.

RESULTS

Physician survey sub-study

Of a total of 456 invited physicians, 441 (96.7%) returned valid questionnaires. Those that responded had a mean 14 ± 8.6 years of professional activity. Three hundred and seventy-four (84.8%) were members of one or more scientific societies, and 189 (42.9%) were aware that their respective societies had published guidelines or recommendations for the management of NSAIDs. Two hundred and eighty (63.4%) were orthopedic surgeons, 116 (24.7%) were rheumatologists, and 45 were other types of specialists (10.2%).

Only 24 (5.7%) doctors responded that NSAID use was not associated with GI toxicity; 368 (88.2%), a substantial majority, stated that NSAID use was associated with GI, renal, CV, or liver damage. A total of 207 (50.2%)

Table 1 A summary of the main questions (from a total of 22) assessing physicians' knowledge of current evidence in the field of NSAID use and adverse effects

NSAID use is associated with adverse effects. Which of the following do you believe is not associated with NSAID use?
What is the expected annual incidence of upper GI complications in patients taking NSAIDs, as reported in the most recent large outcome studies?
The occurrence of dyspepsia in patients who take NSAIDs has been reported to be less than 25% (true or false)
NSAIDs may induce GI complications in the lower GI tract (true or false)
Which of the following factors do you believe is/are risk factors for GI complications in patients who take NSAIDs? (list)
Which of the following NSAIDs do you believe is more toxic to the GI tract? (list)
Concerning COX-2 selective inhibitors, for each of the following, indicate whether the statement is true or false:
They are not as effective as traditional NSAIDs in the treatment of OA or RA
The use of these compounds is associated with a 50% reduction in the risk of GI complications compared to NSAIDs
The concomitant use of low-dose aspirin reduces or eliminates the GI benefit of these compounds when compared to NSAIDs
The use of these compounds has been associated with an increased risk of CV events
In high-risk patients, the combination of NSAIDs plus a PPI is safer than a coxib alone
Concerning gastroprotective agents, indicate for each of the following statements whether they are true or false:
H2-RAs are effective in the prevention of gastric ulcers, duodenal ulcers, and GI complications
PPIs are effective in the prevention of gastric ulcers, duodenal ulcers, and GI complications
Misoprostol is effective in the prevention of gastric ulcers, duodenal ulcers, and GI complications
Which of the following agents has been proved to be effective in the treatment or prevention of NSAID-induced dyspepsia? (list)

NSAID: Nonsteroidal anti-inflammatory drug; GI: Gastrointestinal; CV: Cardiovascular; PPI: Proton pump inhibitor; H2-RAs: H2 receptor antagonists.

Table 2 Responses to the question, "Which of the following factors do you believe is/are risk factors for GI complications in patients who take NSAIDs?" *n* (%)

	Rheumatologists	Orthopedic surgeons	Others	Total
History of peptic ulcer	115 (99.1)	275 (98.2)	21 (100.0)	411 (98.6)
History of complicated peptic ulcer	116 (100.0)	275 (98.2)	21 (100.0)	412 (98.8)
Age > 65 yr	114 (98.3)	229 (81.8)	18 (90.4)	361 (86.6)
Concomitant use of low-dose aspirin for CV prevention	114 (98.3)	228 (81.4)	19 (90.4)	361 (86.6)
Concomitant use of anticoagulants	112 (96.5)	247 (88.2)	20 (95.3)	379 (90.9)
Helicobacter pylori infection	103 (88.8)	257 (91.8)	19 (90.4)	379 (90.9)
Smoking	87 (75.00)	223 (79.6)	13 (61.7)	323 (77.5)
Dyspepsia history	73 (62.9)	250 (89.3)	19 (90.4)	342 (82.0)
Alcohol	105 (90.5)	257 (91.8)	20 (95.3)	382 (91.6)
High dose of NSAIDs	113 (97.4)	275 (98.2)	21 (100.0)	409 (98.1)

overestimated the overall rate of upper GI complications in NSAID users, and 261 (63.0%) stated that NSAID use could lead to complications of the lower GI tract. The two symptoms that doctors considered to be the most frequently reported by patients in relation to NSAID therapy were epigastric pain (67.1%) and heartburn (54.8%). The frequency of dyspepsia as an adverse effect of NSAIDs was underestimated by 45.2% of respondents. As summarized in Table 2, most identified the risk factors for GI complications in NSAID users; there were no differences between the responses of rheumatologists and orthopedists, which were the two main specialties represented by the participants. Indomethacin (61.9%), piroxicam (34.0%), diclofenac (18.5%) and ketorolac (11.0%) were considered to be the most gastrotoxic agents, while coxibs, paracetamol and metamizol were considered to be the safest for the GI tract.

