

## Case Series



### Ayurvedic Approach to Atherogenic Dyslipidemia: A Prospective Interventional Case Series

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#### ABSTRACT:

**Background:** Atherogenic Dyslipidemia (AD) is recognized by elevated serum triglyceride (TG) and low-density lipoprotein (LDL) levels, along with reduced high-density lipoprotein (HDL) levels. Extensive research has shown that the raised levels of LDL and apolipoprotein B (Apo-B) are the main causative factors in the occurrence of atherosclerotic cardiovascular diseases. According to Ayurvedic perspective, the condition of AD can occur due to an imbalance in *Jatharagni* and *Medodhatwagni*, leading to *Medodushti*. **Aim:** This prospective interventional case series aims to evaluate the effect of an Ayurvedic treatment protocol, in regulating atherogenic dyslipidemia. **Material and Methods:** Total six patients with atherogenic dyslipidemia were selected in this case series. The treatment protocol included *Udvartana* (therapeutic powder massage) and *Virechana* (therapeutic purgation), along with oral Ayurvedic medications and dietary-lifestyle modification, administered for sixty days. The primary outcome was change in lipid levels and Apo-B, while secondary outcome comprised change in symptoms, body mass index (BMI), Atherosclerotic Cardiovascular Disease (ASCVD) risk score and QRISK3 score. The assessments were performed prior and post-treatment. **Results:** There was a reduction in symptoms and lipid levels, such as mean Sr.TG decreased by 62.67 mg/dL (29.51%), LDL by 84.13 mg/dL (51.45%), LDL/HDL ratio by 2.86 mg/dL (60.98%), and Apo-B by 73.40 mg/dL (43.64%), while improvement in HDL by 8.43 mg/dL (24.22%). The mean BMI decreased by 1.43 kg/m<sup>2</sup> (5.23%) in sixty days. There was a noticeable reduction in 10-year cardiovascular risk scores (ASCVD and QRISK3) shifting from moderate or high risk to low-risk categories, highlighting a reduction in atherogenic risk. **Conclusion:** The Ayurvedic treatment protocol of *Udvartana* and *Virechana* procedures, integrated with oral medications and dietary-lifestyle modifications, showed improvements in the condition of Atherogenic dyslipidemia. The improvements were observed in clinical symptoms, lipid profile parameters, and next 10-year cardiovascular risk scores.

**KEYWORDS:** ASCVD risk score, Atherogenic dyslipidemia, Case series, *Medodushti*, QRISK3 score.

RECEIVED ON:

18-02-2026

REVISED ON:

21-04-2026; 14-06-2026

ACCEPTED ON:

14-06-2026

Access This Article  
Online:

Quick Response Code:



Website Link:

<https://jahm.co.in>

DOI Link:

<https://doi.org/10.70066/jahm.v14i6.2603>

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CITE THIS ARTICLE AS

Shravani Uday Mahajan, Digvijay Tanaji Patil, Dhananjay V. Patel, Mandip Goyal. Ayurvedic Approach to Atherogenic Dyslipidemia: A Prospective Interventional Case Series. Journal of Ayurveda and Holistic Medicine (JAHM) 2026; 14(6):128- 139.



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## 1. INTRODUCTION

Atherogenic dyslipidemia is one of the common lifestyle disorders worldwide. [1] The global prevalence of hypertriglyceridemia, high LDL, and low HDL is 28.8%, 18.93%, and 38.4%, respectively. [2] It is estimated that nearly 25 million people will die from cardiovascular diseases (CVDs), chiefly heart disease and stroke, by 2030. [3] Observational studies have shown that a 1% reduction in lipid profile lowers the incidence of cardiac disorders by 2.5%. [4] Conventional management of dyslipidemia includes the use of antihyperlipidemic agents. [5] Despite the availability of conventional medications, long-term adherence remains a challenge for some patients, thereby encouraging the exploration of adjunctive therapies.

*Medodushti* results from impairment of *Jatharagni* and *Medodhatwagni*, leading to excessive accumulation of vitiated *Kapha* and *Meda* in *Rasavaha* and *Medovaha Srotas*. The abnormal increase in *Poshaka Medodhatu* can be correlated with elevated circulating lipids, due to the similarity in their properties. According to Ayurveda classics, the drugs with *Ruksha*, *Laghu Gunas*, *Ushna Virya* helps to pacify *Kapha* and promote *Lekhana* of accumulated *Meda* [6] can be useful in the management of *Medodushti*. The present case series aimed to evaluate an Ayurvedic treatment protocol for AD, as AD shares pathophysiological similarities with *Medodushti*. However, limited evidence exists regarding the Ayurvedic management. Clinical and biochemical assessment, particularly using Apo-B as a biomarker and validated 10-year cardiovascular risk scores as outcome measures.

## 2. METHODS

This study was a prospective interventional case series conducted on six patients diagnosed with AD attending the specialty OPD of metabolic disorders, and fulfilling the inclusion criteria were selected using a consecutive non-probability sampling method. Pre- and post-treatment

assessments were performed using lipid profile, BMI, ASCVD risk score, and QRISK3 score.

The next 10-year cardiovascular risk was calculated using validated calculators (ASCVD and QRISK3), to objectively assess short-term (60 days) cardiovascular risk reduction following changes in lipid profile, as recommended in lipid management guidelines.

### Inclusion Criteria:

1. Age: 30-60 years
2. Diagnosis based on the National Cholesterol Education Program (Adult Treatment Panel-III) guidelines. [7]

### Exclusion Criteria:

1. Previous history of myocardial infarction (MI), stroke or those who have undergone Percutaneous Transluminal Coronary Angioplasty (PTCA).
2. Major systemic illness such as rheumatoid arthritis (RA), acute respiratory distress syndrome (ARDS), chronic kidney disease (CKD) or active liver disease.
3. Unfit for *Virechana Karma*.

As this case series includes participants from routine clinical practice at the specialty OPD for metabolic disorders at ITRA Hospital, according to institutional rules, no separate IEC approval is required. Written informed consent was obtained from all patients after explaining the nature, purpose, and potential benefits and risks of the intervention.

