Journal of Anesthesia (2020) 34:944–949
https://doi.org/10.1007/s00540-020-02840-5

REVIEW ARTICLE

Analogy between classical Yoga/Zen breathing and modern clinical respiratory therapy

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Received: 2 July 2018 / Accepted: 9 August 2020 / Published online: 17 August 2020

Abstract
Anesthesiologists and intensivists are modern-day professionals who provide appropriate respiratory care, vital for patient survival. Recently, anesthesiologists have increasingly focused their attention on the type of spontaneous breathing made by non-intubated patients with pulmonary disease cared for in an intensive care unit, and also patients with chronic pain receiving cognitive behavioral therapy. Prior to our modern understanding of respiratory physiology, Zen meditators recognized that breathing has a significant impact on a person's mental state and general physical well-being. Examples of this knowledge regarding respiration include the beneficial effects of deep inhalation and slow exhalation on anxiety and general wellness. The classical literature has noted many suggestions for breathing and its psycho-physical effects. In the present review, we examine the effect of classical breathing methods and find an analogy between typical Yoga/Zen breathing and modern clinical respiratory therapy. Evidence is increasing about historical breathing and related meditation techniques that may be effective in modern clinical practice, especially in the field of anesthesiology, such as in improving respiratory function and reducing chronic pain. Clarification of the detailed mechanisms involved is anticipated.

Keywords Zen · Spontaneous breathing · Respiratory care

Importance of spontaneous breathing

Respiration is fundamental to normal human physiological function. Anesthesiologists and intensivists are modern-day professionals who provide respiratory care during surgery, interventional procedures and intensive care [1–6].

Recently, the effects of breathing management have re-focused on more general health-care interests, such as "mindfulness", from a neuroscientific viewpoint [7, 8]. The sedative action of particular types of breathing has been evaluated by electroencephalography [8, 9], and functional magnetic resonance imaging [10–12], as well as other scientific techniques. The resultant modifications in autonomic nervous activities have also been assessed by physiological measurements [13, 14]. The pain-managing effect of certain types of breathing has often been clinically evaluated in cognitive behavioral therapy, in which patients are taught to breathe in a particular way to control their pain [15, 16].

In patients with acute respiratory failure and acute respiratory distress syndrome, spontaneous breathing is associated with multiple physiologic benefits: it prevents muscle atrophy, avoids paralysis, decreases sedation needs and is associated with improved hemodynamics [17]. But, there are still many unresolved controversies concerning the advantages and disadvantages of maintaining spontaneous breathing in critically-ill patients with respiratory failure. Notably, barotrauma and volutrauma may be induced during supportive spontaneous ventilation (i.e. injurious supportive ventilation and/-or patient-ventilator asynchrony) [17–19]. Currently, patients are educated on how to inhale and exhale by respiratory therapists, to achieve better oxygenation and carbon dioxide exhalation.

Before such modern medical management techniques were introduced, Yoga and Zen meditators also had a profound interest in the management of breathing and its psycho-physiological effects. In this review, we briefly describe the respiration-related knowledge of Zen and Yoga meditators and compared their methods with modern clinical recommendations.

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How breathing is viewed in European and Asian societies

In Europe around the fourth century BC, the Hippocratic School considered breathing to be an important part of living [20, 21], giving detailed descriptions of various breathing patterns. However, scholars in Europe were more interested in the anatomical and physiological aspects of breathing.

In contrast, in oriental countries, the notion that the method of breathing has a significant impact on health has been transmitted from country to country [22]. This idea can be traced back approximately 3000 years to India. Although the precise age of this concept cannot be specified, inscriptions in ancient ruins suggest that people long ago considered that the method of breathing had a special effect on human health [23].

Trends in Yoga breathing from ancient India

Yoga refers to a group of physical, mental and spiritual practices or disciplines that originated in ancient India. The origins of Yoga have been speculated to date back to pre-Vedic Indian traditions (1500–600 BC), although they most likely developed around the sixth and fifth centuries BC. In Yoga, breathing methods are a key issue, even in the most classical Yoga practice, and are considered to be important for mental and physical stability [22]. Yoga breathing techniques and meditation influence physical and mental functions.

