

DRDO successfully tests NAG: 8 facts about India's deadly anti-tank missile

DRDO's NAG missile is now ready for induction into the Indian Army. Read to know about the made-in-India anti-tank missile.

Made-in-India Anti Tank Guided Missile (ATGM) NAG was successfully flight-tested at Defence Research and Development Organisation's (DRDO) test facility on February 28.

NAG passed the flight and target destruction tests with precision in desert conditions against two tank targets at different ranges and timings.

Dr G Satheesh Reddy, Director General (Missiles and Strategic Systems), said that with the successful test flights, the technologies pertaining to ATGM to engage targets in different conditions have been established.



ATGM NAG is one of the five indigenous missiles developed by the DRDO under the Integrated Guided Missile Development Programme (IGMDP).

With this, the developmental trial of the NAG ATGM missile is complete and it is now ready for induction in the Indian Army. Dr S Christopher, DRDO Chairman and Department of Defence R&D Secretary, congratulated the NAG team for the achievement.

With its induction in the Indian Army, the NAG is said to replace the existing Russian Konkours and European missile Milan, both of which are currently manufactured under license by Bharat Dynamics Limited.

In November 2017, Indian government canceled \$500 million deal with Israeli defense contractor Rafael Advanced Defense Systems Ltd for 321 Spike ATGM system missiles as it would discourage development of DRDO's indigenous NAG anti-tank missile programme.

8 facts about made-in-India anti-tank guided missile NAG:

1. NAG (meaning Cobra) is developed by DRDO under Integrated Guided Missile Development Programme (IGMDP) and is manufactured exclusively by Bharat Dynamics Limited (BDL)
2. NAG comes in five variants- HeliNa (Helicopter-launched Nag), Land version (with mast-mounted missile launcher), Man Portable NAG, Air-launched version for tactical interdiction aircraft (upgraded version of Jaguar IS) and NAMICA (NAG MIssile Carrier), a tank destroyer variant built for the army. NAMICA is a modified BMP-2 IFV produced "Sarath" in India.
3. Design: standard NAG missile comes with four movable flaps having a wingspan of 0.4m each. It measures 1.85m in length, 0.20m in diameter, and weighs 43kg. But, it also comes in smaller 'Man Portable' variant, which comes 15kg load capacity.
4. NAG has an operational range of 500meters to 4 km on land and when it is air-launched, it can operate anywhere between 7-10km
5. NAG has a top speed of 230meter/second (or 828 km/hour)
6. NAG comes with Active Imaging infra-red (IIR) seeker and millimetric wave (mmW) active radar homing seeker, but the latter version is still under development
7. NAG is a Lock-on-before-Launch - Top attack mode missile. It is also known as a fire-and-forget missile, as it is locked to the particular target and only then, it is released to attack.
8. NAG is said to have a Single Shot of Probability score of 0.9 [**Note:** If a weapon is expected to hit a target nine times out of ten with a representative set of ten engagements, one could say that this weapon has a "Phit" score of 0.9]

<http://www.ibtimes.co.in/drdo-successfully-tests-nag-8-facts-about-indias-deadly-anti-tank-missile-762351>

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Thu, 01 March, 2018

India's New Anti-Tank Guided Missile Destroys 2 Tanks in Test

An indigenously designed and developed anti-tank guided missile was successfully tested on February 28.

By Franz-Stefan Gady

India's Defense Research and Development Organization (DRDO) successfully tested its indigenously designed and developed third-generation anti-tank guided missile (ATGM) Nag in desert conditions against two tank targets on February 28, according to an Indian Ministry of Defense (MoD) press release.

The tests "have once again proved its capability," the statement reads. "With this, the developmental trials of the missile have been completed and it is now ready for induction." The Indian Army has so far not publicly commented on the successful Nag ATGM test. Notably, DRDO had announced the completion of development trials already in September 2017.

Indian Army officials have repeatedly stated that they expect development trials to be concluded by the end of 2018. The Army has delayed the induction of the Nag, a fire-and-forget ATGM with an estimated range of 4 kilometers, due to numerous technical shortcomings including inadequate thermal sensors. The missile's high price tag has also been a point of controversy.