### Outcomes:

Primary outcome: Changes in lipid parameters (TG, LDL, HDL, and LDL/HDL ratio) and Apo-B levels.

Secondary outcome: Changes in symptoms, BMI, and 10-year cardiovascular risk scores (ASCVD and QRISK3).

### Patient Information:

**Case 1:** A 46-year-old male businessman presented with a gradual onset of exertional dyspnea and fatigue over the past year, with TG 230 mg/dL, LDL 142.3 mg/dL, HDL 32.5 mg/dL, Apo-B 154.7 mg/dL, BMI 23.2 kg/m<sup>2</sup>, ASCVD score 4.3%, and QRISK3 score 5.1%. The symptoms worsened in the last seven

days, so he visited the hospital for treatment. The patient's family history did not indicate any metabolic disorders.

**Case 2:** A 40-year-old male loco pilot presented with exertional dyspnea for six months, with TG 198 mg/dL, LDL 219.4 mg/dL, HDL 33.4 mg/dL, Apo-B 198.2 mg/dL, BMI 27.4 kg/m<sup>2</sup>, ASCVD score 3.9%, and QRISK3 score 3.9%. He had taken allopathic medication for one month but discontinued it voluntarily. As the lipid profile worsened, he approached for Ayurvedic treatment. The patient had a positive family history of diabetes mellitus.

**Case 3:** A 45-year-old male chemical engineer presented with a gradual onset of paresthesia and fatigue for one year, and a history of smoking for 8 years, along with TG 223 mg/dL, LDL 113.5 mg/dL, HDL 32.7 mg/dL, Apo-B 143.2 mg/dL, BMI 23.8 kg/m<sup>2</sup>, ASCVD score 8.0%, and QRISK3 score 6.8%. Initially, he consulted an Ayurveda hospital and took medications for 15 days. The patient's family history did not indicate any metabolic disorders.

**Case 4:** A 49-year-old female homemaker presented with paresthesia and xanthelasma on the left upper eyelid for two years. Baseline TG 200 mg/dL, LDL 162.8 mg/dL, HDL 35.1 mg/dL, Apo-B 168.6 mg/dL, BMI 31.5 kg/m<sup>2</sup>, ASCVD score 2.8%, and QRISK3 score 4.4%. She had not received prior

treatment for these complaints. The patient had a positive family history of dyslipidemia.

**Case 5:** A 47-year-old male teacher, receiving Tb.Metformin 500mg, BD for T2DM (8 months), had exertional dyspnea, paresthesia, and fatigue for the last six months. Before treatment, TG 240 mg/dL, LDL 142.2 mg/dL, HDL 37.2 mg/dL, Apo-B 168.2 mg/dL, BMI 31.4 kg/m<sup>2</sup>, ASCVD score 8.5% (intermediate), and QRISK3 score was 13% (moderate). He started a few home remedies, walking and made a few changes in diet, but did not achieve satisfactory improvement. The patient's family history did not indicate any metabolic disorders.

**Case 6:** A 57-year-old female homemaker, on Tb. Amlodipine 5mg, OD for hypertension (2 months) and Tb. Thyronorm 100mcg, OD for hypothyroidism (10 years), presented with exertional dyspnea, paresthesia, and fatigue for one year, along with TG 183 mg/dL, LDL 200.7 mg/dL, HDL 38.0 mg/dL, Apo-B 176.3 mg/dL, BMI 27.2 kg/m<sup>2</sup>, ASCVD score 5.5% (borderline), and QRISK3 score 17.2% (moderate). She sought Ayurveda treatment for the first time. The patient's family history did not indicate any metabolic disorders.

The baseline details about diet, lifestyle, and physical activity of all the patients are mentioned in [Table 1](#).

**Table 1: Baseline dietary, lifestyle, and physical activity profile of patients**

| Case | Occupation        | Dietary habits                                                                 | Sleep pattern                     | Exercise               | Sedentary time/day |
|------|-------------------|--------------------------------------------------------------------------------|-----------------------------------|------------------------|--------------------|
| 1    | Businessman       | Overeating, <i>Guru, Atisnigdha</i> food: 5-6 days/week                        | 8-9 hrs, sound                    | None                   | 10-12 hrs          |
| 2    | Loco pilot        | Irregular timing, late-night meals due to shift duty, fast food: 4-5 days/week | Disturbed (shift duty), day sleep | None                   | 8-9 hrs            |
| 3    | Chemical Engineer | Oily street food, junk food: 4-5 days/week                                     | Disturbed (shift duty)            | None                   | 8-10 hrs           |
| 4    | Homemaker         | <i>Guru, Atisnigdha</i> food, daily sweets intake                              | 7-8 hrs, sound                    | None                   | 7-8 hrs            |
| 5    | Teacher           | Irregular meals, dairy-rich food: 5-6 days/week                                | Disturbed (stress, overthinking)  | Walking (occasionally) | 7 hrs              |
| 6    | Homemaker         | <i>Guru, Atisnigdha</i> food                                                   | 7-8 hrs, sound, day sleep-2 hrs   | None                   | 8 hrs              |

**Clinical Findings:** Clinical and systemic examination of all six patients was within normal limits. The severity of symptoms

was evaluated using a validated symptom grading scale [8] to obtain patient-reported outcomes. ([Table 2](#))

After detailed history taking, the identified *Nidana* (causative factors) included intake of *Guru* (heavy to digest), *Atisnigadha* (excessive oily and greasy food), *Atimatra Ahara* (overeating), along with *Avyayama* (lack of exercise) and *Divaswapna* (daytime sleep) were contributory factors for *Jatharagni* and *Medodhatvagni Dushti*, resulting in *Srotorodha* of *Rasavaha* and *Medovaha Srotas*, leading to *Medodushti* and resulting in *Medoroga*.

In *Nadi Pariksha* (pulse examination), all patients showed *Kapha-Vata* dominance. *Mala* (stool) evacuation was unsatisfactory, once or twice a day. *Mutra* (urine) was normal. Appetite was average, sleep was normal in four patients and disturbed in cases 2 and 3, due to shift work. The *Koshtha* of the patients was assessed, which revealed *Madhyam Koshtha* in cases 1, 2, and 5 and *Mrudu Koshtha* in cases 3, 4, and 6.