Pranayama is a typical way of breathing in Yoga. *Pranayama* is a Sanskrit word that translates as “breath control” (Fig. 1). Several researchers have reported that *Pranayama* techniques are useful in treating a range of stress-related disorders [24].

Another well-known Yoga breathing technique is, *Ujjayi* breathing, a diaphragmatic breathing method that is better known as “ocean sound”. It first starts by filling the lower belly, rises to the lower rib cage, and finally moves into the upper chest and throat. Inhalation and exhalation are both done through the nose. The "ocean sound" is created by moving the glottis as air passes in and out. The length and speed of each breath are controlled by the diaphragm as one imagines oneself by the sea, breathing with the rhythm of the waves. Inhalations and exhalations are equal in duration and are controlled in a manner that causes no distress to the practitioner. This helps bring air into all parts of the lungs, increases oxygenation, builds internal body heat and regulates blood pressure [25]. Another technique, the *Kapalabhati* involves short and strong forceful exhalations followed by automatic inhalation. It is thought to be effective for cleaning the cranial sinuses. Finally, *Nadi Shodhana* is an alternative nostril breathing method that helps in becoming calm.

Fig. 1 *Pranayama* image. *Pranayama* is the conscious awareness of breathing: the life force that both energizes and relaxes the body. The term is derived from the Sanskrit, *prana*, meaning "life force," and *ayama*, meaning "extension." *Pranayama* is an integral part of Yoga. Controlled breathing enables both a rhythm for performing Yoga poses and a relaxation of the mind for meditation

The breathing of Buddha

The Buddha (Gautama Śiddhārtha: 1029 BC–949 BC, 624 BC–544 BC, 566 BC–486 BC, as well as several other speculated-on eras), was born in Lumbini, India, as a prince of the Śākya tribe [26]. The belief among Yoga practitioners is that one’s pattern of breathing is important for proper meditation and total health care, and this was thought to influence the Buddha’s meditation practice. Following the Buddha’s experience, it was thought in Buddhism that by practicing Zazen (meditative discipline) as the Buddha did, a practitioner can become enlightened and, in turn, himself become the Buddha [22].

Several researchers have described how the Buddha himself focused on respiration during meditation and thus recommended deep abdominal inhalation and slow exhalation with some oral resistance [27]. A later text, the "Anapanasati Sutta", described further details of Buddha's breathing technique during meditation, as "*anapana-sati*", which consisted of deep abdominal breathing and slow exhalation, sometimes with counting [27, 28].

Zen and breathing methods in medieval Buddhism

Both Yoga and Zen are commonly undertaken during meditation and in calming the heart. Zen, though, is thought to be a denomination of Buddhism. However, Yoga is almost regarded as a philosophy, not a religion.

Zen focuses on meditation and a person's daily attitude. Zen meditation is a way of vigilance and self-discovery that is practiced while sitting on a meditation cushion in a quiet room [29]. A practitioner should sit down quietly, stop moving, and let go of his or her thoughts. The focus should be solely on a Zazen posture and way of breathing, keeping one's back straight.

The twelve ways of unique Zen breathing were explained in "Tendai-shoshikan" and "Makashikan" as follows (Table1) [30]:

Of these twelve ways of breathing, deep abdominal breathing, slow and prolonged breathing, and rhythmic and peaceful breathing seem to be compatible with modern respiratory rehabilitation. Of note, these twelve ways of breathing resemble the breathing methods described in Dokyo (Dàojiào, Taoism) written in "Yojoenmeiroku" by Tao Hongjing (China, 456–536) [31].

Promotion of Zen breathing in Japan during the Edo era (1603–1868)

Almost 1000 years after Eisai and Dogen, Ekiken Kaibara (1630–1714) and Hakuin Ekaku (1686–1769) refocused their efforts on the effects of breathing on health. In particular, "Yasenkanna", written by Hakuin in 1757, stressed *Tanden* breathing (i.e. a deep abdominal breathing as described below) and the twelve ways of breathing shown in "Makashikan" (Table 1) [27]. According to the description in the text, Hakuin himself recovered his physical health by adopting such breathing methods.

