



# Physicians' and Patients' Perceptions and Practices Concerning Antithyroid Drug-Induced Agranulocytosis

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## Abstract

**Objectives** We aimed to ascertain physicians' attitudes and practices and evaluate patients' knowledge of antithyroid drugs (ATDs). Also, we would like to review the quality of patients' information on the Internet (in Arabic) concerning ATDs' including agranulocytosis.

**Methods** A mixed methods study design was employed, including an online physician questionnaire, structured interviews of patients on ATDs, and evaluation on web sites containing patients' information in Arabic.

**Results** Most physicians (82.6%) thought the frequency of agranulocytosis in patients receiving antithyroid medications is 1 to 5 per 1,000 per annum. Nearly 72% of the participants reported educating their patients about the risk of agranulocytosis when they receive ATDs regularly verbally only. Most physicians thought patients should be warned about sore throat and fever. More participants would measure a white blood cell (WBC) count only if a patient developed suggestive symptoms (57.0%) than those who do it routinely (43.0%). If a patient receiving ATDs develops suspicious symptoms, participants thought that the most efficient way to deal with this is to attend the nearest hospital emergency department (37.2%). Less thought they can go to any facility with a laboratory that can do WBC count (29.8%) or contact their usual endocrine clinic (24.4%). Nearly half of the patients (49%) were aware of the side effects of ATDs, but only 17 respondents (17.3%) identified one or both of the two most typical symptoms of agranulocytosis. The quality of the information received was evaluated as "not good at all" or "poor" by 19.2%. Over two-thirds (69.7%) of

## Keywords

- ▶ thyrotoxicosis
- ▶ antithyroid drugs
- ▶ agranulocytosis
- ▶ thionamides
- ▶ physicians' practices
- ▶ Internet
- ▶ physicians' perceptions
- ▶ questionnaire
- ▶ survey

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participants thought the amount of information was about right. Most participants (72.5%) preferred receiving information on side effects during consultations with their physicians. Since starting ATDs, 37.0% of patients have experienced different symptoms suggestive of agranulocytosis in various combinations. However, only one-third (12/37) had an urgent blood count. A review of 190 selected Arabic patient information Internet sites revealed a significant variation in patient advice. Six percent 11/190 (5.8%) of the sites can be considered good.

**Conclusions** The findings of suboptimal and inconsistent perceptions and practices of physicians and patients put patients with ATD in the Middle East at increased risk and call for more action from professional and patient advocacy groups.

## Introduction

Hyperthyroidism affects approximately 1% of the adult population.<sup>1-3</sup> Antithyroid drugs (ATDs) are commonly used to control hyperthyroidism.<sup>1-3</sup> The medications are not free of complications. Albeit rare, agranulocytosis is a serious adverse effect of ATDs.<sup>4</sup> Fatalities due to ATD-induced agranulocytosis were recorded in various parts where good medical records are maintained, though this was considered underestimated.<sup>4</sup> Agranulocytosis, of whatever cause, usually presents with a sore throat or fever. The quoted frequency of agranulocytosis among ATD users ranges between 0.03 and 0.18% per year.<sup>5-7</sup> Accordingly, an approximate 20 to 100 episodes of agranulocytosis may occur in the Middle East and North Africa (MENA) yearly. However, an estimate cannot be made precisely since it is influenced by ethnicity.<sup>8</sup>

The serious side effects of ATDs have unpredictable timing and no well-defined risk factors. Therefore, patient education remains critical in managing patients receiving this treatment. It is a good clinical practice that patients are advised about agranulocytosis and instructed to stop ATDs and seek urgent medical advice if they develop symptoms suggestive of agranulocytosis. Arrangements for an urgent white blood cell (WBC) count should be in place to confirm or exclude agranulocytosis.<sup>1-3</sup> The rarity of the condition may make physicians and patients forget. How much this guidance is translated to day-to-day clinical practice has yet to be widely known, particularly in developing parts of the world. Previous audits of the information recalled by patients on side effects of ATDs indicated that 56 to 70% would take an appropriate action if they have any symptoms suggestive of agranulocytosis.<sup>9,10</sup> In general, information remains sparse in the literature, and no data exists from non-European regions. Equally important is the notion that physicians initiating medication are responsible for preventing, detecting, and managing their complications. Despite the availability of guidelines and literature, how endocrinologists react to the risk of agranulocytosis in ATD-treated patients is not well established.

