Crossword Puzzle as a Learning Tool to Enhance Learning about Anticoagulant Therapeutics

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Abstract

Background

Educational games make the learning process more enjoyable, fun, and create a competitive classroom environment that can positively affect learning. This study sought to implement and evaluate pharmacy students' perceptions towards using crossword puzzles (CWPs) as a learning tool in the pharmacotherapy cardiovascular module focusing on the therapeutics of anticoagulants.

Methods

Clues for the puzzle were developed, validated, and piloted by course faculty. A free internet puzzle generator was used to create puzzles with 10 to 20 clues. Students were given 30 minutes to solve the puzzle following the completion of the didactic topic. An 8-item survey instrument and Pharmacists' Inventory of Learning Styles (PILS) questionnaire were administered to examine students' perceptions of the game and their learning style preference, respectively.

Results

Over three consecutive course offerings, 267 students participated in the activity from both undergraduate programs (Bachelor of Pharmacy (BPharm) and Doctor of Pharmacy (PharmD)). Most students expressed favorable perceptions of the puzzle. Female and BPharm students had significantly more favorable perceptions than male students and PharmD students on several perception items. There was no association between student perceptions and their learning styles.

Conclusion

CWP presented an innovative, creative, and easy active learning tool to enhance students' learning and engagement.

Background

Old habits are hard to break. Didactic lectures continue to resemble the school days of Charlie Brown and his schoolteacher in the classroom. The COVID-19 pandemic has further complicated effective delivery of didactic lectures with the absence of the visual confirmation that students are actively participating and understanding the information. Such barrier has led to a lack of learner engagement objectively exemplified by an increase in absenteeism in pharmacy school lectures, students underestimating the importance of lectures, and a corresponding decrease in performance, particularly in therapeutics courses^{6,7}. Contrarily, students who are stimulated by effective learning methods are more likely to attend lectures than their colleagues⁸. On average, the first 10 minutes of a lecture are associated with the peak of student attention and highest retention of information⁹⁻¹¹. Student interest declines from that point and is barely salvaged in the last 5 to 10 minutes. In totality, students are disengaged for approximately 75% of the lecture. This is not surprising since millennials have been weaned upon technological

advances and various means of communication and entertainment ^{12,13}. This has resulted in both reality and an absence of consistent stimulation becoming something that is no longer considered intriguing.

Evidence supports the positive impact of using innovative educational tools to benefit the teaching and learning process for health professions, and pharmacy education is no exception ¹⁴. The Accreditation Council for Pharmacy Education (ACPE) placed high emphasis in “Standard 10: Curriculum Design, Delivery, and Oversight” on student engagement through teaching and learning activities that promote self-directed learning and accommodate the diverse learning needs of students ¹⁵. Gleason and colleagues categorized classroom-based active learning methods into five types: Cooperative Learning, Problem-Based Learning, Team-Based Learning, Case-Based Learning, and Ability-Based Education and Assessment-as-Learning ¹⁶. Stewart et al. surveyed 114 US colleges and schools of pharmacy faculty members to evaluate the extent and the promoting factors for using active learning techniques ¹⁷. Eighty-seven percent of the faculty members reported using active learning activities such as case-based learning (71%), deliberative discussion (50%), team-based learning (47%), clickers (45%), simulation (25%), Interactive Web-based learning (19%) and process-oriented guided inquiry learning (12%). Promoters for active learning techniques include younger faculty age, lower faculty rank, and departments of pharmacy practice or social/behavioral/administrative sciences. In the Middle East, Alruthia et al. surveyed faculty members in health colleges from 17 countries throughout the region ¹⁸. The majority of pharmacy colleges respondents (n=202) acknowledged utilizing various active learning strategies including class discussions (87%), small group discussions (56.9%), learning by teaching (49.5%), case studies and problem-based learning (41.1%). Several other studies have also described the incorporation of active learning techniques into pharmacy curriculum ^{17,19–23}.