**Diagnostic Assessments:** All the patients were diagnosed

**Table 2: Symptoms grading scale**

| Breathlessness (Exertional Dyspnea)                                                                       | Grade |
|-----------------------------------------------------------------------------------------------------------|-------|
| Dyspnea after heavy work and walking                                                                      | 0     |
| Dyspnea after moderate work and walking                                                                   | 1     |
| Dyspnea after mild work                                                                                   | 2     |
| Dyspnea even at rest                                                                                      | 3     |
| Paresthesia                                                                                               | Grade |
| No any altered sensation (tingling, numbness, pins and needles)                                           | 0     |
| Occasional, mild sensations, not interfering with daily activities                                        | 1     |
| Constant, intense sensations, occasionally interfering with daily activities                              | 2     |
| Complete numbness or debilitating sensations, rendering the individual unable to perform daily activities | 3     |
| Fatigue                                                                                                   | Grade |
| No fatigue                                                                                                | 0     |
| Fatigue occasionally on doing heavy work                                                                  | 1     |
| Not able to perform routine work                                                                          | 2     |
| Even without doing work                                                                                   | 3     |

**Table 3: Diagnostic findings**

| Parameters               | Case 1 | Case 2 | Case 3 | Case 4 | Case 5 | Case 6 |
|--------------------------|--------|--------|--------|--------|--------|--------|
| Sr. Triglyceride (mg/dL) | 230    | 198    | 223    | 200    | 240    | 183    |
| Sr. LDL (mg/dL)          | 142.3  | 219.4  | 113.5  | 162.8  | 142.4  | 200.7  |
| Sr. HDL (mg/dL)          | 32.5   | 33.4   | 32.7   | 35.1   | 37.2   | 38.0   |

according to the NCEP ATP III guidelines, which include elevated serum triglycerides (>150 mg/dL) and serum LDL (>100 mg/dL), along with reduced serum HDL levels (<40 mg/dL in male and <50 mg/dL in females), without a prior history of drug-induced dyslipidemia.

The laboratory investigations revealed elevated apolipoprotein B (Apo-B) levels in all the cases. The 10-year ASCVD score indicated three patients at low risk, one at borderline risk and two at intermediate risk. The QRISK3 score assessment categorized four patients at low risk and two at moderate risk. Detailed findings (BT) for each case are presented in [Table 3](#).

**Timeline:** The participant's timeline shows approximately 60 days of treatment protocol with assessments (clinical, laboratory, BMI, and CVD risk scores) at baseline and day 60. ([Figure 1](#))

|                                                       |                      |        |        |        |        |        |
|-------------------------------------------------------|----------------------|--------|--------|--------|--------|--------|
| LDL/HDL ratio                                         | 4.37                 | 6.56   | 3.46   | 4.63   | 3.82   | 5.28   |
| Apolipoprotein B (mg/dL)                              | 154.7                | 198.2  | 143.2  | 168.6  | 168.2  | 176.3  |
| BMI (kg/m <sup>2</sup> )                              | 23.2                 | 27.4   | 23.8   | 31.2   | 31.4   | 27.2   |
| Blood pressure (mmHg)                                 | 110/70               | 118/80 | 122/80 | 120/80 | 130/80 | 130/90 |
| Fasting blood glucose, liver and renal function tests | Within normal limits |        |        |        |        |        |
| ASCVD risk score (%) 10-year risk                     | 4.3                  | 3.9    | 8.0    | 2.8    | 8.5    | 5.5    |
| Lifetime risk                                         | 46                   | 50     | 50     | 39     | 50     | 50     |
| QRISK3 score (%)                                      | 5.1                  | 3.9    | 4.1    | 3.7    | 13     | 17.2   |

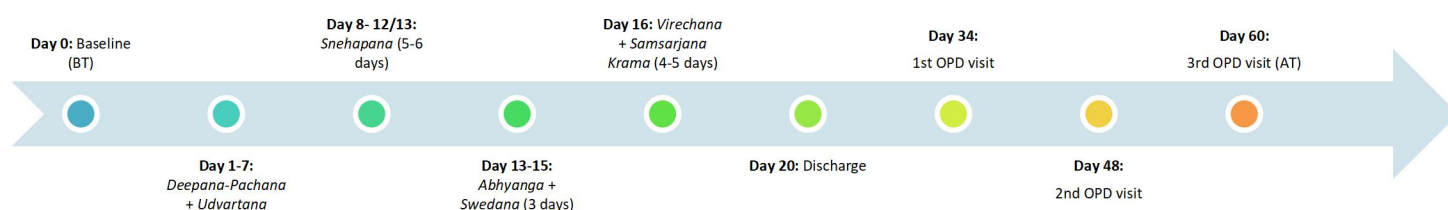


Figure 1: Participant's Timeline

#### Therapeutic Intervention:

Initially, *Agni Deepana* (improve appetite) and *Ama Pachana* (digestion of *Ama*) were done, followed by *Snehapana* (internal oleation) until *Samyaka Snigdha Lakshana* achieved. *Virechana* (therapeutic purgation) was administered after

assessing *Koshtha* of the individual patient and were continuously monitored for their vitals, bowel frequency, level of hydration, and any adverse events. The oral Ayurvedic medications along with dietary-lifestyle guidelines, were advised after the discharge, detailed in [Table 4](#) & [5](#).