The Nag ATGM, manufactured by India's sole missile producer, state-owned Bharat Dynamics Limited, until the recent test had only been fired from an armored combat vehicle specifically designed for that purpose. As I reported in 2017:

The Nag Missile Carrier (NAMICA) is an Indian license-produced variant of the Soviet-era BMP-II armored infantry fighting vehicle. NAMICA can launch Nag missiles from a retractable armored launcher that contains four launch tubes (the armored vehicle can carry up to 12 missiles in total) and the guidance package including a thermal imager for target acquisition. The missile's targeting system is based on visual identification prior to its launch ('lock-on-before-launch system').

DRDO has been working on the Nag ATGM for over a decade. The Indian Army intends to procure up to 8,000 Nags, although it most likely will place an initial order for only 500 ATGM systems. As I reported in January, the Indian Army has a requirement for around 68,000 anti-ATGMs of various types and over 850 launchers.

"The service is reportedly pushing for a fast-track procurement of 2,500 third-generation shoulder-fired ATGMs and 96 launchers through a government-to-government contract," I noted. "Weapon systems under consideration include the Israeli Spike ATGM and the FGM-148 Javelin ATGM."

In December 2017, the Indian government scrapped a \$500 million deal with Israeli defense contractor Rafael Advanced Defense Systems Ltd. for 321 Spike ATGM systems and 8,356 missiles in favor of an indigenous ATGM system currently under development by DRDO.

The cancellation of the deal was allegedly the result of intense lobbying by DRDO, which has vowed to expedite delivery of the Nag ATGM system. The Indian Army originally selected the Spike ATGM over the U.S.-made FGM-148 Javelin ATGM system in October 2014, expecting the Nag ATGM not to be ready for operational deployment for some time.

<https://thediplomat.com/2018/03/indias-new-anti-tank-guided-missile-destroys-2-tanks-in-test/>



Thu, 01 March, 2018

India's Homegrown Anti-Tank Guided Missile Clears Final Trial

Last December, the Indian government canceled a plan to purchase the Israeli Spike ATGM in favor of homegrown NAG. The Indian Army reportedly has a current requirement for around 68,000 ATGMs of various types and over 850 launchers over the next 20 years. Nag can hit high-speed moving tanks without the support of an operator.

New Delhi (Sputnik) — India's Defence Research & Development Organisation (DRDO) has announced that the homegrown Anti-Tank Guided Missiles (ATGM) NAG is ready for induction into the armed forces with the successful completion of its developmental trial on Wednesday evening. In the final, trial which was conducted in Pokhran desert, the third generation missile destroyed two targets at different ranges and timings.

"With the successful test flights, the technologies pertaining to ATGM to engage targets in different conditions have been established," Dr. G Satheesh Reddy, Director General (Missiles and Strategic Systems), DRDO, said after the Wednesday test trial.

In September 2017, when the DRDO had announced the near completion of the development trials, the Indian Army reportedly voiced concern over certain technical shortcomings like inadequate thermal sensors. Nevertheless, the defense ministry has backed the DRDO's claim that the system is now induction-ready.

"NAG ATGM has been developed by DRDO and today's flight tests have once again proved its capability. With this, the developmental trials of the missile have been completed and it is now ready for induction," India's defense ministry said in a statement.

The missile is equipped with an indigenous high-resolution imaging infrared seeker, capable of operating during day and night, which provides passive homing guidance for engaging static/moving tank targets. The ATGM has a flight speed of 230 meters per second and is armed with an 8kg tandem shaped-charge warhead. It has a rocket motor using a nitramine-based smokeless extruded double base sustainer propellant, has a single-shot hit probability of 0.77 and a CEP of 0.9 meters, and has a 10-year maintenance-free shelf-life.

The DRDO has been working on the NAG (Hindi for "Cobra") since 2009, spending approximately \$47 million on its development. The 14.8 metric ton, NAG is a little bit heavier than the current crop of ATGMs of the Indian Army but it can make up for this shortcoming with its carrier- the NAMICA.

Nag is heavier but since it's carrier mounted the extra weight is considered acceptable. The big advantage to the Army would accrue from its easy & cheaper upgradability.

NAMICA is an improved version of the Soviet-designed BMP-2 infantry fighting vehicle that India uses extensively. NAMICA is equipped with nuclear, biological and chemical (NBC) protection, independent gunner and commander sights, silent watch capability, and a fire suppression system for crew safety and comfort. The NBC system provides dry, temperature-controlled filter air to the crew. The NAMICA has a retractable armored launcher that can carry 12 Nag ATGMs, with six of them in ready-to-fire mode at a distance of 4km.