Furthermore, many Internet pages are dedicated to providing patients' information.<sup>11</sup> These pages must be developed by professional or advocacy groups to be subjected to rigorous quality control, particularly in developing regions

and using non-European languages.<sup>12</sup> All three arguments above make our study timely. Variations in the quality and content of patient-focused health information on the Internet for some conditions have been shown.<sup>13,14</sup> Some workers were concerned about the potential for patient confusion and misinformation.<sup>13,14</sup> Many pages in Arabic made by individuals suffer badly from unrevised copy and paste and unchecked digital translations (Google Translate) by people with no background knowledge of the subject.

We aimed to (a) document the perceptions and practices of a sample of physicians in patients' education and case detection and responses to such events, (b) obtain information about the knowledge of patients treated with ATDs about agranulocytosis and their views and experience about the information received on this side effect; in particular explore how patients might react to a hypothetical scenario of drug-induced agranulocytosis, and (c) review the information available to patients on the Internet (in Arabic being the primary spoken language in the MENA region) about ATD-induced agranulocytosis.

## Materials and Methods

### Setting and Design

We used three approaches to address our research questions. A convenience sample of 100 consecutive patients receiving ATDs from four endocrine clinics in the cities of Al Ain, Abu Dhabi, Dubai, and Fujairah, United Arab Emirates (UAE) were interviewed using a unified questionnaire. Seventy-one physicians responded to an online survey questionnaire on their perceptions and practices relevant to ATD-induced agranulocytosis. We also conducted an appraisal of the contents of Arabic web sites containing patients' information about ATDs. This study is a part of a more comprehensive project aiming to ascertain the patterns of clinical practice in managing common endocrine conditions in the MENA region.<sup>15-20</sup>

### The Physicians' Online Survey

The physicians from the MENA region were surveyed using an online questionnaire on their perceptions and practices relevant to ATD-induced agranulocytosis. As previously described, a web-based commercial survey management

service (Survey Monkey, Palo Alto, California, United States) was used.<sup>15–20</sup> All participants received an initial email or a link explaining the rationale of the survey and what is required from the consented participants, followed by five subsequent reminder emails/messages during the study period. The survey web site was open from August 1, 2017, to January 31, 2018. In the end, survey responses were collected and stored electronically for an anonymous analysis. The survey questions were addressed: (1) confirmation of eligibility and consent question; (2) location of residence and practice; (3) specialty; (4) career stage; (5) several patients with hyperthyroidism have been seen in clinic within the previous 12 months; (6) their perception of the frequency of agranulocytosis in patients receiving antithyroid medications; (7) what method(s) are practiced in educating patients about the risk of agranulocytosis when they are receiving antithyroid medications; (8) what they perceive as the common symptoms of agranulocytosis that patients using antithyroid medications may experience, and they should be warned about?; (9) assuming that there are no other indications, if and when measurements of WBC count in patients using antithyroid medications are requested in the clinic; and finally, (10) if a patient on ATDs develops suspicious symptoms, what would be the most efficient facility to deal with this?

### The Patient's Survey

A questionnaire on the ATD's side effects was used to collect patients' data in two languages (Arabic and English). The English survey was identical to the one used in the UK study.<sup>21</sup> The Arabic version was translated and prepared by one of the authors in a similar layout to the English version. It was piloted initially in a small number ( $n=8$ ) of patients in one clinic (Sheikh Khalifa Medical City, UAE) and was improved the ease of completion and clarity of questions.