Gamification or serious games have gained popularity recently ^{24–26}. In their overview of game implementation in the classroom, Biehle and Jeffres provided four essential fundamentals toward game development and use: (1) Motivation for participating should initially be external with the objective of internally motivating the student to master the material, (2) students should benefit from the material whether they win or lose, (3) all students should equally be engaged in participating, and (4) the objective of the game should be clearly explained to the students ²⁶. Several systematic reviews concluded that gamification can possibly improve the learning outcomes of health professions education including pharmacy ^{27,28}. The published literature includes descriptions of a lengthy list of the different types of games used to aid students in learning ^{5,22,29–45}. The use of crossword puzzle (CWP) has been used occasionally in the literature with studies conducted in several pharmacy courses. Gaikwad et al. reported a significant improvement between CWP pre- and post-test scores when used in a pharmacology course covering antihypertensive and antiepileptic drugs for second-year Bachelor of Medicine and Bachelor of Surgery (MBBS) medical students ⁴¹. Medical students in their fifth year of the MBBS degree indicated satisfaction with a CWP covering hormonal contraceptives ⁴². Student perceptions toward the activity were also positive. Shah and colleagues developed a CWP during a pharmacology and medicinal

chemistry module about anti-ulcer agents ⁵. A post-activity survey revealed that most students over a two-year period enjoyed the CWP and felt as if it enhanced their learning.

Although it is assumed that active learning strategies will increase student engagement for most participants, there is scarce of literature that investigated whether there is an association between student learning styles and their preference for active learning strategies in the classroom. Conversely, when a mismatch occurs in the instructor's teaching style and a student's learning style, student learning may be impacted ⁴⁶. A study describing millennial students in the Philippines found that most students are application-oriented, focusing on applying what they studied to what they learned in practice ⁴⁷. This finding is important given that modern pharmacy curricula include more application courses and experiential education. Crawford et al. compared the dominant learning styles of pharmacy students and faculty members and found no significant differences between faculty members and student learning styles ⁴⁸. However, the study found that learning styles differed by gender and faculty track (tenure vs clinical).

Studies evaluating the use of CWP as an educational tool for learning therapeutics aspects of drugs in Saudi Arabia are limited. The objective of this study was to evaluate students' perception toward the use of CWP as an educational tool for enhancing their learning about anticoagulant therapeutics taught in the pharmacotherapy courses in the Doctor of Pharmacy (PharmD) and the Bachelor of Pharmacy (BPharm) undergraduate programs. In addition, we sought to determine whether students' learning style preferences influenced their perception of this active learning technique.

Methods

The CWP was implemented as an active learning tool in therapeutic courses for the PharmD and BPharm programs. These courses are covered in the seventh level (third professional year), and the content included module on cardiovascular diseases including the use of anticoagulant drugs. Didactic lectures on the management of venous thromboembolism and atrial fibrillation with overview of anticoagulant drugs were discussed over 6 contact hours. The learning objectives related to anticoagulant therapy are presented in Table 1. CWP was developed using a free online CWP generator (TheTeachersCorner.net). The course instructors developed the puzzle clues (questions and answers) based on the material covered during the lectures and designed to cover Bloom taxonomy of knowledge, comprehension, and application levels. The content validity of these CWP was mapped to the intended learning outcomes of the modules and was peer-reviewed by another course instructor. Additionally, the CWP was also piloted among a group of student interns in their advanced pharmacy practice experiential training. Printed copies of the CWP were provided to the students to solve immediately after the lecture (BPharm group, 10 clues CWP) or during pharmacy practice lab (PharmD group, 20-clues CWP). During these sessions, students were divided into groups, and 30 minutes was allocated for solving each CWP. Although students were expected to self-correct the answers to solve the puzzle, a debriefing session was provided to discuss any confusing points or misconceptions related to the topic. An example puzzle is shown in Fig. 1. At the end of the activity, students were asked to complete two post-activity surveys administered

via SurveyMonkey. The first survey was the Pharmacists’ Inventory of Learning Styles (PILS), a survey tool validated for pharmacy practice ⁴⁹. The second survey was an 8-item questionnaire to measure students’ attitudes towards the use of games in learning developed by Shah et al ⁵. No extra marks were given to the students for completing the puzzle or the survey. Students were also informed that their grade in the course would not be impacted by their participation, or lack thereof, in the activity. We implemented the CWP over three consecutive years using different puzzles. The study was approved by institutional review board at King Saud University and was granted an exemption status (**Project # E-21-6205**).

Table 1
Specific Learning Objectives for Lectures Covering Anticoagulation therapeutics.