DRDO is also developing the helicopter-launched version of the NAG, known as Helina. This ATGM uses the same uncooled LWIR sensor as the NAG ATGM, and has a range of 7km. The Helina, using the "Rudrastra" canister-encased twin-launcher system, will arm both the "Rudra" helicopter-gunships as well as the LCH attack helicopters of both the Indian Army and the Indian Air Force.

<https://sputniknews.com/military/201803011062119346-indian-anti-tank-missile-tested/>



Thu, 01 March, 2018

India successfully tests 3rd-gen anti-tank missile NAG in desert conditions

The Anti Tank Guided Missiles (ATGM) NAG, developed by Defence Research and Development Organisation (DRDO), were successfully flight tested on Wednesday.

The ATGM NAG was tested at Pokhran's field firing range in Jaisalmer district against two tank targets at different ranges and timings.

The ATGM NAG has been developed by Defence Research and Development Organisation (DRDO) and the flight tests have once again proved its capability. With this, the developmental trials of the missile have been completed and it is now ready for induction.

The Fire and Forget 3rd generation ATGM NAG is incorporated with many advanced technologies including the Imaging infrared (IIR) Seeker with integrated avionics, the capability which is possessed by few nations in the world.

Earlier, Imaging Infra Red Seekers were not able to differentiate between the target and surroundings in hot desert temperatures. Now, highly sensitive detectors have been put in the missile for sensing heat or infra red signals.

Director General (Missiles and Strategic Systems) Dr. G Satheesh Reddy said that with the successful test flights, the technologies pertaining to ATGM to engage targets in different conditions have been established.

Department of Defence Research and Development Secretary and DRDO Chairman Dr. S Christopher, congratulated the NAG team for the achievement.

It is known that last trails of Fire and Forget 3rd generation ATGM Nag were conducted on 13 June 2017, in Pokhran field firing range in Jaisalmer in which also missiles successfully hit the targets.

<https://www.indiatoday.in/india/story/pokhran-3rd-generation-atgm-nag-successfully-tested-in-desert-conditions-1179656-2018-03-01>



Thu, 01 March, 2018

India completes trials of ant-tank guided missile `Nag`

India on Wednesday successfully test-fired anti-tank guided missile `Nag` in desert conditions. The test, conducted in the desert area in Pokhran against two different targets, proved Nag's capabilities in desert conditions.



Defence Research and Development Organisation said the tests were conducted in different conditions against two tank targets at different ranges and timings.

With this, the developmental trials of the missile have been completed and it is now ready for induction into the armed forces.

The Nag is a third-generation "fire-and-forget" missile. Once fired, its infrared seekers automatically guides the missile to the target. Initially, the Army is likely to place an order for 443 Nag ATGMs and 13 NAMICA missile launch vehicles. In its perspective plan, the Army has projected the need for 7,000 Nag missiles and around 200 NAMICAs.

The DRDO is currently developing two new variants of the missile for the Indian Air Force: the 8 km-range 'Helina' to arm Dhruv Advanced Light Helicopter and a 10 km-range variant capable of being launched from aircraft. A man-portable version of the missile, which would weigh less than 14 kg, is also being developed.

Director General (Missiles and Strategic Systems) G Satheesh Reddy said that with the successful test flights, the technologies pertaining to ATGM to engage targets in different conditions have been established.

Chairman, DRDO and Secretary, Department of Defence R&D S Christopher congratulated the Nag team for the achievement.

The Nag ATGM, which has been developed by the DRDO, adds to the list of India's missile arsenal, which also includes the Agni, Prithvi, Nirbhay, and Dhanush series of missiles, while submarine-launched ballistic missiles Sagarika and Shaurya along with Prahaar and Agni-V are in the development stage.

Earlier, India also successfully test-fired indigenously developed Dhanush missile off Odisha coast. The surface-to-surface missile is a naval variant of nuclear-capable Prithvi missile which can hit any target in the range of 350 km. The missile was test-fired from a ship positioned near Paradip in the Bay of Bengal at around 10.52 AM, defence officials said.