### Review of the Online Patients' Information

Using the Google Search Engine, the Internet was searched using the Arabic terms for "thyroid." The results were evaluated for relevance by predefined three categories namely (a) no side effects mentioned, (b) no recommendations (no advice of what to do when the side effects are encountered), and (c) excellent description (site describes the drugs, side effects, and what to do when someone suffers from the side effects). One hundred ninety sites were scanned and 102 of these were excluded for lack of relevance. The remaining 88 sites were included in the analysis.

### Data Management and Statistical Analysis

For physicians' data, the survey server tools were used for analysis. The responses were entered into a spreadsheet for the patients' questionnaire analysis. For both datasets, descriptive analysis was used to define the trends; Results are expressed for categorical data in terms of absolute frequency (count) and relative frequency (percentage). Percentages were calculated for each question individually. Continuous

variables are expressed as mean (standard deviation [SD]) or median (range). The comparison between patients' responses in the UK and the present study was made by independent sample analysis using chi-squared or Fisher's exact test (Supplementary Material). No numerical presentations or data were relevant to the online patients' information appraisal.

## Results

### Physicians' Perceptions and Practices

Eighty-six doctors participated in the survey. They all resided and practiced in the MENA region. Over half of the respondents were adult endocrinologists (59.0%; ▶Table 1). Participants' workloads varied but over one-third have 1 to 10 patients on their books (37.2%), and more than a quarter have more than 30 patients (26.7%; ▶Table 1). Most participants (82.6%) thought the frequency of agranulocytosis in patients receiving ATDs is 1 to 5 per 1,000 per annum; 71.8% of them regularly educated their patients about the risk of agranulocytosis verbally only when they received ATD. However, 14.1% admitted to doing it less consistently. The typical top symptoms of agranulocytosis patients using ATDs may experience and should be warned about, selected by respondents, sore throat (87.2%) and fever (74.4%). Chills, mouth ulcers, myalgia, and cough were less recognized. (▶Table 1) More participants would measure a WBC count only if a patient developed symptoms suggestive of possible agranulocytosis (57.0%) than those who do it routinely in every visit (43.0%). If a patient on ATDs develops suspicious symptoms, about one-third of the participants thought that the most efficient way to deal with this is to attend any emergency department of the nearest hospital (37.2%). However, slightly fewer thought they should go to any facility with a laboratory that can measure WBC (29.8%) or their endocrine clinic if in working hours (24.4%; ▶Table 1).

### Patients' Knowledge and Attitudes

We included 100 patients in the study: 85 using the Arabic and 15 using English questionnaires. They attended Sheikh Khalifa Medical City (32%), Dubai Hospital (29%), Fujairah Hospital (22%), and Tawam Hospital (17%). The vast majority of patients (93) had Graves' disease, two patients had toxic multi-nodular goiter, and one had a single toxic nodule. This index episode of thyrotoxicosis was the first in 72% and recurrent in 28%. All patients were receiving ATD treatment during the study. More women (80) were seen than men (20). The median age was 41 years (15–80). The mean (SD) age was 42.9 SD (14) years. Patients took thionamides for a median (range) of 11 (1–144) months.

A summary of the interview findings is shown in ▶Tables 2 and 3. Nearly half of the patients (49.0%) stated that they knew the ATDs' side effects (▶Fig. 1). Seventeen responders identified one or both of the two most typical symptoms of agranulocytosis (fever, sore throat). Most responders ( $n=46$ , 90.1%) had received information about side effects from health professionals, mostly without additional information in leaflet form. A minority accessed sole or additional