<p>PHCL 412 and PHCL 416 Anticoagulation Therapy Lectures Objectives:</p> <ol style="list-style-type: none"> 1. Compare and contrast between the different anticoagulant therapies about: <ol style="list-style-type: none"> a. Place of therapy b. Mechanisms of action c. Advantages and disadvantages in terms of their pharmacokinetic and pharmacodynamic properties (e.g. dosing, onset of action, drug & food interaction, etc) d. *Key pivotal clinical trials of anticoagulant drugs e. Side effects and management f. Monitoring of drug therapy g. Patient education h. *Use in selected population (e.g. cancer patients, pregnancy, morbid obesity, renal impairment, and pediatrics) 2. Apply evidence-based guideline recommendation for the use of anticoagulants in the: <ol style="list-style-type: none"> a. Prevention and treatment of venous thromboembolism b. Stroke prevention in Atrial fibrillation c. *Perioperative management of anticoagulant therapy
<p><i>* not included in the learning objectives for PHCL 416</i></p>

Statistical analysis:

The data were analyzed using IBM SPSS Statistic version 22. The data was presented in frequencies (N) and percentages (%). The continuous data were expressed by the mean and standard deviation (SD). A normality test (Kologrove-Smirnov and Shapiro-Wilk test) was conducted for the dependent variables (student perceptions of CWPs) and the independent variables (gender and education degree) to determine whether students' perceptions were normally distributed among gender categories (i.e. male and female)

and education degree categories (i.e. PharmD and BPharm). As data were not normally distributed, the Mann-Whitney U test was used to test for the differences in perception among the independent groups.

Results

Data were available on 267 students who participated in the game. The mean age of the students was (21.34 ± 1.21), the majority were females (67%), and two-thirds (71%) were enrolled in the PharmD program. Table 2 summarizes the student demographics. On the PILS survey, the most preferred learning styles among all students were convergers (35.6%) and assimilators (25.3%), while 15.7% of students were multimodal. Learning style order of preference based on gender showed a significant difference ($p < 0.05$), with female students preferring assimilator and converger learning styles, while male students' preference was higher for accommodator and diverger learning styles. Less than 10% of students were able to complete the puzzle in 30 minutes and fewer number have correct answers. On the perception survey, students perceived that CWP helped them to identify the most important topics to focus on (82.4%), served as a good review of the lecture material (81.3%), enjoyed classmate interaction, and reviewing material while solving puzzle (79.1%), enhanced their learning (77.2%), found the material pertinent (74.2%) and learned more from the class because of CWP (67.4%). Most of the students perceived the amount of time given was sufficient (73.1%) and most of them expressed preference to have extra credits for such activities (67.4%). Table 3 summarizes students' perceptions of CWP as a learning tool.

Table 2
Demographic Characteristics (N=267)

Characteristics	N(%)
Age (years)*	21.34 ±1.21
Gender	
Male	88 (33)
Female	179 (67)
Learning style‡	
Accommodator	28 (10.7)
Assimilator	66 (25.3)
Converger	93 (35.6)
Diverger	34 (13.1)
multimodal	41 (15.7)
Educational degree	
PharmD	191(71.5)
BPharm	76 (28.5)
<i>*mean ± SD, ‡ (6 students did not answer this question)</i>	

Table 3
Student Perceptions of CWP as a Study Tool (N=267)*

Question	Mean (SD)	Strongly Disagree N (%)	Disagree N (%)	Neutral N (%)	Agree N (%)	Strongly Agree N (%)
The CWP provided enhanced my learning	4.1(0.9)	7(2.6)	9(3.4)	45(16.9)	119(44.6)	87(32.6)
Enjoyed classmate interaction and reviewing material while solving puzzle	4.1(0.9)	5(1.9)	9(3.4)	42(15.7)	104(39)	107(40.1)
CWPs oriented us to the topics we should focus on	4.1(0.8)	5(1.9)	7(2.6)	35(13.1)	121(45.3)	99(37.1)
Length of time provided for solving the puzzles was sufficient	3.9(0.9)	5(1.9)	18(6.7)	49(18.4)	100(37.5)	95(35.6)
The material on the puzzles was pertinent	3.9(0.8)	5(1.9)	3(1.1)	61(22.8)	118(44.2)	80(30)
Learned more in class because of the CWPs	3.8(0.9)	5(1.9)	18(6.7)	64(24)	115(43.1)	65(24.3)
Solving CWPs are good reviews of material covered	4.0(0.8)	4(1.5)	9(3.4)	37(13.9)	125(46.8)	92(34.5)
Extra credit should be associated with activities such as CWPs	4.0(0.9)	6(2.2)	13(4.9)	52(19.5)	94(35.2)	102(38.2)
<i>*Survey adapted with permission from Ref 36.</i>						