Dhanush is capable of carrying a payload of 500 kg and hitting both land and sea-based targets. Officials added that the trial of the missile was conducted by Strategic Force Command (SFC) of the defence forces.

http://www.domain-b.com/aero/mil_avi/miss_muni/20180301_nag.html

Thu, 01 March, 2018

India Test-Fires its Indigenous Surface-to-Surface Missile

India has been trialing its indigenous surface-to-surface missile system technology. India test-fired its medium range nuclear capable Agni-II surface-to-surface missile with a strike range of 2,000 km. The 20-mt-long Agni-II ballistic missile has a launch weight of 17 tonnes and can carry a payload of 1,000 kg over a distance of 2,000 km.

Already a part of the country's arsenal for strategic deterrence, the missile was launched as a training exercise by the armed forces, a DRDO scientist said. The missile trial was conducted from a mobile launcher.

The Intermediate Range Ballistic Missile (IRBM) has already been inducted into the services and the test was carried out by the Army's Strategic Forces Command (SFC) with logistic support provided by the Defence Research and Development Organisation (DRDO), according to defenseworld.net.

The two-stage missile, equipped with advanced high accuracy navigation system and guided by a unique command and control system was propelled by solid rocket propellant system.

The entire trajectory of the trial was tracked by a battery of sophisticated radars, telemetry observation stations, electro-optic instruments and two naval ships located near the impact point in the down range area of the Bay of Bengal.

Agni-II was developed by the Advanced Systems Laboratory along with other DRDO laboratories and integrated by the Bharat Dynamics Limited, Hyderabad, sources said.

The missile is part of the Agni series of missiles which includes missiles with ranges from 700 km to long range.

According to thediplomat.com, citing defense sources, India also test-fired its Prithvi-II tactical surface-to-surface short-range ballistic missile in February. The missile was fired as part of a nighttime user trial. “

<https://i-hls.com/archives/81652>



Thu, 01 March, 2018

India's Indigenous Anti-Tank Missile Clears Final Trials, Declared Ready for Induction into Army

India's indigenously developed Anti-Tank Guided Missile (ATGM) Nag has been declared ready for induction into the Indian Army after the latest desert trials of the missile against two tank targets at different ranges and timings were successful.

The Nag is a third-generation “fire-and-forget” missile. Once fired, its infrared seekers automatically guides the missile to the target. The ATGM has been developed by the Defence Research and Development Organisation (DRDO).

The internals of India's Nag ATGM in this model. Programme in final stretch before service entry with the Indian Army.

Initially, the Army is likely to place an order for 443 Nag ATGMs and 13 NAMICA missile launch vehicles. In its perspective plan, the Army has projected the need for 7000 Nag missiles and around 200 NAMICAs.

The DRDO is currently developing two new variants of the missile for the Indian Air Force: the 8km-range 'Helina' to arm Dhruv Advanced Light Helicopter and a 10km-range variant capable of being launched from aircraft. A man-portable version of the missile, which would weigh less than 14 kg, is also being developed.

<https://swarajyamag.com/insta/indias-indigenous-anti-tank-missile-clears-final-trials-declared-ready-for-induction>



Thu, 01 March, 2018

Indian Army's Nag Anti-Tank Guided Missile Ready for Induction

India's locally-made Anti Tank Guided Missile (ATGM), Nag was successfully tested on Wednesday in desert conditions against two tank targets at different ranges and timings.

The tests "have once again proved its capability," a statement by the Indian Ministry of Defense (MoD) says. "With this, the developmental trials of the missile have been completed and it is now ready for induction."

The Nag is a fire-and-forget short range missile effective against armored target developed by Defence Research and Development Organisation (DRDO).

Director General (Missiles and Strategic Systems) Dr G. Satheesh Reddy said with the successful test flights, technologies pertaining to the ATGM to engage targets in different conditions have been established.

Nag is a third-generation, fire-and-forget, anti-tank guided missile developed to support both mechanised infantry and airborne forces of the Indian Army. It can be launched from land and air-based platforms. The land version is currently available for integration on the Nag missile carrier (NAMICA), which is derived from a BMP-2 tracked infantry combat vehicle.