When questioned about coxibs, 93 (22.5%) of the specialists believed them to be less effective than NSAIDs, but 84.6% said they were safer for the GI than NSAIDs were. However, 43.9% of the specialists stated that coxibs were more toxic for the GI tract than a combination of NSAID + PPI. Furthermore, 211 (52.2%) reported that concomitant low-dose aspirin reduced the GI benefit of coxibs, and 394 (94.7%) considered coxibs to be toxic to the CV system; a proportion that fell to 72.7% ($P = 0.140$) when the same question was asked about NSAIDs.

Over half of the physicians (56.1%) reported that histamine H2 receptor antagonists (H2-RAs) were effective in preventing ulcers and ulcer complications in NSAID users; almost all (98.5%) reported the same effect with PPIs. Responding about GI prevention therapy habits with NSAIDs, 217 (52.4%) took this precaution on a routine basis, 45.9% only when risk factors were present, and 5.3% only when patients were receiving long-term NSAID therapy. H2-RAs (44.6%), misoprostol (41.2%) and PPIs (94%) were considered to be effective for the prevention and treatment of NSAID-induced dyspepsia.

Effects of the educational program on patient management

Demographics and characteristics of patients: Of 456 invited participants, 382 (83.7%) submitted information regarding 3728 patients over the two phases (1732 in phase Ⅰ - before the evidence-based seminar, and 1722 in phase Ⅱ - after the seminar). Two hundred and seventy-four patients were excluded for the following reasons: 43 were under the age of 18 years, and 231 lacked an NSAID prescription. Table 3 summarizes the main characteristics of the patients included in the study. No statistical

Table 3 Characteristics of patients included in the educational program of the study[1] *n* (%)

Variable	Phase Ⅰ (*n* = 1732)	Phase Ⅱ (*n* = 1722)
Age (mean ± SD)	61.06 ± 13.37	60.81 ± 13.89
Female	1038 (60.4)	980 (57.6)
History of ulcer	238 (13.7)	307 (17.8)
History of ulcer bleeding	61 (3.5)	69 (4.0)
ASA use	167 (9.6)	168 (9.8)
CV history	203 (11.7)	205 (11.9)
Increased blood pressure	845 (48.8)	810 (47.0)
Anticoagulant use	126 (7.3)	120 (7.0)
Corticosteroid use	162 (9.3)	190 (11.0)
History of dyspepsia	782 (45.1)	766 (44.5)

[1]No statistical differences were found between patients enrolled in the two phases. Phase Ⅰ: Before physicians attended the evidence-based seminar; Phase Ⅱ: After the seminar; ASA: Aspirin.

Table 4 Prescription of NSAIDs to patients in each of the two study phases of the educational program *n* (%)

Drug therapy	Phase Ⅰ		Phase Ⅱ	
	Before visit	After visit	Before visit	After visit
No NSAID therapy	718 (41.45)	162 (9.35)	653 (37.92)	190 (11.03)
NSAID therapy	1014 (58.55)	1570 (90.65)	1069 (62.08)	1532 (88.97)
Aceclofenac	146 (8.43)	248 (14.32)[b]	148 (8.59)	202 (11.73)[b]
Celecoxib	45 (2.60)	100 (5.77)[b]	35 (2.03)	116 (6.74)[b]
Diclofenac	229 (13.22)	271 (15.65)	238 (13.82)	270 (15.68)
Etoricoxib	16 (0.92)	46 (2.66)[b]	18 (1.05)	79 (4.58)[b]
Ibuprofen	281 (16.22)	432 (24.94)[b]	297 (17.25)	406 (23.58)[b]
Indomethacin	63 (3.64)	62 (3.58)	73 (4.24)	75 (4.36)
Ketorolac	15 (0.87)	25 (1.44)	28 (1.63)	31 (1.80)
Meloxicam	71 (4.10)	234 (13.51)[b]	101 (5.87)	215 (12.49)[b]
Piroxicam	74 (4.27)	75 (4.33)	64 (3.72)	64 (3.72)
Other NSAIDs (includes naproxen)	19 (1.10)	22 (1.27)	16 (0.93)	28 (1.63)
Analgesics				
Paracetamol	137 (7.91)	120 (6.93)	136 (7.90)	122 (7.08)
Metamizol	35 (2.02)	28 (1.62)	53 (3.08)	26 (1.51)
Total	1732 (100)		1722 (100)	

[b]$P < 0.001$ *vs* before the visit.

differences were found between patients referred to in the two phases.