There was a significant difference in students' perception of CWPs among gender groups. Female students had a significantly higher mean score for the statement "length of time provided for solving the puzzles was sufficient" than their male counterparts ($p = 0.001$) (Table 4). Furthermore, there was also a significant difference in student perceptions about CWPs among the two different undergraduate programs. The BPharm students' mean score was significantly higher on several perception questionnaire items compared to PharmD students, specifically on statement items "CWPs oriented them to the topics they should focus on" ($p = 0.003$), "the length of time provided for solving the puzzles was sufficient" ($p = 0.001$), and "the material on the puzzles was pertinent" ($p = 0.038$). There was no association observed between learning style and student's perception of CWP ($p = 0.19$). Student feedback and suggestions about using the CWP in the teaching and learning process are summarized in Table 5. Overall, students found the method enjoyable and helpful to memorize and retain the newly learned information; however, several students urged that it would be much better if they had the chance to check their spelling or use their reference books. Students also believed that CWP is an effective way to teach

confusing subjects prior to exams and suggested to extend the use of CWP for other topics such as antibiotics, drug-drug interactions, microbiology and medicinal chemistry.

Table 4
Association of Student Perceptions of CWPs with demographic Characteristics

Question	Gender		P value*	Education degree		P value*
	Male	Female		PharmD	BPharm	
	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
The CWP provided enhanced my learning	4.0(0.98)	3.9(0.90)	0.462	3.9(0.91)	4.0(0.97)	0.463
Enjoyed classmate interaction and reviewing material while solving puzzle	4.0(0.94)	4.1(0.91)	0.416	4.1(0.91)	4.1(0.94)	0.840
CWPs oriented us to the topics we should focus on	4.0(0.93)	4.1(0.84)	0.741	4.0(0.85)	4.3(0.90)	0.003
Length of time provided for solving the puzzles was sufficient	3.7(1.02)	4.1(0.95)	0.001	3.8(0.98)	4.2(0.96)	0.001
The material on the puzzles was pertinent	3.8(0.88)	4.0(0.85)	0.163	3.9(0.82)	4.1(0.95)	0.038
Learned more in class because of the CWPs	3.7(1.01)	3.8(0.91)	0.668	3.7(0.91)	3.9(1.01)	0.086
Solving CWPs are good reviews of material covered	4.1(0.83)	4.0(0.87)	0.971	4.0(0.86)	4.1(0.86)	0.146
Extra credit should be associated with activities such as CWPs	4.1(0.87)	3.9(1.03)	0.051	3.9(0.99)	4.2(0.93)	0.008
<i>*Mann - Whitney U test</i>						

Table 5
Students' free comments on the CWP activity

Feedback about using the game in the teaching-learning process	Suggestions for future use
<ul style="list-style-type: none"> ● Change the narration style and create a stimulating learning environment for students. ● "It is much better studying in game format rather than normal assignments." ● "I liked how we did not use any reference to answer it was a mind refreshing activity." ● "I like the idea it is creative and fun, it made me focus more on the spelling which is important." ● Improve thinking and memorizing. ● "Made my brain thinks faster" ● "A good change in the routine it made me want to pay mor attention in class" 	<ul style="list-style-type: none"> ● "It was good, but I wish we were able to check spell." ● Puzzles to solve in shorter time ● It should be implemented after each pharmacotherapy block. ● Assigning grades/bonus will be also rewarding. ● Use it to teach confusing subjects. ● Use it as a review before the exam. ● Let students know before hands about the puzzle

Discussion

The pathophysiology and therapeutic of cardiovascular diseases, specifically topics about thromboembolism and atrial fibrillation are essential topics taught in the Pharm.D. and Bachelor programs in King Saud University, Riyadh, Saudi Arabia. These cardiovascular topics are usually introduced in the first therapeutic course series, and they require students to use critical thinking and clinical decision-making skills when implementing guideline recommendations, which most student perceive it to be challenging. The courses also rely on student's prior knowledge on the pharmacology of cardiovascular drugs. Feedback from students and course faculty showed students' knowledge about anticoagulant drugs pharmacology was suboptimal due to misalignment of some topics in the curriculum. To ease out student's trepidation, the course instructors utilized variety of active learning pedagogy to engage students in this first therapeutic course, including CWP activity. To the best of our knowledge, this is the first study conducted to evaluate the pharmacy' students' perceptions about the use of CWP for enhanced learning about the anticoagulating therapeutics in Saudi Arabia.