DRDO has also been working on a more advanced air-launched variant of the Nag, the Helina ATGM with a maximum range of up to seven kilo-meters.

http://www.defenseworld.net/news/22063/Indian_Armys_Nag_Anti_Tank_Guided_Missile_Ready_For_Induction



Thu, 01 March, 2018

India's NAG Anti-Tank Guided Missile approved for induction

India's Anti Tank Guided Missiles (ATGM) NAG were successfully flight-tested today in desert conditions against two tank targets at different ranges and timings, the Defence Research and Development Organisation (DRDO) said on February 28, 2018. NAG ATGM has been developed by Defence Research and Development Organisation (DRDO) and today's flight tests have once again proved its capability. With this, the developmental trials of the missile have been completed and it is now ready for induction.

The third-generation fire-and-forget ATGM has been fully developed by the DRDO. The Indian Army plans to purchase up to 8,000 missiles after the country's government scrapped a \$500 mn deal with Rafael for 321 Spike AT

Director General (Missiles and Strategic Systems) Dr. G Satheesh Reddy, said that with the successful test flights, the technologies pertaining to ATGM to engage targets in different conditions have been established. Chairman, DRDO & Secretary, Department of Defence R&D Dr. S Christopher, congratulated the NAG team for the achievement.

http://www.armyrecognition.com/march_2018_global_defense_security_army_news_industry/india_s_nag_anti-tank_guided_missile_approved_for_induction.html



Thu, 01 March, 2018

Anti-tank missile Nag successfully tested, ready for induction

Defence News, Nation, (New Delhi), March 1 :-The Anti-Tank Guided Missile (ATGM) Nag was successfully flight-tested in desert conditions on Wednesday against two tank targets at different ranges and timings, informed the Defence Ministry.

The Ministry said that as the developmental trials of the missile have been completed, it is now ready for induction in the Army.

The missile has been developed by Defence Research and Development Organisation (DRDO).

Director General (Missiles and Strategic Systems) Dr G Satheesh Reddy said that with the successful test of the missile, the technologies pertaining to ATGM to engage targets in different conditions have been established.

The ATGM Nag is a third generation "fire-and-forget" anti-tank missile. It is one of the five missile system developed indigenously by the DRDO under integrated guided missile development programme (IGMDP).

The other four missiles developed under this programme include Agni, Akash, Trishul and Prithvi.

-(NAV, Inputs: Agencies)

<https://citytoday.news/anti-tank-missile-nag-successfully-tested-ready-for-induction/>



Thu, 01 March, 2018

We are now more open to collaborating with private players, says DRDO chairman

The country's research and development body for defence sector is now more open to collaborating with private players within the country and the academia, to meet requirements of the defence forces, a top official said here on Thursday.

Addressing 'italk', an event organised jointly by Gujarat Innovation Society (GIS) and Gujarat University in the city, S Christopher, chairman of Defence Research and Development Organisation (DRDO), said that while earlier the collaboration was with units of Ordnance Factory Board (OFB) and public sector undertakings (PSUs), more and more private companies are now being roped in for partnership.

“There is an exponential growth in Transfer of Technology, or ToT, from DRDO to private players,” he said. Already 27 technologies have been transferred and another 25 are ready for ToT.

He highlighted the case of Brahmos supersonic cruise missile, being jointly developed by Indian and Russian companies. While this is a case of collaboration with a company of a friendly country, such cases are now a reality with local firms as well.

He gave the example of indigenously developed Advanced Towed Artillery Gun System (ATAGS) with Bharat Forge. The system is at least as good as the imported Bofors guns, he said.

“After the demonstration to the defence minister and Army chief, there was an immediate order of 40 guns for user assisted trials, which is a big thing,” he said.

<http://www.dnaindia.com/ahmedabad/report-we-are-now-more-open-to-collaborating-with-private-players-says-drdo-chairman-2589999>



Thu, 01 March, 2018

India's AWACS is low-cost, better than Pakistan's, says DRDO chief

DRDO chief Dr S Christopher said the indigenous AEW&C built by DRDO using modified Brazilian Embraer jets is cost effective and better than the Swedish systems owned by Pakistan.

The indigenous airborne early warning and control system (AEW&C) built by Defence Research and Development Organisation using modified Brazilian Embraer jets is cost effective and better than the Swedish systems owned by Pakistan, said DRDO chairman Dr S Christopher at an event in Gujarat University on Thursday.