**Table 1** Characteristics of the physicians and their responses to the physicians' survey questions

Characteristics	Answer choices	Responses
Career stage	Senior	60 (69.8%)
	Mid-grade	26 (30.3%)
Specialty	Adult endocrinologist	50 (58.1%)
	GIM with endocrine interest	17 (19.8%)
	General physicians	5 (5.8%)
	Pediatric endocrinology	5 (5.8%)
	Primary care	3 (3.5%)
	Gynecology	2 (2.3%)
	Other	4 (4.7%)
How many hyperthyroid patients have been on your clinic lists within the last 12 months [86]	None	3 (3.5%)
	1–10	32 (37.2%)
	11–20	16 (18.6%)
	21–30	12 (14.4%)
	> 30	23 (26.7%)
What is the frequency of agranulocytosis in patients receiving antithyroid medications? [86]	1–5 per 1,000 PA	71(82.6%)
	6–10 per 1,000 PA	7 (8.1%)
	11–15 per 1,000 PA	6 (7.0%)
	16–20 per 1,000 PA	0 (0.0%)
	21–25 per 1,000 PA	2 (2.3%)
How do you educate patients about the risk of agranulocytosis when they are receiving ATDs [85]	I do not do it regularly.	12 (14.1%)
	I do it regularly, verbally only	61 (71.8%)
	I do it regularly verbally and using written material	11 (12.9%)
	My endocrine nurse does this verbally only	0.0%0
	My endocrine nurse does this verbally and using written material	1(1.2%)
What common symptoms of agranulocytosis that patients using antithyroid medications may experience and should be warned about? [86]	Sore throat	75 (87.2%)
	Fever	64 (74.4%)
	Chills	22 (25.6%)
	Mouth ulcers	20 (23.3%)
	Myalgia	15 (17.4%)
	Cough	9 (10.5%)
	Others	7 (8.1%)
Assuming that there are no other indications when you measure WBC in patients on ATD is done: [86]	A. Only If a patient developed symptoms suggestive of possible agranulocytosis	49 (57.0%)
	B. Routinely in every visit	37 (43.0%)
If a patient on antithyroid medication develops suspicious symptoms, the most efficient way to deal with this is to attend:[86]:	Their own GP/family doctor	13 (15.1%)
	Their endocrine clinic if within working hours	21 (24.4%)
	The emergency department of the nearest hospital	32 (37.2%)
	Any "Minor Injuries or Urgent Care" facility.	0 (0.0%)
	Call a telemedicine facility to get guidance	3 (3.5%)
	Any facility with a laboratory and ask for a CBC	17 (29.8%)

Abbreviations: ATD, antithyroid drugs; CBC, complete blood count; GIM, general internal medicine; GP, general practitioner; PA, per annum; WBC, white blood cell.

**Table 2** Patients' knowledge of the antithyroid drug's adverse effects, source of information, confidence in self-management, and their need for more information and its delivery

Questions	Responses
<b>Are you aware of any serious side effects of the antithyroid drugs you take? [98]</b>	
Yes	48 (49.0%)
No	50 (51.0%)
<b>What are they? [open ended questions]</b>	See ► <b>Fig. 1</b>
<b>How many patients reported symptoms of agranulocytosis?</b>	17/98 (17.3%)
<b>How did you receive this information if you are aware of the potential side effects of antithyroid drugs? [responses are not mutually exclusive?]</b>	
The hospital clinic doctor informed me	42/48
I was handed a leaflet in the endocrine clinic	1/48
My GP told me	1/48
The nurse in my GP practice told me	1/48
My GP surgery handed me a leaflet	1/48
The hospital clinic nurse informed me	0/48
I read it in the packet insert of the tablet	9/48
I looked it up on the Internet	6/48
<b>Since starting the antithyroid medication, has anyone reminded you about the potential side effects and what to do if you get them? [48]</b>	
Yes	24/48 (50.0%)
No	24/48 (50.0%)
<b>If yes, how many times?</b>	Median 1.5 (1–2)
<b>On a scale from 0 to 10, how confident do you feel about your knowledge of the side effects of your antithyroid drugs? [97]</b>	
Confident	29/97(29.9%)
Slightly confident	25/97 (25.8%)
Not confident at all	18/97 (18.6%)
Unsure	14/97 (14.4%)
Very confident	11/97 (11.3%)
<b>On a scale from 0 to 10, how confident do you feel about knowing what to do if you develop serious side effects? [96]</b>	
Confident	28/96 (29.2%)
Slightly confident	24/96 (25.0%)
Very confident	17/96 (17.7%)
Not confident at all	15/96 (15.6%)
Unsure	12/96 (12.5%)
<b>Do you think the amount of information you have received about the side effects of antithyroid drugs has been? [96]</b>	
About right	67/96 (69.8%)
Too little	25/96 (26.0%)
Too much	4/96 (4.2%)