Table 4: A timeline of therapeutic interventions for six patients

| Treatment given                                                                 | Case 1                                                                                                                       | Case 2            | Case 3             | Case 4               | Case 5             | Case 6           |
|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-------------------|--------------------|----------------------|--------------------|------------------|
| <b>Day 1 to 7</b>                                                               | 22 May to 28 May                                                                                                             | 30 May to 05 June | 04 June to 10 June | 31 July to 06 August | 12 July to 18 July | 06 Aug to 12 Aug |
| <b>Deepana- Pachana</b>                                                         | 1. <i>Chitrakadi Vati</i> , (Institutional pharmacy, batch 2) 2 tablets, each of 250mg, BD, after a meal with lukewarm water |                   |                    |                      |                    |                  |
| <b>Kaphahara- Medovilayana</b>                                                  | 2. <i>Udvartana</i> with roasted <i>Kolakulathadi Churna</i> (Vaidyaratnam, batch no.25B0938)                                |                   |                    |                      |                    |                  |
| <b>Snehapana (Day 8 to 12)</b>                                                  | <i>Snehapana</i> with <i>Triphala Ghrita</i> (AVS, Kottakal, batch no.226489)                                                |                   |                    |                      |                    |                  |
| <b>Day 1</b>                                                                    | 30mL                                                                                                                         | 30mL              | 30mL               | 30mL                 | 30mL               | 30mL             |
| <b>Day 2</b>                                                                    | 60mL                                                                                                                         | 60mL              | 60mL               | 60mL                 | 60mL               | 60mL             |
| <b>Day 3</b>                                                                    | 90mL                                                                                                                         | 90mL              | 90mL               | 90mL                 | 90mL               | 90mL             |
| <b>Day 4</b>                                                                    | 120mL                                                                                                                        | 120mL             | 120mL              | 110mL                | 120mL              | 120mL            |
| <b>Day 5</b>                                                                    | 160mL                                                                                                                        | 160mL             | 150mL              | 130mL                | 160mL              | 150mL            |
| <b>Day 6</b>                                                                    | -                                                                                                                            | 200mL             | -                  | -                    | 190mL              | -                |
| <b>Sarvanga Abhyanga and Sarvanga Bashpa Swedana (Day 13 or 14 to 15 or 16)</b> | <i>Sarvanga Abhyanga</i> with <i>Tila Taila</i> and <i>Sarvanga Bashpa Swedana</i> with <i>Dashamoola Kwatha</i>             |                   |                    |                      |                    |                  |
| <b>Virechana: (Day 16 or 17)</b>                                                | 30g                                                                                                                          | 40g               | 40g                | 30g                  | 35g                | 30g              |
| <i>Trivrita Churna</i> (Institutional pharmacy, batch 2)                        |                                                                                                                              |                   |                    |                      |                    |                  |

|                                                          |                                                                                                                                                                                                                                                                                                                                                                 |                             |                              |                              |                              |                             |
|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------|------------------------------|------------------------------|-----------------------------|
| <i>Katuki Churna</i> (Institutional pharmacy, batch 1)   | 10g                                                                                                                                                                                                                                                                                                                                                             |                             |                              |                              |                              |                             |
| <i>Triphala Kwatha</i> (Institutional pharmacy, batch 4) | 150mL                                                                                                                                                                                                                                                                                                                                                           |                             |                              |                              |                              |                             |
| <b>Shuddhi</b>                                           | <i>Madhyama</i><br>(18 Vega)                                                                                                                                                                                                                                                                                                                                    | <i>Pravara</i><br>(22 Vega) | <i>Madhyama</i><br>(15 Vega) | <i>Madhyama</i><br>(17 Vega) | <i>Madhyama</i><br>(15 Vega) | <i>Pravara</i><br>(24 Vega) |
| <b>Samsarjana Krama (Day 17 or 18 to 20 or 21)</b>       | 4 days                                                                                                                                                                                                                                                                                                                                                          | 5 days                      | 4 days                       | 4 days                       | 4 days                       | 5 days                      |
| <b>Oral medications (Day 21 or 22)</b>                   | 1. <i>Amritadi Guggulu</i> (Institutional pharmacy, batch 3), 3 tablets, each of 500mg, with <i>Anupana</i> of <i>Phalatrikadi Kwatha</i> (Institutional pharmacy, batch 2), 40 mL twice a day, on an empty stomach<br>2. <i>Arogyavardhini Vati</i> (Institutional pharmacy, batch 1), 1 tablet, each of 250 mg, twice a day, after a meal with lukewarm water |                             |                              |                              |                              |                             |
| <b>Discharge (Day 21 or 22)</b>                          | 09 June                                                                                                                                                                                                                                                                                                                                                         | 18 June                     | 21 June                      | 18 August                    | 31 July                      | 25 August                   |
| <b>1<sup>st</sup> OPD visit (Day 35)</b>                 | Assessment of clinical status and the same medications                                                                                                                                                                                                                                                                                                          |                             |                              |                              |                              |                             |
| <b>2<sup>nd</sup> OPD visit (Day 49)</b>                 | Assessment of symptoms and compliance review with the same medications                                                                                                                                                                                                                                                                                          |                             |                              |                              |                              |                             |
| <b>3<sup>rd</sup> OPD visit (AT) (Day 63)</b>            | 21 July                                                                                                                                                                                                                                                                                                                                                         | 30 July                     | 02 August                    | 29 Sept                      | 11 Sept                      | 06 Oct                      |
|                                                          | Lipid profile, Apo-B, ASCVD risk score, and QRISK3 test done                                                                                                                                                                                                                                                                                                    |                             |                              |                              |                              |                             |

**Table 5: Dietary and physical regimens advised**

| <b>A. Dietary Regimen</b>                |                                                                                                                       |                                                            |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| Category                                 | <i>Pathya Ahara</i> (Recommended)                                                                                     | <i>Apathya Ahara</i> (To be Avoided)                       |
| <b>Breakfast</b>                         | Soup or boiled green gram/ Vegetable soup/ Sprouts salad/ <i>Ragi idli</i> with <i>sambar</i> / Vegetable <i>poha</i> | Milk and milk preparations (Curd, Paneer, etc.), sweets    |
| <b>Grains</b>                            | <i>Roti</i> made up of Barley/ Maize/ <i>Bajara</i> / <i>Ragi</i>                                                     | Refined flour products, bakery foods                       |
| <b>Rice</b>                              | <i>Raktashali</i> (brown rice), only if needed; avoid pressure cooking                                                | Excess polished white rice                                 |
| <b>Vegetables</b>                        | Pointed guard/ Drumstick/ Bitter gourd/ Ridge gourd/ Bottle gourd/ Leafy vegetables                                   | Deep-fried vegetable preparations                          |
| <b>Protein and Liquids</b>               | Buttermilk/ <i>moong dal</i> / <i>masoor dal</i>                                                                      | Non-vegetarian foods                                       |
| <b>Dinner</b>                            | Millet <i>Khichadi</i> / Vegetable soup/ Multigrain <i>roti</i> and vegetable/ <i>Ragi dosa</i>                       | Heavy, oily, late-night meals                              |
| <b>Eating behaviour</b>                  | Fixed meal timings; eat only when hungry                                                                              | Overeating, irregular meals, sweets after meals            |
| <b>B. Physical and lifestyle Regimen</b> |                                                                                                                       |                                                            |
| Category                                 | <i>Pathya Vihara</i>                                                                                                  | <i>Apathya Vihara</i>                                      |
| <b>Daily Activity</b>                    | Exercise for 30 minutes of moderate intensity activity (Brisk walking/ Cycling/ practiced workouts)                   | Prolonged sitting, sedentary lifestyle                     |
| <b>Yoga Practices</b>                    | <i>Sukshma Vyayama</i> / <i>Anuloma-Viloma</i> / <i>Bhramari pranayama</i> (at least 10 min)                          | —                                                          |
| <b>Structured Practice</b>               | <i>Suryanamaskara</i>                                                                                                 | Physical inactivity                                        |
| <b>Post-meal Practice</b>                | <i>Vajrasana</i> after meals                                                                                          | Lying down immediately after food                          |
| <b>Sleep Discipline</b>                  | Regular sleep schedule                                                                                                | Day sleep after lunch, night awakening, oversleep (>8 hrs) |