The breathing methods in Zen have been described for ordinary citizens in a simple manner by Ekiken Kaibara and Hakuin Ekaku. Better eating habits and ways of breathing were widely promoted among citizens as a way of maintaining their health to live a long life. The published works, "Yojokun" written by Kaibara in 1712 and "Yasenkanna" by Hakuin, were woodblock printed many times and sold quite well. Furthermore, to date, modern versions with several explanations have been republished many times [32].

Breathing methods in modern Zen practice

Although the twelve ways of breathing outlined in "Tendai-shoshikan" and "Makashikan" are not popular today, more conventional ways of Zen breathing prevail and are a fundamental part of Zazen practice [29]. Practitioners on Zazen

Table 1 Twelve ways of Zen breathing

	Way of Zen breathing	Chinese character	English breathing method name	Detailed breathing method
1	Jousoku	上息	Upwards respiration	Forced expiration with the intention to blow out one's own body weight
2	Kasoku	下息	Downwards respiration	Inspiration through the nostrils with special attention to "Tanden"
3	Mansoku	滿息	Filling respiration	Deep and slow breathing
4	Shousoku	燋息	Scorching respiration	Rapid rhythmic breathing
5	Zouchousoku	增長息	Increasing respiration	Gradual slow and deep breathing
6	Genkaisoku	滅壞息	Dissipating respiration	Expiration through the mouth
7	Dansoku	煖息	Warming respiration	Inspiration of warm air, effective for warming up a chilled body
8	Reisoku	冷息	Cooling respiration	Inspiration of cold air, effective for cooling down fever
9	Kousoku	衝息	Forceful respiration	Forced short breathing
10	Jisoku	持息	Retained respiration	Breathing with a stable rhythm
11	Wasoku	和息	Peacefull respiration	Peaceful breathing, effective for total body management
12	Hosoku	補息	Nourishing respiration	Breathing rhythm adjustment

This table presents the twelve ways of unique Zen breathing in "Tendai-shoshikan"

focus on the notion that the mind and breathing are tightly correlated [33]. During meditation, it is important to center attention on the *Tanden*, located two inches below the navel and recognized as the physical and spiritual center of the body according to the Zen Sect [27]. Then imagine a breath coming deep from the abdomen and returning there. Counting breaths is an effective way to take the mind away from wandering thoughts during meditation. If the mind starts to wander, then it is deliberately and consciously refocused by counting further until a spiritual state of nothingness is achieved [28].

Breathing methods applied in modern clinical practice

To compare breathing methods in Zen versus those recommended by modern respiratory therapists, we describe here typical modern pulmonary rehabilitation methods. In this regard, a patient education statement has been promoted by the National Heart, Lung, and Blood Institute, in Bethesda, MD, USA [34].

Pulmonary rehabilitation helps improve the physical well-being of people who have chronic and ongoing breathing problems [35, 36]. It also benefits patients with chronic obstructive pulmonary diseases, other types of pulmonary diseases with dyspnea, and patients both before and after surgery [37]. The program includes breathing strategies, exercise training and nutritional counseling. Patients learn how to take longer and deeper breaths as they practice pursed-lip breathing [38]. Such breathing results in a decrease in the frequency of breaths and keeps the airways open longer. Patients breathe in through the nostrils and then slowly breathe out through slightly pursed lips, creating some airflow resistance. In this way, exhalation lasts two to three times longer than inhalation. Some people find it helpful to count to two while inhaling and to four or six while exhaling. Maintaining a proper upright position of the body to allow for maximum lung expansion is another important tip. Patients also learn how to use the diaphragm and abdominal muscles, rather than accessory respiratory muscles, to more effectively breathe in and out [39].