(Continued)

**Table 2** (Continued)

Questions	Responses
<b>How would you like to receive more information (reminders)? [91]</b>	
In-person	66 (72.5%)
By email	13 (14.3%)
By text (SMS)	11 (12.1%)
By telephone	7 (7.7%)
By letter	3 (2.2%)
<b>If more information is needed, are reminders every few months welcome?[98]</b>	
Yes	84/98 (85.7%)
No	14/98 (14.3%)
<b>Rating of quality of information about side effects of antithyroid drugs by participants: [99]</b>	
Good	34/99 (34.3%)
Okay	31/99 (31.3%)
Excellent	15/99 (15.2%)
Poor	12/99 (12.1%)
Not at all good	7/99 (7.1%)
Some response options are rearranged in a decreasing order of responses.	

Abbreviation: GP, general practitioner.

information through the Internet or drug packet inserts (► **Table 2**).

Half of the respondents who confirmed receiving information (i.e., 24/48) corresponding to less than a quarter of the study group (24%) recalled having a reminder about side effects once or twice during follow-up. The quality of the information received was rated as “poor” or “not good at all” by 19.2% (19/99) of responders. Over two-thirds (69.8%, 67/96) of participants thought that the amount of the information was about right, and about a third (26.0%, 25/96) of them thought it was too little. Most participants (72.5%, 66/91) preferred receiving information on side effects during a consultation with a health professional. Since starting ATDs, 37.0% of patients had experienced different symptoms suggestive of agranulocytosis in various combinations (sore throat, fever, or painful throat ulcers). However, only 32.4% (12/37) of this subgroup had an urgent blood count on at least one occasion (► **Table 2**).

Assessment of patients' practical aspects of dealing with ATD adverse effects based on case scenarios with branching questions logic is illustrated in ► **Table 3**. Patients were asked about the action they would take if they developed a sore throat while taking their medication. The responses were routine appointment with their general physician (GP) or contact hospital clinic by 17.5% (17/97) and 10.3% (10/97), seek medical advice urgently by 20.6% (20/97), or carry on as usual by 58.8% (57/97). Of those who responded that they would make a routine appointment with the GP or hospital clinic, only 31.8% (7/22) would stop taking ATDs.

**Table 3** Patients' practical aspects of dealing with ATD adverse effects based on case scenarios with branching questions logic

Questions	Responses
<b>What else would you do if you developed a sore throat while taking ATD therapy? [97]</b>	
Continue as before	38 (39.2%)
Wait another day to see if it improves or worsens, then decide what to do	19 (19.6%)
Get an appointment with your doctor	17 (17.5%)
Attend accident and emergency	10 (10.3%)
Contact the hospital clinic by phone	9 (9.3%)
Attend a walk-in center minor injuries unit	2 (2.0%)
Do an Internet search	1 (1.0%)
<b>Moreover, would you stop the medication now?[90]</b>	
Yes	15 (16.7%)
No	75 (83.3%)
<b>After 24 hours, what else would you do? [96]</b>	
Contact the hospital clinic by phone	28 (29.2%)
Wait for the appointment	26 (27.1%)
Attend a walk-in center minor injuries unit	25 (26.0%)
Attend accident and emergency	20 (20.8%)
Do an Internet search	2 (2.1%)
<b>After 24 hours, would you stop the medication now?[89]</b>	
Yes	22 (24.7%)
No	67 (75.3%)
<b>Suppose that on the following day, your (A) sore throat is worse, and you are still taking the ATDs [90]</b>	
Yes	41 (45.6%)
No	49 (54.4%)
<b>What else would you do?[95]</b>	
Attend accidents and emergency	57 (60.0%)
Ring the GP and try to bring the appointment forward	29 (30.5%)
Attend a walk-in center/minor injuries unit	16 (17.9%)
Ring the hospital clinic	7 (7.4%)
Do an Internet search	3 (3.2%)
<b>Suppose you managed to get the appointment with your GP forward by a day (A). You wake up the following day, still have a sore throat, and feel worse. Your appointment with your GP is in a day or two. Would you stop the medication? [73]</b>	
Yes	51 (69.9%)
No	22 (30.1%)
<b>..... and what else would you do? [96]</b>	
Attend accident and emergency	74 (77.1%)
Attend a walk-in center/ minor injuries unit	21 (21.9%)
Do an Internet search	3 (3.1%)