Giving an insight into various modern technologies being developed for the military, Christopher, delivering the first i-talk organised by Gujarat Innovation Society (GIS), spoke about how DRDO's AEW&C platform, christened "Netra", was close to his heart since he was involved in it right from inception. "In 1985, we thought we should make an AWACS (airborne warning and control system) because at that time the US had brought in their own system," Christopher said while narrating how the DRDO faced teething problems in the project, which also involved a crash.

The DRDO chief said they had gone for a simpler and smaller platform by using the Brazilian Embraer-145 jets when the project was restarted. "It started with a simpler and smaller platform that is the Embraer," Christopher said, adding how the five-hour endurance of the system was expanded by adding a complex air-to-air refueling facility.

Claiming that the DRDO's AWACS was cheaper than its Pakistani counterpart, Christopher said except for the aircraft, the electronics was indigenously made. "Except for the aircraft, all the electronics is ours. So when you compare the cost, it is less than what Pakistanis are having; the Swedish system. In addition to that, their aircraft itself is not as good as ours. It is because our is a jet and that is a turboprop," the DRDO chief said. Pakistan has Saab 2000 Erieye AEW&C from Sweden.

Tejas Mark-II to fly by 2022

Speaking of Light Combat Aircraft (LCA) Tejas, Christopher said HAL had already got an order to manufacture 123 LCAs. "In addition to that, the air force has given in writing another 201 aircraft, which is the next version, that we call as Mark-II. We are working on it and by 2022 it will be flying," he said.

<http://indianexpress.com/article/india/indias-awacs-is-low-cost-better-than-pakistans-says-drdo-chief-5083268/>

A stroke can't stop this scientist's zeal

Technologist recovering from a paralytic stroke writes book for students

A year after his retirement as a distinguished scientist and director of the Naval Physical and Oceanographic Laboratory (NPOL), a systems laboratory of the Defence Research and Development Organisation (DRDO), S. Anantha Narayanan suffered a paralytic stroke.

It was mid-2016, and as he was on the path to recovery, with intensive physiotherapy and medication, he found a way to keep himself engaged: write a book on eminent technologists for students.

“It was tough, but it helped me recover fast, and my physiotherapist suggested that I publish it,” explained Mr. Anantha Narayanan as to why he brought out the book, *Ningalkkumakam Ivareppole* (You can also be like them), which comprises the life sketches of Indian technologists, written for the benefit of the science-loving student community.

“I chose to write it in Malayalam as there weren't many books on technologists with a Kerala connection available in Malayalam. I was told there weren't many readers for such books, but that was because there weren't many such books in the first place. It's a vicious cycle,” he said.

At the rehab institute in Vellore, he learnt about Dr. Mary Varghese, the wheelchair-bound surgeon. But it surprised him that her college itself did not know about the illustrious alumnus from Cherai. “So, I wrote about her life, which inspired me too. In the process, I found my handwriting illegible due to stroke and slowly, I found my way to writing in computer,” Mr. Anantha Narayanan said. As he researched, he realised that Varghese Kurien of Amul was a mechanical engineer; M.S. Swaminathan was selected for IPS but did not join; Keltron's K.P.P. Nambiar, his first paymaster, also suffered a stroke and was recommended for the Padma Bhushan by the Karnataka government, and M.G.K. Menon had a role in saving the Silent Valley.

And they are all in the book. There are chapters on Vikram Sarabhai, Arogyaswami J. Paulraj, V.K. Aatre, K.P.P. Nambiar, Varghese Kurien, Dr. M.S. Valyathan, Dr. Mary Varghese, E. Sreedharan, M.S. Swaminathan, M.G.K. Menon, C. Achutha Menon, and C. Subramanyam.

Written in simple Malayalam with a perspective, the book places these figures and their contributions in a larger scientific and social context. For instance, describing the contributions of G. Madhavan Nair to Indian space science, he said that the controversies surrounding him over his decisions as ISRO Chairman could not invalidate his solid accomplishments as a scientist.

Meanwhile, Mr. Anantha Narayanan, still to fully recover from the stroke, has already completed another book, titled *Sasthraratnangalum Muttathe Mullakalum*, which introduces to lay readers a more pan-Indian picture of popular scientists like Homi Bhabha and less-known ones like botanist Janaki Ammal. “I intend to bring it out as soon as possible,” he says.

<http://www.thehindu.com/news/cities/Kochi/a-stroke-cant-stop-this-scientists-zeal/article22884302.ece>