NSAID treatment: In both phases, ibuprofen (16.2% and 17.25% in phases Ⅰ and Ⅱ, respectively), diclofenac (13.2% and 13.8%) and aceclofenac (8.4% and 8.6%) were the three most frequently prescribed NSAIDs. Coxib prescription was low (3.5%). There was a statistically significant ($P < 0.0001$) increase in prescription rates of aceclofenac, celecoxib, ibuprofen, meloxicam and etoricoxib after the visit with the specialist, but this increase was similar in both phases (Table 4). The main reasons for prescribing NSAIDs was the diagnosis of osteoarthritis [1015 (63.24%) in phase Ⅰ and 987 (61.96%) in phase Ⅱ] or rheumatoid arthritis [148 (9.22%) and 186 (11.68%) in phases Ⅰ and Ⅱ, respectively]. In phase Ⅰ, NSAID therapy was terminated in 15.98% of patients following the visit to the specialist, a similar percentage

Table 5 Risk factors (RFs) of patients reported by doctors in the educational program according to either a non-restrictive or a restrictive definition[1] *n* (%)

Number of RFs	Non-restrictive		Restrictive	
	Phase Ⅰ[2]	Phase Ⅱ[3]	Phase Ⅰ[2]	Phase Ⅱ[3]
0	347 (20.03)	352 (20.44)	961 (55.48)	891 (51.74)
1	660 (38.11)	598 (34.73)	558 (32.22)	573 (33.28)
2	517 (29.85)	536 (31.13)	176 (10.16)	213 (12.37)
> 2	208 (12.01)	236 (13.70)	37 (2.14)	45 (2.61)
Total	1732 (100)	1722 (100)	1732 (100)	1722 (100)

[1]A non-restrictive definition of risk factors for NSAID-related complications included age > 60 years, history of dyspepsia, history of either complicated or non-complicated ulcer, concomitant therapy with NSAIDs and low-dose aspirin, or anticoagulants or corticosteroids. A restrictive definition of risk factors included age ⩾ 70 years, history of complicated or non-complicated ulcer, concomitant therapy with NSAIDs and low-dose aspirin, or anticoagulants or corticosteroids; [2]In Phase Ⅰ, the specialists received an anonymous questionnaire regarding data and prescriptions for their last five consecutive patients; [3]In Phase Ⅱ, the process was repeated 4-5 mo later after specialists had attended an evidence-based seminar that reviewed current evidence on NSAID-related issues, with a focus on GI prevention strategies in NSAID users.

to that reported in phase Ⅱ (17.77%). The duration of NSAID therapy after the visit was also similar in both phases. Most treatments were prescribed for a short duration (< 30 d) (74.8% and 72.04% in phases Ⅰ and Ⅱ, respectively). No significant differences were found between the two phases.

NSAID treatment and dyspepsia: In phase Ⅰ, 1129 (66%) of 1710 patients who were seen had suffered or were suffering GI symptoms prior to the visit, and 65.6% of the 1129 were receiving NSAID therapy; a higher proportion than those who did not have symptoms before the visit 256/581 (45.6%) ($P < 0.0001$). After the visit, physicians increased the prescription of NSAIDs to a similar rate (88.8% and 94%) in both groups of patients ($P = 0.0006$ *vs* before the visit). Similar percentages were observed in phase Ⅱ, and no differences were observed between the phases.

Among the patients with GI symptoms, 57.1% in phase Ⅰ and 60.1% in phase Ⅱ were undergoing treatment for symptom relief before the visit to the specialist, and about one-third of them were being treated with a PPI. After the visit to the specialist, almost all these patients with symptoms were prescribed PPI therapy ($P < 0.0001$). No differences were found between the two phases.