### 3. OUTCOMES AND FOLLOW-UP

After completion of treatment, improvement was observed in all symptoms and lipid profile parameters, with a mean reduction in TG (29.51%), LDL cholesterol (51.45%), LDL/HDL ratio (60.98%), Apo-B (43.64%), and a rise in HDL cholesterol (24.22%), indicating lower atherogenic risk. The BMI showed a modest reduction of 5.23%. The 10-year ASCVD risk score decreased to low-risk category, but the lifetime ASCVD risk remained high in most cases. The QRISK3 score was reduced to low-risk category (AT), but was high (BT) in cases 5 and 6 due to comorbidities. Detailed in [Table 6](#), [Table 7](#) and illustrated in [Figure 2](#) and [Figure 3](#). The Ayurvedic intervention is beneficial, but the lifestyle modifications (proper diet, exercise and sleep) play a crucial role in maintaining long-term reduction of CVD risk.

#### Individual outcomes:

**Case 1:** As the LDL/HDL ratio dropped from 4.37 (moderate risk) to 1.48 (optimal risk), resulting in very low chances of cardiovascular risk and even lifetime cardiovascular risk was reduced from 46% to 36%, along with marked improvement in the symptoms.

**Case 2:** Noted complete relief in exertional dyspnea, as well as the LDL/HDL ratio dropped from 6.56 (high risk) to 2.16 (optimal risk), indicating prevention from further cardiovascular complications.

**Table 6: Outcomes Summary**

| Parameters             | Case 1 |      | Case 2 |      | Case 3 |      | Case 4 |       | Case 5 |       | Case 6 |      |
|------------------------|--------|------|--------|------|--------|------|--------|-------|--------|-------|--------|------|
|                        | BT     | AT   | BT     | AT   | BT     | AT   | BT     | AT    | BT     | AT    | BT     | AT   |
| Exertional Dyspnea     | 03     | 01   | 02     | 0    | -      | -    | -      | -     | 03     | 0     | 02     | 0    |
| Paresthesia            | -      | -    | -      | -    | 03     | 01   | 02     | 01    | 03     | 02    | 02     | 0    |
| Fatigue                | 04     | 0    | -      | -    | 03     | 01   | -      | -     | 03     | 01    | 01     | 0    |
| Sr. TG (mg/dL)         | 230    | 147  | 198    | 131  | 223    | 151  | 200    | 144   | 240    | 194   | 183    | 131  |
| Sr. LDL (mg/dL)        | 142.3  | 64.8 | 219.4  | 96.4 | 113.5  | 73.2 | 162.8  | 75.8  | 142.4  | 114.2 | 200.7  | 51.9 |
| Sr. HDL (mg/dL)        | 32.5   | 43.7 | 33.4   | 44.5 | 32.7   | 42.3 | 35.1   | 44.2  | 37.2   | 42.3  | 38.0   | 42.5 |
| LDL/HDL ratio and risk | 4.37   | 1.48 | 6.56   | 2.16 | 3.46   | 1.73 | 4.63   | 1.71  | 3.82   | 2.69  | 5.28   | 1.22 |
|                        | mod    | low  | high   | low  | mod    | low  | mod    | low   | mod    | low   | high   | low  |
| Apo-B (mg/dL)          | 154.7  | 69.2 | 198.2  | 94.0 | 143.2  | 70.5 | 168.6  | 108.2 | 168.2  | 149.8 | 176.3  | 77.1 |

**Case 3:** The 10-year ASCVD risk score improved from 8% (Intermediate risk) to 3.6% (low risk), and the LDL/HDL ratio decreased from 3.46 (moderate risk) to 1.73 (optimal risk).

**Case 4:** The LDL/HDL ratio decreased from 4.63 (moderate risk) to 1.71 (optimal risk), thereby enhancing metabolic stability and quality of life. Additionally, the BMI reduced from Obese Class I to the overweight category.

**Case 5:** The 10-year cardiovascular scores calculated using the ASCVD risk score showed a reduction from 8.5% (Intermediate risk) to 5.9% (borderline risk), and the QRISK3 score decreased from 13% (moderate risk) to 10.2 % (moderate risk).

**Case 6:** Attained marked relief in exertional dyspnea, paraesthesia and fatigue. The LDL/HDL ratio significantly reduced from 5.28 (high risk) to 1.22 (optimal risk), along with the ASCVD risk score decreasing from 5.5 % (borderline risk) to 2.4% (low risk) and QRISK3 score from 17.2 % (moderate risk) to 8.4 % (low risk).

#### Adherence and Tolerability:

The adherence to treatment was assessed directly during IPD stay and through the follow-up visits after discharge. The dietary and lifestyle guidelines were monitored through a checklist, which showed adherence above 90%. The interventions were well tolerated by all six patients, and no adverse effects were noted.