In the present study, student perceptions about the value of CWP was generally positive. Overall, most of the students agreed that CWP enhanced their learning, oriented them to key information they need to focus on, improved retention of information and was a good review for the material covered in the lectures. These findings in consistent with other published studies ^{1,3,50}. Shah et al. reported higher agreement on the same survey items compared to the present results. Ninety percent of students indicated positive perceptions such as CWPs enhanced their learning, helped them focus on important topics in the lectures, and served as a good review of the lecture material ⁵. Mirroring the results from

other studies about the recreational and fun aspects of the puzzles, most students enjoyed the classroom interactions while solving the puzzle. They felt the puzzle was interactive, enjoyable, and encouraged a competitive environment within the classroom^{2,3,42,51–55}.

In the current study, students from the BPharm program reported statistically significant positive perceptions compared to PharmD students specifically on the following items: “CWP oriented us to the topics we should focus on” and “the material on the puzzle was pertinent”. This difference could be explained by the fact that traditional teaching is more predominant in BPharm curriculum. Crawford et al. found significant differences between tenure track and clinical track learning styles among faculty at the University of Illinois at Chicago Pharmacy college⁴⁸. The tenure track had a predominantly abstract sequential learning style that focuses on theoretical concepts and analytical approaches. The clinical faculty have a more concrete sequential learning style that focuses on application and practicality of information. The use of active learning is reported to be higher in clinical faculty members and faculty members in the social/behavioral/administrative sciences¹⁷. In KSU, BPharm curriculum is focused predominantly on pharmaceutical sciences, with only two therapeutic courses.

On the perception item about “the length of time provided for solving the puzzle was sufficient”, students from the BPharm program have a significantly higher agreement than the PharmD students ($p=0.001$). We attributed this difference to the shorter puzzle administered to the BPharm group (10 clues) compared to the PharmD group (20 clues). Nonetheless, different studies reported described variable clues numbers ranging from 12 to more than 50 and completion time from 5 to 60 minutes, and all showed favorable agreement that the allocated time was adequate regardless of the size of the puzzle or completion time^{2,5,42,50–52,56–59}. Notably, in the current study male students were less satisfied with the time provided for solving the puzzles than female students. Two factors could have produced such difference. First, active learning, specifically games, are less utilized by male faculty. This is supported by a recent study that found that female faculty are more likely to implement active learning strategies in classroom teaching than male faculty¹⁸. Furthermore, faculty from different generations could be differ in their interaction, learning, and teaching skills regardless of gender¹³. Second, gender variation in learning styles could have affected their perceptions about the time. Although some studies have reported more men being divergers and women have an assimilator learning style, others did not find such differences^{48,60–62}.

The present study found that the predominant learning style in our student population is consistent with the learning styles of pharmacists and pharmacy students reported in the literature^{47–49, 60,63–65}. The learning styles primarily reported with the pharmacy profession are assimilators and convergers. Similarly, in this current study, the converger learning style was predominant in both male (35%) and females (36%). The second most prominent learning style was assimilator in female students (33%) and divergent in male students (26%). It is worth noting that male representation in this study is only one third of the sample studied. No significant difference was found between student perceptions about CWP and their learning styles. Studies on the relationship between pharmacy students learning styles and academic performance are scarce and with divergent conclusions. A study conducted in medical

students in Thailand showed that students' learning styles differed between pre-clinical and clinical years. Furthermore, the learning style is only associated with students' academic achievement during the pre-clinical years, with the reflective learning style associated with high academic success^{66,67}. Another study found a similar correlation between reflective abilities and academic success in undergraduate pharmacy education⁶⁸. Both assimilators and divergers on the Kolb learning style inventory possess reflective abilities⁶⁹. On the other hand, several other studies did not find an association between learning styles and academic achievement⁶¹.

Millennials (those born between 1981 and 1996), represented by students participating in the current study, could have different approaches to learning and different preferences of learning styles, hence, different perceptions towards the variable approaches of learning. Corrido et al showed that based on Vermunt's Inventory of Learning Styles (ILS), millennial Filipino pharmacy students have a predominantly application-directed learning style (i.e. those who try to discover relationships between things and apply what they learned); followed by a reproduction-directed learning style (i.e. those who memorize the learning content in order to be able to reproduce it in a test)^{47,70}. Eng et al. also concluded that learning styles inventory could influence the learning environment during experiential education of millennial pharmacy students⁷¹.

The previous studies and others raise an important issue to consider for both educators as well as students about identifying learning styles to improve learning experience rather than to stigmatize. Student's self-awareness about their learning styles can help them refine their study habits and encourage them to reach out to faculty members when struggling academically due differences in teach and learning styles; therefore, the learning environment can be catered to maximize students' gain, confidence, and ability to transfer learning. At the same time, for faculty and preceptors, self-awareness of their own learning style and that of their students could help improve teaching styles and promote better approaches to better facilitate teaching and assessment.