Risk factors and prevention strategies: The number of patients with risk factors depends on the definition of these factors. The two most prevalent risk factors were age and a history of dyspepsia. We present data for a restrictive definition (age > 70 years and excluding history of dyspepsia) and for a non-restrictive definition of those risk factors (e.g. age > 60 years and history of dyspepsia; Table 5). Very few patients with risk factors were switched from a traditional NSAID to a coxib alone; 54 (3.1%) *vs* 129 (7.4%) ($P < 0.0001$) before and after the visit to the specialist in phase Ⅰ, and 42 (2.4%) *vs* 155

Table 6 Proportion of patients on NSAID therapy that received concomitant therapy with a PPI or misoprostol after the medical visit, according to the number of RFs *n* (%)

Number of RFs	Non-restrictive		Restrictive	
	Phase Ⅰ	Phase Ⅱ	Phase Ⅰ	Phase Ⅱ
0	268/347 (77.2)	283/352 (80.4)	782/961 (81.4)	728/891 (81.7)
1	536/660 (81.2)	499/598 (83.4)	471/558 (84.4)	504/573 (87.9)
2	453/517 (87.6)	456/536 (85.1)	151/176 (85.8)	168/213 (78.9)
> 2	175/208 (84.1)	201/236 (85.2)	28/37 (75.7)	39/45 (86.7)

(9.0%) in phase Ⅱ ($P < 0.0001$). No differences between phases Ⅰ and Ⅱ were observed after the visit, although we observed a trend toward an increase in coxib prescription in phase Ⅱ ($P = 0.09$).

The most widely used strategy for prevention of GI complications in Spain is concomitant therapy with PPIs. In both phases of the study, physicians prescribed appropriate gastroprotection therapy for over 80% of patients with risk factors, with little therapeutic benefits observed after the educational program (Table 6). The study also reveals a similar pattern of gastroprotection prescription rates among patients without GI risk factors.

A sub-analysis of data in high-risk patients (defined as those with previous ulcer bleeding or those who were being treated with anticoagulants) showed that very few of these patients were prescribed NSAIDs without PPIs [11/163 (8.4%) in phase Ⅰ, and 6/158 (4.08%) in phase Ⅱ].

DISCUSSION

We found that the majority of specialists who treat patients with rheumatic disease are aware of recent evidence concerning the adverse effects associated with traditional NSAIDs and coxibs. The study also revealed that gastroprotection-related prescribing rates by the specialists among at-risk patients receiving NSAIDs were high, and that an educational program aimed at influencing prescription patterns had little impact.

The first step in the process of implementing prevention strategies in NSAID-treated patients at risk of GI complications is to be familiar with the risk factors. We observed that the specialists who treat patients with different rheumatic conditions are well informed of these factors, which may explain the high rates of preventative prescriptions observed in our study population. Other recent findings in the field, such as the increased risk of CV events with coxibs and traditional NSAIDs, are also well known and may explain the use of short-term courses of treatment with these compounds.

Previous studies have reported that most patients on NSAIDs with one or more risk factors for GI complications were not prescribed prevention-related treatment[6,7]. This was not the case in our patient population, of which a high proportion showed risk factors and received concomitant prescription of NSAIDs with gastroprotective agents, specifically PPIs. The reasons for this discrepancy are not clear, but previous studies were based on a primary care database and not on prescribing data obtained from specialists, who may be more aware of risk factors and strategies to reduce their impact. In addition, this study provides more recent data on prescribing habits than the above-mentioned studies[6,7], which did report a tendency towards more appropriate prescribing rates with time.

This study differs from those carried out in the United States[5], in one aspect specifically: the most prevalent prevention strategy in the current study was the concomitant prescription of PPIs and NSAIDs, while the prescribing rate of coxibs was low, in agreement with sales data for these compounds across Europe[14]. This difference between practices in the United States and Europe[15] may reflect a widespread belief among the participants in the current study that adding a PPI to a NSAID confers greater upper GI protection than administration of a coxib alone, a belief that is not based on evidence[16].

Also of interest is our finding that the PPI prescribing rate was high among patients whose NSAID treatment was discontinued after a visit to the specialist, and in patients with no risk factors. Even considering the non-restrictive framework for risk factors, which includes a history of dyspepsia as justification for prescribing gastroprotectants, > 20% of patients from the overall study population who had no GI risk factors were being prescribed preventative therapies. This excess of PPI concomitant therapy is not intrinsically inappropriate, given that it may reduce the risk of complications in patients with a low risk of GI, but it does significantly increase the cost of NSAID therapy by an estimated 80%[17]. Even in a market in which generics are prescribed and promoted widely, this added expense is not to be disregarded. Furthermore, although PPI treatment is considered to be relatively safe[18], the long-term treatment with these type of drugs is associated with some adverse effects, including an increased risk of GI infections, pneumonia and even hip fracture[19-22]. Finally, according to current guidelines, implementing unnecessary prevention strategies is incorrect medical practice.