**Table 3** (Continued)

Questions	Responses
<b>If, instead of a sore throat, you had fevers, would you act differently? [98]</b>	
No	64 (65.3%)
Yes: More likely to insist that you are seen early by a doctor	29 (29.6%)
Yes: Less likely to insist that you are seen early by a doctor	5 (5.1%)
<b>If, instead of a sore throat, you had several painful mouth ulcers, would you act differently? [98]</b>	
Yes: More likely to insist that you are seen early by a doctor	54 (55.1%)
No	40 (40.8%)
Yes: Less likely to insist that you are seen early by a doctor	4 (4.1%)

Abbreviations: ATD, antithyroid drugs; GP, general practitioner.

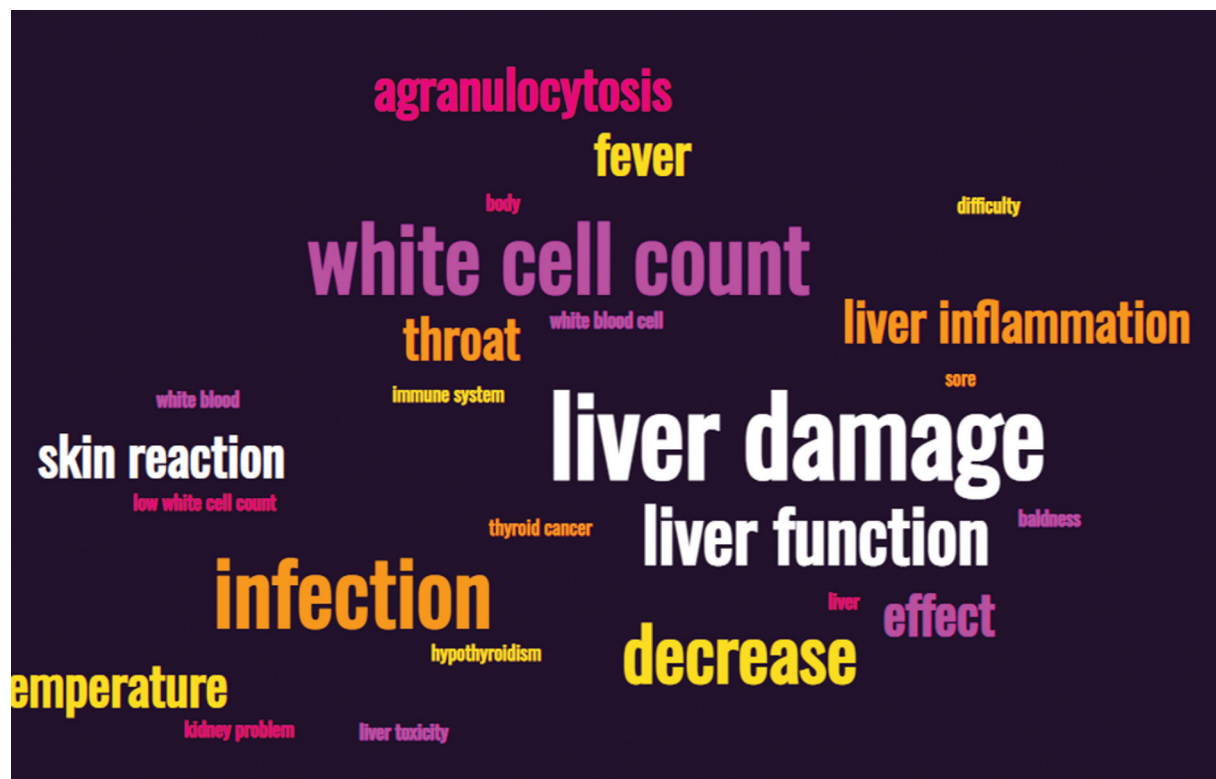
In response to the case scenario that an appointment to see the GP was offered in 5 days, 27.1% (26/96) of patients accepted this, and 91.7% (22/24) continued to take ATDs. The second response to the other case scenario showed that on the following day, the symptoms were worse, 52% (13/25) of patients sought immediate medical advice, and 79.2% (19/24) of patients responded that they would continue taking the antithyroid medication. The scenario of further worsening symptoms and an inability to access medical attention led to 69.9% of patients discontinuing the antithyroid medication, and many 88.4% (91/96) would now seek emergency medical help. Concerning symptoms of agranulocytosis other than a sore throat, 34.7% of patients stated they would act differently if the symptoms were fever, and 59.2% would act differently if they had multiple painful mouth ulcers. In 5.1% (12/18) and 4.1% (4/98) of cases, patients said they were less likely to seek medical attention than if they had a sore throat.