The open comment section of the survey highlighted how the students valued the puzzle activity as a learning and self-assessment tool. One of the interesting comments repeated by several students is the fact that spelling was an obstacle while solving the puzzle. Other researchers reported similar spelling challenges surfaced while solving CWP^{3,55,72,73}. For pharmacy students, such accuracy is vital to patient and medication safety. The positive reception toward this tool encourages faculty members to develop creative tool that carry low burden (such as the CWP) to engage students especially in large class-size, which can be deterrent to incorporating active learning in teaching⁷⁴.

This study had several limitations. First, due to logistic reasons, administering the puzzle in relation to the lecture delivery was variable among the cohorts (right after the lecture, during the same week, or two weeks later). Although this might have affected the recall of information, the several open comments about spelling difficulties could be the main reason for not getting the right answers. Secondly, there was only one BPharm cohort group compared to three PharmD cohort groups. Thirdly, the length of the puzzle used for the BPharm group was shorter (10 questions and clues vs 20 for the PharmD group); this is

mainly because the content material for the BPharm is less than the PharmD and the need to deliver the puzzle in the short break after the lecture immediately. The learned information could have still been fresh and easy to retrieve. Hence, the perception of time sufficiency was satisfactory. Lastly, we did not assess the impact of the game on short- or long-term retention of the information, nor on student's final grade in the course or pre- and post-testing examination; however, the activity was purposely implemented to guide students towards the most important information about the topic and assist them to identify any gaps in knowledge or understanding.

Conclusion

The study demonstrated that students valued active learning engagement in the class environment using the CWP. CWPs presented an easy and versatile tool that can be customized in difficulty to enhance students' educational experience and promote more self-awareness of the teaching and learning trends for both students and faculty. Providing students with a self-learning tool and engaging them during the learning process may lead to better understanding, retention, and application of the learned material and eventually in academic performance. Future studies should investigate the impact of CWPs on both short- and long-term retention of the lecture material.

Abbreviations

ACPE

Accreditation Council for Pharmacy Education

BPharm

Bachelor of Pharmacy

CWP

Crossword Puzzle

KSU

King Saud University

PharmD

Doctor of Pharmacy

PILS

Pharmacists' Inventory of Learning

Declarations

Ethics approval and consent to participate

The activity described in this study was conducted as part of the course delivery, no consent form provided. The study was approved by institutional review board at King Saud University and was granted an exemption status (**Project # E-21-6205**).

Consent for publication

Not applicable

Availability of data and material

Data are available upon request

Competing interests

none

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Authors' contributions

Conceptualization, and Methodology, G.B.; Validation, G.B., A.D.; Formal Analysis, M.M.;

Investigation, G.B. I.S.; Resources, M.J. H.B.; Data Curation, H.B., M.J.; Original Draft Preparation, G.B., I.S., M.M.; Writing – Review & Editing, G.B., I.S., A.A. A.D.; Visualization, G.B.;

Project Administration, G.B., I.S. A.H., A.D.; Funding Acquisition, I.S. All authors approved the final manuscript prior to submission.

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Figures

Anticoagulation Therapeutics

Complete the crossword below. Please ignore any space or special characters such as periods or hyphens.
Answers are not case sensitive.

Created using the Crossword Maker on TheTeachersCorner.net

Across

1. causes dyspepsia as the most common side effect
6. preferred to use in cancer and pregnant women
7. a synthetic, injectable indirect FXa inhibitor
9. an option in patients receiving rifampin
10. all pivotal trials showed that DOAC efficacy is _____ to warfarin in VTE treatment
12. site for drug interaction with all DOAC
15. a substance given to minimize DOAC absorption in case of toxicity
16. a DOAC that can be dosed once daily
17. a tool to assess risk of major bleeding in patients with atrial fibrillation
18. dose should be taking with the evening meal
20. a non-hemorrhagic and life-threatening side effect of heparin

Down

2. an anticoagulant that can be used in individuals with HIT
3. the site of action of dabigatran
4. a warfarin antidote
5. not an indication of DOAC
8. a parameter, if negative, can rule out VTE
11. a DOAC that can be used for initial management of VTE without injectable anticoagulant
13. duration (in months) for the treatment of provoked DVT
14. a lab parameter to assess and adjust warfarin therapy
19. lab parameter to assess and adjust heparin therapy

Figure 1

An Example of a CWP Clues