The benefits to the patient of such breathing are the effective removal of airway secretions, the recruitment of atelectatic alveoli, subsequently increasing functional residual capacity and tidal volume, and, consequently an improvement in oxygenation [36, 40, 41]. Rapid shallow breathing is deleterious to ventilation and gas exchange due to a potential increase in dead space ventilation and in progressive air trapping [36, 42].

Even for patients with more serious pulmonary disease, who were admitted to a respiratory intensive care unit after recovering from acute respiratory failure, with or without mechanical ventilation, comprehensive early pulmonary rehabilitation, as described above, worked better than standard medical therapy [40, 43–45].

The analogy between ancient breathing methods and modern respiratory therapy

Deep inhalation, slow exhalation with some resistance, and a low respiratory frequency are commonly recommended both in classical and modern respiratory textbooks. Counting the number of breaths is also common to both eras.

Effects of Zen/Yoga breathing methods on respiratory function, mental status and chronic pain evaluated by the modalities used in modern medicine

In addition to an interest in Zen breathing and meditation, the practical effects of Yoga breathing (considered to be the origin of Zen breathing) have been re-evaluated using modern methods. Regular Yoga practice increases vital capacity, timed vital capacity, maximum voluntary ventilation, breath-hold time, maximal inspiratory and expiratory pressures and oxygen saturation, and thus ameliorates dyspnea [43, 46]. *Pranayama* or, Yoga breathing has a beneficial effect on cardiovascular [47] and pulmonary [48] functions in healthy individuals. In addition, in a meta-analysis that included sixteen studies with a total of 1233 participants, three months of Yoga with timed breathing techniques were associated with a significant improvement in a six-minute walk distance [42].

Peaceful breathing during meditation activates the left prefrontal cortex while suppressing activity in the right prefrontal cortex. It can also counteract serious stress and reduce the risk of panic attacks, depression, and headaches [10–12]. It also helps the practitioner sleep in a deeper and more peaceful manner giving time for exhausted muscles to repair themselves.

Psychiatrists and psychologists are investigating the effects of breathing instructions on brain function, psychiatric conditions and pain sensation [49]. Several recent randomized clinical trials have suggested that Yoga is also effective for persistent pain [50, 51]. Ebnezar et al. undertook a randomized clinical trial (RCT) to study the effect of integrated Yoga on pain, morning stiffness and anxiety in 250 participants with osteoarthritis of the knee joint. Resting pain, morning stiffness, and a state of anxiety were more reduced in Yoga than a control group having physiotherapy exercises [50]. In another RCT, Tilbrook et al. compared the effectiveness of Yoga and the usual care given for chronic or recurrent low back pain [51]. This RCT showed that offering

a 12-week Yoga program led to greater improvements in back function than did usual care. In one study, a total of 88 female nurses were randomized into Yoga and physical exercise groups. The Yoga group underwent integrated Yoga therapy, 1 h/day, 5 days a week for 6 weeks, while the physical exercise group practiced a set of physical exercises for the same period of time. All participants were assessed at baseline and after 6 weeks according to a World Health Organization Quality of Life-brief. A between-group analysis showed a higher percentage of improvement in the Yoga compared to the exercise group in physical, psychological and social (except environmental) domains [52].

The additional psychological benefits of Zen/Yoga meditation

By extrapolating the beneficial effects of Zen meditation and yoga breathing, Zen/Yoga practice was expected to contribute to younger and healthier looks [53], better skin appearance [54], better balance and mobility [55], increased flexibility for better posture [56], and to overcoming addictions to alcohol, drugs [57], and cigarettes [58]. A reduction in the intensity of pain is also noted as a beneficial effect of Zen meditation. For example, in cognitive behavioral therapy, patients are educated on how to cope with pain using such Zen-style breathing [15, 16].

Meditation and *Pranayama*, along with relaxing *asanas*, can help individuals deal with the emotional aspects of chronic pain, effectively reducing anxiety and depression [59], and improving their perceived quality of life [60].

Increasing evidence suggests that historical breathing and related meditation techniques are effective in modern clinical practice, especially in the field of anesthesiology, such as for improving respiratory function and reducing chronic pain. Clarification of the detailed mechanisms involved is anticipated in future.

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