#### Online Information on ATD-Induced Agranulocytosis

The web sites were a wide collection of commercial, personal, local journals, and magazines. They were either interviews, patients' information, or self-advertising. The majority could not be tracked to an organization and the level of authority can be ascertained in most of them. \*\*\*\*Only the relevant eighty-eight web sites considered the treatment of hyperthyroidism were counted as relevant. Of these, 63 did not mention the side effects of ATDs, 13 sites did mention ATDs but made no recommendations, and only 11 sites at the time of the review gave excellent descriptions and correct recommendations. These 11 sites could be considered reliable and sound.

#### Comparison of Patients' Perceptions in UAE and UK

Notwithstanding the differences between the circumstances of the two regions, the supplementary materials in **Supplementary Appendix S1** and **S2** (available in the online version) compare awareness and confidence, information



**Fig. 1** Word cloud representation of the free text responses of patients.

source, and self-rated quality and quantity of information reported from patients from the present study UAE Study). Also, ► **Supplementary Appendix S2** (available in the online version) compares the patients' responses to what they would do in a scenario based on several hypothetical scenarios of current ATD users. Our patients have significantly lower awareness of the cardinal symptoms of agranulocytosis (fever/sore throat) than in the UK. There was less satisfaction with the amount of information received about the side effects of ATDs by our patients than the UK patients (► **Supplementary Appendix S1**, available in the online version). However, consultation with a health professional is the preferred method to receive information by both groups, although it is more emphasized by our patients (72.53% versus 57.4%). There were no differences in the quality of information and the self-rated confidence in dealing with the situation. However, our patients tended to be less proactive in dealing with suspected agranulocytosis by seeking immediate medical advice with persistent symptoms (► **Supplementary Appendix S2**, available in the online version).

## Discussion

We report a study of the problem of ATD-induced agranulocytosis from three different angles. We combined the assessments of doctors' perceptions and practices regarding the risk and management of ATDs with patients' knowledge and practices. We added a careful evaluation of web sites claiming to provide safety information to patients receiving ATDs. This study is the first to combine these three methods for this problem. This approach is most appropriate to address this

serious adverse effect of conventional medication. The patients' population came from four clinics representative of different geographical areas of the UAE, and all data were derived from detailed face-to-face structured interviews. The interview included a hypothetical case scenario designed to ascertain the response to symptoms of agranulocytosis with a three-step increase in complexity based on a previously tested instrument.<sup>21</sup> The physicians' questions addressed their perceptions of ATD-induced agranulocytosis and their timely action to detect this complication. Also, physicians were representative, although the sample size is admittedly small. The Internet search was reasonably exhaustive and covered adequately what an ordinary patient may encounter in an Internet search.