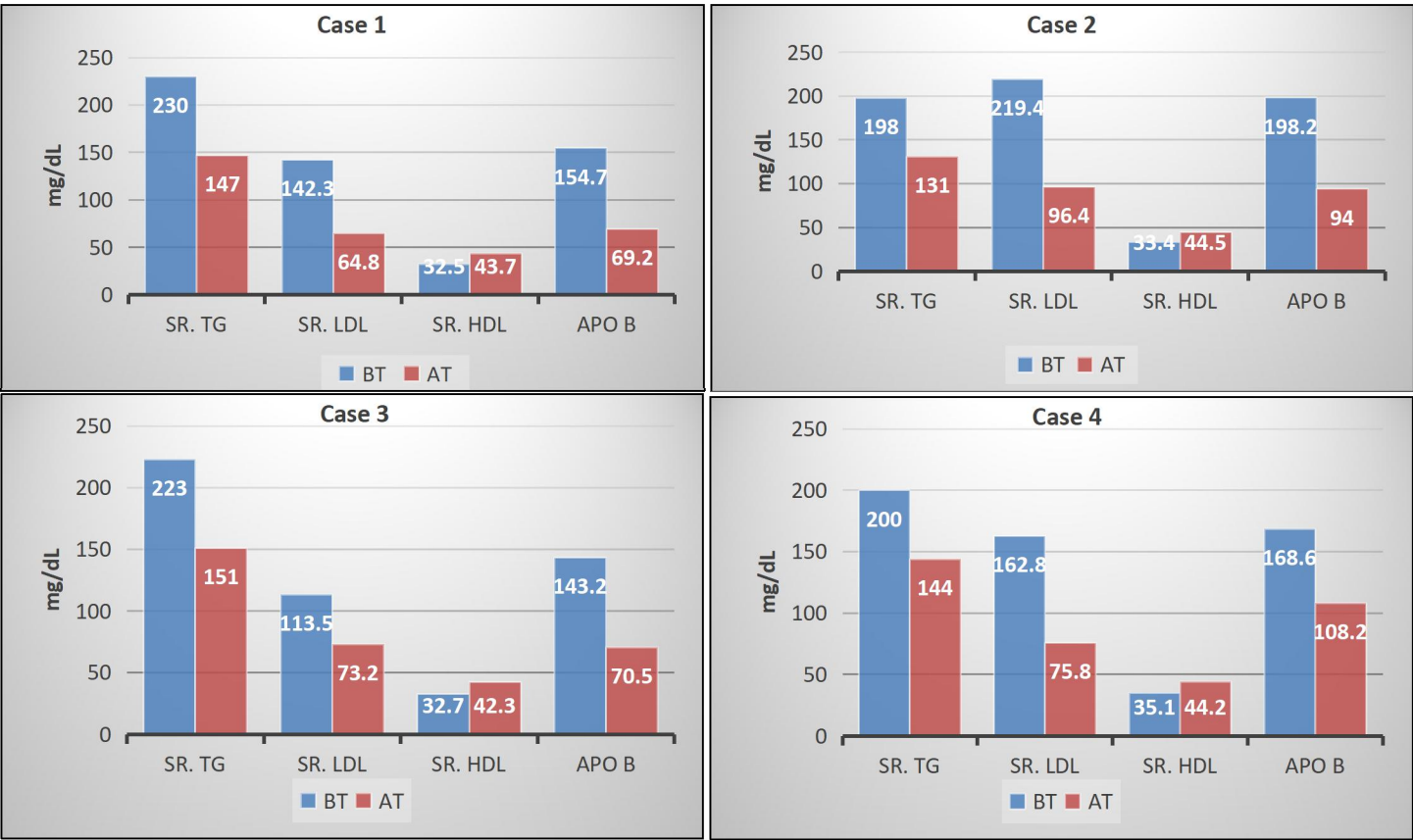


|                          |      |      |      |      |       |      |      |      |       |      |      |     |
|--------------------------|------|------|------|------|-------|------|------|------|-------|------|------|-----|
| BMI (kg/m <sup>2</sup> ) | 23.2 | 21.5 | 27.4 | 25.5 | 23.8  | 22.5 | 31.5 | 29.6 | 31.4  | 30.8 | 27.2 | 26  |
| ASCVD risk score (%)     | 4.3  | 1.8  | 3.9  | 0.9  | 8.0   | 3.6  | 2.8  | 1.0  | 8.5   | 5.9  | 5.5  | 2.4 |
| 10-year risk             | low  | low  | low  | low  | Inter | low  | low  | low  | Inter | bor. | bor. | low |
| Lifetime risk            | 46   | 36   | 50   | 36   | 50    | 50   | 39   | 39   | 50    | 50   | 50   | 39  |
| QRISK3 score (%)         | 5.1  | 2.8  | 3.9  | 1.7  | 6.8   | 4.6  | 4.4  | 2.6  | 13    | 10.2 | 17.2 | 8.4 |
|                          | low  | low  | low  | low  | low   | low  | low  | low  | mod   | mod  | mod  | low |

Table 7: Effect of Intervention on Lipid and Anthropometric Parameters

| Sr.no. | Parameter                 | Pre-treatment (Mean) | Post-treatment (Mean) | Mean Difference | % Change |
|--------|---------------------------|----------------------|-----------------------|-----------------|----------|
| 1      | Sr. Triglycerides (mg/dL) | 212.33               | 149.67                | ↓62.67          | ↓29.51%  |
| 2      | Sr. LDL (mg/dL)           | 163.52               | 79.38                 | ↓84.13          | ↓51.45%  |
| 3      | Sr. HDL (mg/dL)           | 34.82                | 43.25                 | ↑8.43           | ↑24.22%  |
| 4      | LDL/HDL ratio             | 4.69                 | 1.83                  | ↓2.86           | ↓60.98%  |
| 5      | Apo-B (mg/dL)             | 168.2                | 94.80                 | ↓73.40          | ↓43.64%  |
| 6      | BMI (kg/m <sup>2</sup> )  | 27.42                | 25.98                 | ↓1.43           | ↓5.23%   |

Values expressed as Mean. Due to the small sample size (n=6) for the case series, descriptive statistics were applied.