The other major finding of our study was the failure of our educational program to have any real effect on prescribing habits, although the effect achieved may have been so small because of the baseline circumstances. We observed a minor and statistically insignificant increase in prescribing rates for the safest NSAIDs, including coxibs, and for gastroprotectants among patients running the highest risk of GI adverse effects; a change that would appear to be a result of the educational program. On the other hand, we saw no effect on declining prescribing rates for gastroprotectants among patients without GI risk factors. The shift towards an evidence-based approach to practice seems a challenging task.

A recent study demonstrated that intervention consisting of a combination of education and computer alerts improved gastroprotection[23] in at risk patients prescribed NSAIDs, but still the rates were far from being optimal. On the other hand, educational programs may lead to short-term improvements in our knowledge,

but the impact on clinical practice is modest, especially in the mid- to long-term[24]. As suggested previously[25], successful educational tools are costly because they require regular feedback and reinforcement. In any case, our study suggests that a high proportion of specialists are well informed about the latest advances in the NSAID field and implement appropriate prevention therapies in at-risk patients, which suggests that continuing medical education is the key to progress.

Our study had some limitations. The information was not obtained from a database but from the records of the participating physicians. Therefore, it was possible that their records differed from actual practice. However, high PPI prescribing rates have been observed in other studies[26] and reflect the marked decrease in national rates of upper GI bleeding over the last 5 years. In addition, the survey results concerning the degree of knowledge were in accordance with the clinical practice reported. Another limitation was that the study involved only one time point of observation after completion of the educational program, which did not allow the short- or long-term effects of the program to be analyzed. Finally, the data obtained cannot be extrapolated to clinical practice at the primary care level, which accounts for a major part of NSAID prescribing rates. In fact, the concomitant prescribing rate of gastroprotectants in NSAID users before visiting the specialist (which may well reflect practices in primary care) was much lower than that observed after the visit. Obviously, if a continued drop in GI complications among NSAID users is the goal, prevention strategies should be implemented at all levels of care. Further research should be carried out at the level of primary care to detect areas for improvement and to design improved educational programs by which GI complications in NSAID users may be prevented. Finally one potential limitation of the study is the validity of our conclusions outside Spain. While some data may be country-specific (e.g. prescription rates of PPI), we believe that other aspects of the study can probably be extrapolated (e.g. usefulness of the educational approach, awareness of the specialist on the medical advance,) and therefore be of interest in other areas.

ACKNOWLEDGMENTS

The authors thank all the physicians and patients who participated in the study.

COMMENTS

Background

Advances in medical sciences may not be rapidly translated into medical practice. Also contradictory results reported in the literature may difficult appropriate medical care. Advances in the understanding of adverse effects of nonsteroidal anti-inflammatory drugs (NSAIDs) and prevention strategies have been enormous in the last 5 years.

Research frontiers

It is not know whether specialists treating patients rheumatic diseases are aware of advances in the field of NSAID-associated adverse effects and whether these advances have been translated into medical practice. It has been tested whether specialists confronted with scientific evidence incorporate this into medical practice and modify prescription patterns to these patients.

Innovations and breakthroughs

The study shows that specialists dealing with patients suffering from rheumatic diseases and prescribing NSAIDs in Spain are aware of the recent advances in the NSAID field, identify the main gastrointestinal risk factors and of the current available prevention strategies. The study detects inappropriate use of prevention strategies in patients being prescribed with NSAIDs. An evidence based seminar of the prevention strategies carried out with these specialist do not change their prescription patterns.

Applications

The study was carried out in one European country and it is unclear whether the data can be extrapolated to other countries, where prescription patterns have shown to be different. Nevertheless, the study shows other aspects that can be applied to other areas and countries: (1) Knowledge of evidence by the specialist is no automatically translated into clinical practice; (2) Modification of clinical practice based on scientific evidence needs a complex intervention.

Terminology

Evidence based clinical practice refers to medical care which is applied to patients based on studies with sufficient scientific quality that have been published in peer-review and that have been accepted by the scientific community (guidelines, expert reports, scientific societies, *etc.*) as appropriate.

Peer review

This is a well presented approach to evaluation of an evidence-based educational program for improving NSAID-associated prevention strategies.

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S- Editor Tian L **L- Editor** Kerr C **E- Editor** Zheng XM