This survey revealed serious deficiencies in the three aspects of the research question. There was an unacceptable degree of complacency among physicians who admitted not alerting their patients systematically about the side effects of ATDs. This attitude could explain the suboptimal knowledge level among the patients. Patients in the present survey took a long time down the scenario timeline before they saw emergency services, indicating no realization of the situation's urgency and the need to act immediately. Contrary to what is expected, patients continue to take the ATDs while waiting to see their GP or hospital clinic. Furthermore, there needed to be more clarity about the relative importance of various symptoms of agranulocytosis (sore throat, fever, mouth ulcers), and each of these symptoms had a different impact on action taken for a significant proportion of participants, similar to the UK survey respondents.<sup>21</sup> The slight differences in professional

designations of healthcare organizations between the UAE and the UK did not prevent making comparisons between the two studies (Supplementary Material). Patients' knowledge about the side effects of ATDs was below optimal. Most participants did not know the symptoms of agranulocytosis, and although half stated that they had received no information from professionals, a minority recalled any reminders. Some of the patients sought information either on the Internet or relied on the drug packet insert. The responses also indicated that the quality and amount of information received often needed to be improved. The responses to the hypothetical scenarios were incompatible with careful attention to alarming symptoms suggestive of possible agranulocytosis, reflecting low-level knowledge among the patients. However, the responses indicated the preparedness of patients to receive more information and guide them to their preferred methods of receiving it, which should be helpful to regional care providers. Written material was very rarely used to enhance patients' education. Repetition is vital to retaining information to be recalled readily and correctly when dealing with a life-threatening situation.<sup>22</sup> However, reminding patients of the side effects of ATDs by health professionals was reportedly infrequent similar to the UK Study.<sup>21</sup>

Patients with thyroid disease and their families are increasingly browsing the world wide web for medical information. As the information offered is likely to influence their healthcare choices, endocrine care providers must understand the quality and accuracy of that information. Although a minority of our patients' recourse to the Internet, it is alarming that Arabic web sites are poor and may even be dangerously harmful. Similar findings were shown in relationship to several common and less common conditions other condition.<sup>15-20</sup> However, it is still possible that patients using these sites may harm in an emergency when precious time may be lost. The sample size of these web sites is similar to other studies of similar nature.<sup>15-20</sup>

The study is limited by the small sample sizes of patients and healthcare professionals. Also, there is a potential lack of reliability associated with patients' surveys and selection bias (particularly for the web-based survey), heterogeneity of the subjects (duration of taking medication), recollection bias, and the difference between providers. The demographics were similar to that expected from a population of patients treated with ATDs for hyperthyroidism, suggesting that the sample is likely to be representative. Some of the findings of this survey were similar to audits conducted in other UK centers.<sup>11,12</sup> The findings of this survey are likely to reflect the broader population of patients being treated with ATDs. Mortality from ATD-induced agranulocytosis is very low. Nonetheless, educating patients taking ATDs about agranulocytosis is good practice. Such information ought to be evidence-based, clear, and consistent. The Internet search showed significant inconsistencies.

## Conclusions

The minimum requirement is for information on ATD's safety should be delivered by a healthcare professional during the

consultation and enhanced and reminders during subsequent consultations. Physicians should also take the issue seriously and advise patients consistently. Since the highest risk of agranulocytosis is in the first 3 months after commencing ATDs, efforts to educate patients are best concentrated in the initial phase of treatment. Professional organizations and patient advocacy groups should take the lead to provide correct and clear information on the web for patients in local languages.

### Authors' Contributions

SAB designed the study, managed the project, drafted the manuscript, and conducted the physicians' survey. All authors contributed substantially through patients' survey data collection, analysis, and review and approval of the final version of the manuscript. EA performed the Internet patients' information survey.

### Compliance with Ethical Principles

The Sheikh Khalifa Medical City IRB approved study parts involving human subjects. All participants provided explicit informed consent to participate electronically (physicians) or verbally (patients) before participation in the surveys. All data are collected anonymously.

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None received.

### Conflict of Interest

None of the authors declared any multiplicities of interests that may potentially jeopardize the integrity of the study.

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