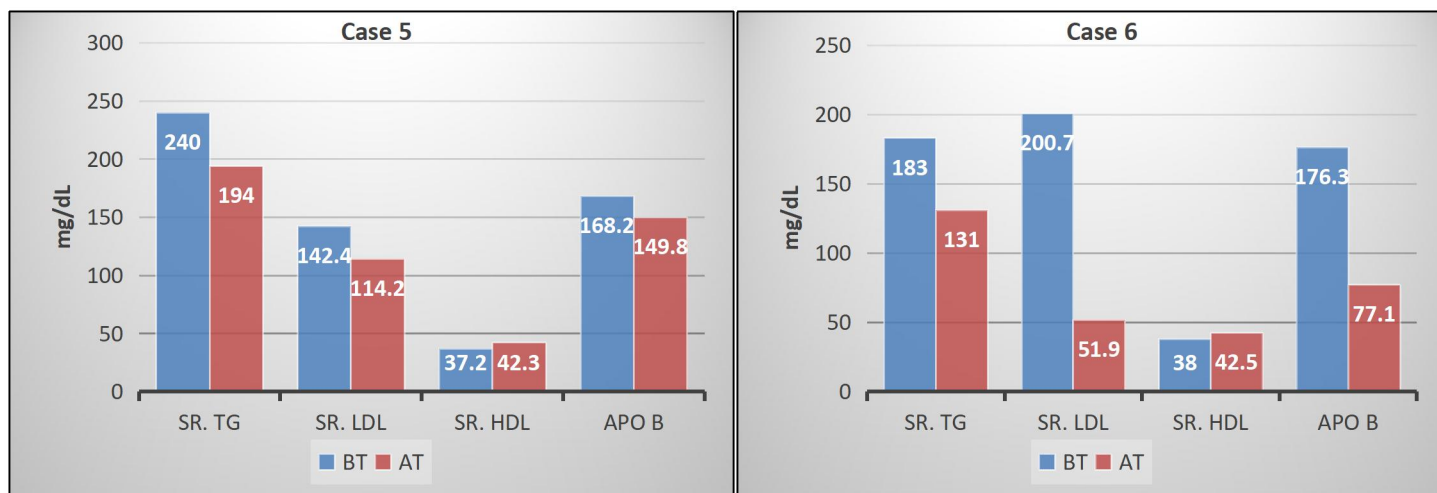


Figure 2: Before and after treatment outcomes in Sr.Triglyceride, Sr.LDL, Sr.HDL, Apolipoprotein-B in six cases

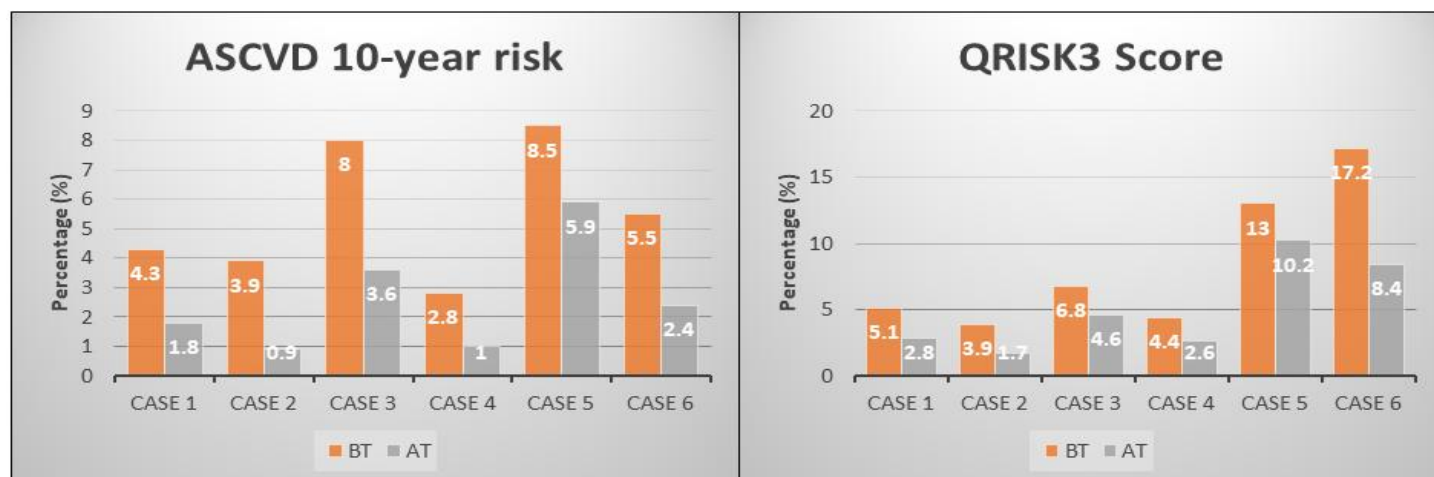


Figure 3: Showing 10-year cardiovascular risk through the ASCVD risk score and QRISK3 score

#### 4. DISCUSSION

One of the main contributory factors for atherosclerotic cardiovascular disease is Atherogenic dyslipidemia (AD), which closely resembles *Medodushti* in Ayurveda. [9] Initially, to correct *Jatharagni Dushti*, *Chitrakadi Vati* was administered, which restores digestive activity, enhances proper transformation of nutrients, and prevents abnormal accumulation of lipids. [10] The mechanical friction produced during *Udvartana* helps reduce *Kapha* and *Meda*, improving peripheral circulation and mobilization of subcutaneous fat. [11]

The *Triphala Ghrita* [12] used for *Snehapana* facilitates the conversion of cholesterol into bile acids, and contains ingredients such as *Triphala*, which has a potent action on

*Meda Dhatu* (fat tissue), and *Ghrta* acts as a carrier due to its lipophilic nature. *Virechana* helps restore metabolic dysfunction by cleansing the gastrointestinal tract, improving fat metabolism, and thereby supporting fundamental correction in the pathology of AD. The observed reductions in TG, LDL, and LDL/HDL ratio may be due to improved metabolism and excretion of lipids during purgation therapy. *Amritadi Guggulu* contains the maximum part of *Guggulu*, possessing *Lekhana* [13] and lipid-modulating properties, as proved by experimental and clinical research. [14] *Guduchi* (*Tinospora cordifolia* Wild.) in this compound has potent anti-hyperlipidemic action, helps to reduce TG and increase HDL level. [15] The *Anupana* given was *Phalatrikadi Kwatha*, [16] stated in *Sharangdhara Samhita*, has properties of

*Amapachana* and *Kapha-Medovishoshana*, as it contains mostly *Tikta Rasa* ingredients. Clinical studies revealed that *Phalatrikadi Kwatha* may reduce hepatic lipid synthesis and improve lipid clearance. [17] *Triphala* helps to decrease the absorption of cholesterol and acts as a hypolipidemic agent. [18] *Arogyavardhini Vati* possesses hepatoprotective and metabolic regulatory actions, which may contribute to the reduction of LDL and Apo-B levels. [19]

[Figure 2](#) illustrates a consistent reduction in lipid parameters and an increase in HDL levels among all six participants, suggesting the applicability of treatment across different individuals rather than being constrained to a single case.

[Table 7](#) demonstrates that the marked reduction in LDL levels indicates a significant lowering in the formation of atherosclerotic plaque. The maximum mean decrease in the LDL/HDL ratio reflects restoration of the appropriate ratio of atherogenic and protective lipoproteins. The decrease in Apo-B, a biomarker of AD, suggests a reduction in circulating atherogenic lipoprotein particles. The reduction was also observed in the estimated 10-year cardiovascular risk scores, as these scores are determined based on lipid parameters and BMI, indicating a lowering of future cardiovascular risk.

In a randomized controlled trial, Deepak et al. reported significant improvements in lipid profile parameters following treatment with *Lekhaniya Mahakashaya Ghana Vati*. Compared with baseline, participants exhibited mean reductions of 11.49 mg/dL in total cholesterol and 10.85 mg/dL in LDL cholesterol, along with a mean increase of 2.24 mg/dL in HDL cholesterol ( $p < 0.05$ ). Furthermore, treatment with *Shunthi-Guggulu Vati* resulted in a statistically significant reduction in triglyceride levels, with a mean decrease of 23.39 mg/dL from baseline ( $p < 0.05$ ). [20]

This Ayurvedic treatment protocol may facilitate a greater effect on metabolic correction and lipid regulation, reducing circulating lipids and improving lipid transport mechanisms, than on visible body weight reduction. In dyslipidemia, lipid

levels respond earlier to dietary and pharmacological intervention than anthropometric measures such as BMI. Even a small change in BMI is considered clinically meaningful in metabolic disorders, especially when accompanied by marked biochemical improvement, as it declines cardiometabolic risk.

The overall results suggest that this Ayurvedic protocol may serve as a useful adjuvant approach in the management of AD. The parallel improvements in lipid parameters, cardiovascular risk scores, and symptoms indicated therapeutic benefits in reducing future risk of cardiovascular disease and its complications.

**Limitations and future scope of study:** This case series has limited sample size ( $n=6$ ), absence of a control group, and a short follow-up period (60-days). The lifestyle modifications advised as part of treatment protocol have long-term adherence. So, future larger sample sizes, multicentric studies with controlled groups, and long-term follow-ups are warranted to authenticate these findings. The use of advanced lipid testing including LDL particle size and new biomarkers like lipoprotein (a) and oxidized LDL, can be beneficial.

## 5. CONCLUSION

In all six patients, the Ayurvedic treatment protocol administered in this case series includes *Udvartana* and *Virechana* procedures, integrating with oral medications such as *Amritadi Guggulu* with *Anupana* of *Phalatrikadi Kwatha*, and *Arogyavardhini Vati*, along with dietary and lifestyle modifications, specified for nearly sixty days, demonstrated noticeable results in the condition of Atherogenic dyslipidemia, with no adverse events. The outcomes revealed resolutions in symptoms, mean reduction in TG by 62.67 mg/mL (29.51%), LDL by 84.13 mg/dL (51.45%), LDL/HDL by 2.86 mg/mL (60.98%), and Apo-B by 73.40 mg/dL (43.64%), while an increase in HDL by 8.43 mg/dL (24.22%). The average decline in BMI by 1.43 kg/m<sup>2</sup> (5.23%) was observed.

There was a noticeable reduction in the next 10-year cardiovascular risk scores (ASCVD and QRISK3), shifting from moderate or high risk to low-risk categories, highlighting a reduction in atherogenic risk.

**Abbreviations:** HTN: Hypertension, T2DM: Type 2 Diabetes Mellitus, OD: omni die, BD: bis in die, AT: After treatment, BT: Before treatment, mod: moderate, Inter: Intermediate, bor: borderline, SOP: Standard Operating Procedure, GMP: Good Manufacturing Practice

**Declaration of adherence to CARE/ICMJE/COPE standards:** The authors declare that this case series has been prepared and reported based on CARE guidelines. The manuscript complies with the recommendations of the International Committee of Medical Journal Editors (ICMJE) and the ethical principles of the Committee on Publication Ethics (COPE).

**Declaration of Patient Consent** – The authors confirm that they have acquired a patient consent form, in which the patient or caregiver has granted permission for the publication of the case, including accompanying images and other clinical details, in the journal. The patient or caregiver acknowledges that their name and initials will not be disclosed, and sincere attempts will be undertaken to safeguard their identity. However, complete anonymity cannot be assured.

**Patient's Perspective:** All the patients reported overall improvement in digestion, feeling energetic, and lightness of the body after completion of the treatment protocol. They perceived noticeable improvement in symptoms along with a gradual reduction in body weight. The procedures of Udvartana and Virechana were well tolerated under supervision. Patients expressed satisfaction and stress reduction after observing improvement in their lipid profiles and cardiovascular risk scores. The diet and lifestyle guidelines were encouraging them to practice for a long-term period for health maintenance and prevention of cardiovascular risk.

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**Acknowledgements:** The authors sincerely thank the patient for their cooperation and compliance throughout the treatment and follow-up period. We also acknowledge the support of colleagues and staff in clinical management and documentation.

#### Declaration of Generative AI

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**Conflict of Interest** – The authors declare no conflicts of interest.

**Source of Support** – The authors declare no source of support.

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